EXPLORATIONS ON THE ACCOUNTABILITY OF INDEPENDENT REGULATORY AGENCIES

by

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Explorations on the Accountability of Independent

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Thesis Abstract

Gizem Korkmaz, "Explorations on the Accountability of Independent Regulatory Agencies"

This thesis aims at analyzing in a game theoretical framework the behavior of a regulator to be appointed by a government that may follow an objective different than the (social) objective that was used at the initial regulatory-design stage. More specifically, the thesis is centered around analyzing the trade-off between independence and accountability of a regulatory authority to be appointed by politically-biased governments subject to reelection, and it aims to contribute to the regulatory design literature by analyzing the performance of an independent regulatory authority subject to differing degrees of accountability under these circumstances. Analyzing the optimal contracts for the games studied, we show how the level of corruptibility of the agency affects the optimal level of investigation to be taken. Certain amount of accountability is necessary to reach the optimum as long as the regulator is not benevolent. However, we find that the politically polarized government can use the accountability as a tool to benefit a certain group in the economy by distorting the output level and hence the social welfare.

Tez Özeti

Gizem Korkmaz, "Bağımsız Düzenleyici Kurumların Denetimi Üzerine"

Bu tez, politik kaygıları olan bir hükümetin denetimi altında çalışmakta olan bağımsız bir düzenleyici kurumun performansını, oyun teoretik modeller çerçevesinde incelemektedir. Kuruma verilen bağımsızlık ile sonrasında yapılacak denetim arasındaki ilişki sosyal refah göz önüne alınarak incelenmektedir. Değişen denetim seviyeleri ve farklı politik eğilimleri olan hükümetler altındaki düzenleyici kurumun performansı incelenerek tasarım literatürüne katkıda bulunulması hedeflenmiştir. Çeşitli modellerle yapılan analizler ve belirlenen optimal kontrat biçimleri aracılığıyla, düzenleyici kurumun rüşvet alabilirliği ile açılması muhtemel soruşturma arasındaki ilişki gösterilmiştir. Tezin sonucunda, rüşvet alma olasılığı altında, bağımsız bir regülatöre belli miktarda denetim yapmanın optimuma ulaşmak için gerekli bir koşul olduğu ortaya çıkmaktadır. Ancak, politik kaygıları olan bir hükümetin, belli bir grubu kollamak adına hesap sorabilmeyi bir araç olarak kullanarak üretim seviyesini ve sosyal refahı etkilemesinin de mümkün olduğu gösterilmektedir.

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CONTENTS

CHAPTER 1: INTRODUCTION 1

CHAPTER 2: GAME-THEORETICAL ANALYSIS 7
The Model 7
Affiliated Regulators 9
Independent Regulators 19
Leniency-like-Mechanism 25

CHAPTER 3: OPTIMAL CONTRACTS 28
The Model 28
The Full Information Benchmark 32
Asymmetric Information Case 34

CHAPTER 4: CONCLUSION 43

REFERENCES 47

CHAPTER 1: INTRODUCTION

Over the past decade, the creation of independent agencies for regulating economic sectors, such as telecommunication, natural gas, electricity, and infrastructure has become a main institutional feature in many countries. Governments are increasingly willing to delegate their regulatory powers to institutions that are partially under their control in order to enhance the credibility of their policies and to reduce costs of procuring expertise. Institutions administering regulatory functions need to be competent (with access to technical expertise), independent (free from government interference and capture by service providers and interest groups), and legitimate (abiding by legal principals and providing transparency and accountability) (Bertolini, 2004).

These regulatory institutions should be independent to ensure that they are insulated from political influence. However, independence must also be reconciled with measures to ensure that the regulator is accountable for its actions and that he does not engage in corrupt practices or become grossly inefficient. To do so, reports, review of budgets and scrutiny arrangements are required. However, it is not straightforward to strike the proper balance between independence and accountability. Faure-Grimaud and Martimort (2005) suggest that independence granted to a regulatory agency will bring about stability to the regulatory environment by shielding the regulatory agency from the politically-biased ad hoc interference of governments. However, without a proper accountability framework their independence can make regulatory agencies too powerful, with increased scope for regulatory capture. Lack of accountability for specific regulatory behavior also runs the more general risk of jeopardizing the

democratic accountability of the overall regulatory regime.

Within this general framework, a specific question arises as to how to analyze the behavior of a politically-biased government, which has the responsibility to regulate an industry, to see why and under which conditions the regulatory authority should be designed as an independent agency as opposed to being directly affiliated with (under the control of) the government (Faure-Grimaud and Martimort, 2005). Therefore, this thesis aims at providing a simple game theoretical and a contractual framework to explore the trade-off between independence and accountability of a regulatory authority to be appointed by politically-biased governments subject to reelection. We study the incentives of a regulator and a government that may follow an objective different than the (social) objective that was used at the initial regulatory-design stage, and we attempt to contribute to the regulatory design literature by analyzing the performance of an independent regulatory authority subject to differing degrees of accountability.

Taking this trade-off as a point of departure, the thesis provides two approaches and therefore benefits from two strands of literature. The first explores the collusive behavior of a regulatory agency and a regulated firm in a simple game theoretical analysis under different setups, and tries to analyze the effects of different games on the deterrence from collusion. For this approach, we benefit from the tools of antitrust literature which we extend with the analysis of Faure-Grimaud and Martimort (2005). The second approach deals with the optimal policy implementation with contracts. For this purpose, we review the regulatory design literature that is based on the principal-agent models analyzing the rent extraction-efficiency trade-off.

Collusive behavior has been intensely studied in the antitrust literature that analyzes cartel formation. In the literature, firms use grim strategies in order to punish

each other in case of deviation from the collusive agreement. Recent literature on cartel prosecution suggests richer and more complex mechanisms than those based simply on an increase in fines with antitrust intervention. Leniency programs, which give reduced fines to firms that reveal information to Antitrust Authority, make enforcement more effective (Motta and Polo, 2003). The authors analyze the impact of leniency on collusion in a framework where the antitrust agency can launch random investigations that sometimes lead to successful prosecution. They suggest that, even though these programs may induce collusion since they decrease the expected cost of misbehavior, the dominant effect would be the deterrence of collusion if the firms are allowed to reveal after an investigation is started. Aubert, Rey and Kovacic (2005) compare the impact of reduced fines and positive rewards and argue that the latter is more effective in deterring collusion.

The literature on antitrust enforcement and leniency gives insights to this study, which modifies these models by taking into account the collusion between the regulator and the regulated firm in different repeated games and uses their methods to find the equilibria. Inspired by Faure-Grimaud and Martimort (2003), and Faure-Grimaud and Martimort (2005), we also introduce a policy choice by distinguishing between an independent regulator and an affiliated agency, where the latter comes in power along with the elected government, thus under the control of the political principal. We analyze the games in both cases, comparing the results in the absence of accountability and when investigation is a concern. Finally, the research also attempts to apply the rewarding (leniency-like) mechanism to this particular setup when the monitoring is carried out by a government which does not necessarily have social objectives, unlike the Antitrust Authority.

We show that in absence of accountability, independent of the political polarization of the government, the agency is very likely to collude. When accountability is a concern, collusion is partially deterred, however less with an affiliated agency. Confirming Faure-Grimaud and Martimort (2005), we observe that independence introduces uncertainty about the polarization of the government to be elected, and hence ensures less incentives for collusive behavior. This effect is diminished with a pro-business political principal for whom the rent given to the firm is not a concern, which rules out the possibility of being investigated. We also show the trade-off between the frequency of investigations and the expertise of the government to detect the collusive activity. Intuitively, lower probability of being caught must be balanced by a higher probability of being reviewed. Another way to balance the incompetence of the government is to set higher fines for the colluding agents. Finally, when we implement a rewarding mechanism for the deviating regulator, we observe that it works effectively in deterring collusion, also confirming Motta and Polo (2003) in this framework.

The second approach we take in order to analyze the trade-off between independence and the accountability of a regulator is closely related to the literature of "the new economics of regulation", which is an application of the principal-agent methodology to the contractual relationship between regulators and regulated firms (Laffont, 1994). Following the pioneering applications of the incentive theory to the regulation problem by Loeb and Magat (1979) and Baron and Myerson (1982), this new approach to the regulation problem has distinguished itself by emphasizing further layers of informational asymmetry that exist between government, regulatory commissions, firms, and various interest groups. Recent work on regulatory design has

largely been based on principal-agent models in the analysis of the rent extraction-efficiency trade-off in such a multi-layered environment, and, among other things, has investigated the distortions arising from informational asymmetries and collusive behavior (Laffont and Tirole, 1993). The regulation models have focused on adverse selection (Baron and Myerson, 1982), moral hazard (Laffont and Tirole, 1993), legislative choice (Baron, 1988), duopoly (Laffont and Martimort, 1997), separation of regulatory powers (Laffont and Martimort, 1999), and duplication of informative signals (Laffont, 2005) as possible means to impart accountability on regulatory agencies.

The basic framework of this part of the research is closely related to the regulation models analyzed by Laffont (2005) and Laffont and Tirole (1991), in which the regulatory structure regulates the firm's rate of return and price. The model composes several assumptions taken from various regulation models which are reviewed by Caillaud et al. (1988). The firm (the "agent") has private information about a technological parameter which allows it to enjoy an informational rent. The regulatory structure is two tiered: the agency and the government. In contrast to the government, the agency has time, resources, and expertise to obtain information about the firm's technology. Besides, the government and the agency, as well as the firm, have different objective functions, which makes it necessary to delegate powers to an independent regulatory authority. However, the agency's expertise allows it to hide information from the government and the firm can bribe the agency in this regard. Keeping the basic framework similar, we extend these models by introducing the political polarization of the government, which determines the level of scrutiny. In addition, we model the investigation as another informative signal received by the government in order to update the report of the regulator.

Implementing the optimal policies, such that the firm always produces the efficient output level if it is low-cost, causes output distortions for the high-cost firm, decreasing social welfare. These distortions are less with a benevolent regulatory authority and zero if the regulator can fully monitor the firm. Introducing the possibility of corruption enables us to show the trade-off between the corruptibility of the agency and the level of investigation to be taken. Similar to the first part, we find that the government with less expertise to detect collusion should be monitoring the agency more often, assuming no cost of audits. Certain amount of accountability is necessary to reach the optimum as long as the regulator is not benevolent. However, we also find that the politically-polarized government can use the accountability as a tool to benefit a certain group in the economy by distorting the output level and hence the social welfare.

The thesis is composed of two parts, as mentioned before. Chapter 2 explores the problem in different game theoretical setups, taking into account an affiliated and an independent regulatory authority, respectively. The sections of the chapter analyze these games, comparing the results in the absence of accountability with those in the case where the regulatory authority is subject to investigation. The last section proposes a leniency-like mechanism as in the antitrust literature in order to deter collusion, and analyzes the effects on the previous results.

The second approach is presented in Chapter 3, which extends the optimal contract framework by introducing the polarization of the government and the accountability of the agency to the existing models. The sections are organized to compare the cases where the regulator is benevolent as opposed to being corruptible, and question how the accountability mechanism works in the latter. Finally, we conclude and discuss possible extensions for future research in Chapter 4.

CHAPTER 2: GAME-THEORETICAL ANALYSIS

In this part, using different games we try to analyze the problem and check how the results depend on the parameters of the games considered. The first section presents the common set up of the models to be analyzed. Section 2.2 considers an affiliated agency, who is appointed by the elected government, therefore excluding the uncertainty about his political polarization as a benchmark case. Section 2.3 introduces the independent agency who keeps office regardless of the government that will be elected, allowing for collusion before the uncertainty is resolved. The last section attempts to propose a mechanism similar to the leniency program in cartel prosecution and analyzes its effect on regulatory capture.

The Model

We consider a three-tier hierarchy: firm/agency/government in a repeated game-theoretical framework. All parties are risk-neutral.

The Firm

We consider a natural monopoly (electricity, gas supplier), which has private information about its marginal cost parameter θ. The government will make transfers to the firm depending on its cost level. In each period, the technology parameter θ can take one of two values: "low" or "efficient" ($\underline{\theta}$), with probability ν, and "high" or "inefficient" ($\bar{\theta}$), with probability $(1-\nu)$. Formally, $\theta \in \left\{\underline{\theta}, \bar{\theta}\right\}$ with $\bar{\theta} - \underline{\theta} = \Delta\theta > 0$ and $\nu = \Pr(\theta = \underline{\theta})$.

The Agency

The regulatory agency has time, resources and expertise to obtain information about the cost level of the firm. The regulator can fully observe the cost level of the firm and reports to the government.[1] The agency's expertise allows it to hide information from the government.

The agency can be offered in advance a bribe b by the firm in order to be reported as inefficient each period and extract a rent equal to $\Delta\theta$, in the periods when the actual cost of the production is low, i.e. $\underline{\theta}$. The bribe is constant and the firm agrees to pay the corruptible regulatory agency $k\Delta\theta$ of the total rent[2] , contingent on the cost level of the period.[3]

We distinguish between the cases of an affiliated regulatory authority and an independent agency as in Faure-Grimaud and Martimort (2005). The former represents the case in which the regulatory authority will be delegated by the elected government, whereas the independent regulatory agency keeps office whoever is elected. In Faure-Grimaud and Martimort (2005), this allows for ex-ante collusion between the firm and the regulator besides the ex-post agreements that can occur under both circumstances. In other words, it enlarges the set of collusive agreements and thus increases the agency cost of capture. In our case, independence will introduce uncertainty about the type of the government, hence on the probability of investigation to be opened.

[1] Initially, we assume that the regulator can observe the actual cost level with probability 1. We can relax this assumption and think that the firm bribes the regulator to exert less effort in the observation of the cost level.

[2] k depends on the bargaining power of the firm and the agency. They can equally share the extracted rent, so that $k = 1/2$.

[3] We will also analyze the case where the bribe is given each period regardless of the cost level in that period.

The Government

As opposed to the regulatory authority, the government is not corruptible but politically biased, in other words, it can be rightist or leftist, depending on the weights it assigns to the consumer and the producer surpluses in the social welfare function. The rent extraction of the firm is less of a concern for the rightist, pro-business government. We simply assume that only the leftist government will open a costly investigation when the report is $r = \bar{\theta}$, in order to prevent the rent extraction of the firm.

Once the investigation is opened, the collusion or the actual cost level is detected with probability ε, in which case the regulator and the firm pay the fine determined by the constitutional design.

Affiliated Regulators

This section analyzes the performance of a regulator, who is affiliated to a political party so that he comes in power if the party he is affiliated gets elected and he is removed from the office each time a new political principal is elected.

We study the case in the absence of accountability and with accountability, respectively, taking into account two types of collusive agreements: first, the firm commits to pay a bribe depending on the cost level each period, and second we consider a constant bribe to be paid to the regulator regardless of the cost level. For the latter, we also analyze the game in which we allow for deviations from the initial collusion, once the cost is realised.

Benchmark: Absence of Accountability

Timing of the game

- Stage 1. The firm and the regulatory authority choose whether or not to enter into a collusive agreement, knowing the type of the elected government. If at least one agent chooses not to collude, then the true cost level is reported to the government, and the game ends for that period. If collusion is chosen, every period has the following structure:

- Stage 2. The cost is realised for that period, the firm decides whether to pay the bribe as promised and then the authority reports to the government.

Firm's decision

In the absence of accountability, collusion generates for the firm the expected rent $\nu(1-k)\Delta\theta$ independent of the type of the government while non-collusive strategy will give zero profits, since the cost level will be fully observed by the agency who will then report to the government and the government will make transfers to the firm no more than the actual cost level.

Therefore, the firm will offer to collude as long as

$$\frac{1}{1-\delta}\nu(1-k)\Delta\theta \geq 0,$$

where δ is the discount factor.

Regulator's decision

With absent accountability, independent of the government's type, the regulator will accept to collude as long as his discounted expected payoff is nonnegative, i.e.

$$\frac{1}{(1-\delta)}\nu k\Delta\theta \geq 0.$$

The following proposition summarizes the first results obtained above.

Proposition 1. In the repeated game without accountability played by the affiliated regulator and the regulated firm, with the collusive agreement such that the firm bribes the regulator whenever the cost of production is low, the agents collude if and only if

$$\frac{1}{1-\delta}\nu(1-k)\Delta\theta \geq 0$$

holds for the firm, and

$$\frac{1}{(1-\delta)}\nu k\Delta\theta \geq 0$$

is satisfied for the regulator.

Therefore, in the benchmark case, as long as they agree on a positive bribe level, the firm and the regulator have incentive to collude. We assume that these conditions hold so that the collusion is indeed a concern. This part suggests that when the regulator is never scrutinized, he will choose to collude.

As an extension, if we analyze the game when the agreement between the firm and the agency does not depend on the cost level, but involves a constant bribe each period, we obtain the results which are stated in the following proposition.

Proposition 2. In the repeated game without accountability played by the affiliated regulator and the regulated firm, with the collusive agreement such that the firm commits to bribe the regulator regardless of the cost level, the agents collude if and only if

$$\frac{1}{1-\delta}k\Delta\theta \geq 0$$

holds for the regulator, and

$$\frac{1}{(1-\delta)}(\nu - k)\Delta\theta \geq 0$$

holds for the firm.

Proof: It is trivial for the regulator, since he will be receiving a constant bribe $k\Delta\theta$ each period.

For the firm, it immediately follows from the condition:

$\frac{1}{1-\delta}\left[\nu(1-k)\Delta\theta - (1-\nu)k\Delta\theta\right] \geq 0$, which simplifies to:

$\frac{1}{1-\delta}\left[(\nu - k)\Delta\theta\right] \geq 0.$

We observe that the condition for the firm will be satisfied when $\nu \geq k$. In the previous contract, it was enough for the firm to have a positive level of rent since the condition was $\nu(1-k)\Delta\theta \geq 0$. Under this agreement, the firm also takes into account the difference between the probability of being efficient in the following periods and the rent he will acquire. This is because the rents are obtained when the firm is actually low cost and he would not agree on a constant bribe if he knows he is more likely to be inefficient all the time.

This type of agreement which is made in advance and commits a bribe regardless of the cost level allows us to analyze what happens if we consider a deviation by the firm while the regulatory authority does not have any incentive to deviate since he gets the constant positive bribe each period and the outside option is zero.[4] However, the firm can deviate from the collusive agreement after the cost level in that period is revealed. In this situation, deviation from the agreement will allow him to avoid paying $k\Delta\theta$ to the regulator but he will get zero profits afterwards.[5] Therefore, in the absence of accountability of the regulatory agency, the collude and deviate strategy (CD) gives the expected rent $\Delta\theta$, while the collude and not deviate strategy (CND) gives $(1-k)\Delta\theta + \frac{\delta}{1-\delta}[(\nu-k)\Delta\theta]$. Hence, the condition under which collusion is sustainable becomes

$$(1-k)\Delta\theta + \frac{\delta}{1-\delta}(\nu-k)\Delta\theta \geq \Delta\theta.$$

The following proposition summarizes the results obtained above.

Proposition 3. In the repeated game without accountability played by the affiliated regulator and the regulated firm, with the unenforceable collusive agreement such that the firm commits to bribe the regulator regardless of the cost level, the firm sticks to the collusive agreement if and only if

$$\nu \geq \frac{k}{\delta}.$$

[4] We assume agents choose not to deviate when they are indifferent.

[5] We assume that once there is a deviation by one of the agents, the collusion will never take place again.

As we have shown before, the condition when we consider the game in which deviation is not allowed, i.e. when the collusive agreement is enforceable, is $\nu \geq k$. Now, we suggest that the possibility of deviation makes collusion less likely to occur in the first place. As a special case, when the firm and the regulatory agency share the rent equally, i.e. when $k = 1/2$, it becomes $\nu \geq \frac{1}{2\delta}$.

Implementing Accountability

Timing of the game

- Stage 1. Similar to the previous model, the firm and the regulatory authority choose whether or not to enter into a collusive agreement, knowing the type of the elected government. If at least one agent chooses not to collude, then the true cost level is reported to the government, and the game ends for that period. If collusion is chosen, every period has the following structure:

- Stage 2. The cost is realised for that period, the firm decides whether to pay the bribe as promised and then the authority reports to the government.

- Stage 3. The government investigates and fines both agents if the collusion is revealed.

Firm's decision

If the elected government is rightist, we assume that there will not be an investigation since the rents given to the firm is not a concern. Hence, the condition will be the same as in the case of the absence of accountability, that is

$$\frac{1}{1-\delta}\nu(1-k)\Delta\theta \geq 0.$$

On the other hand, under a leftist government, the expected rent generated with collusion when investigation is a concern is given by

$$\frac{1}{1-\delta}\nu\left[(1-\varepsilon)(1-k)\Delta\theta-\varepsilon F\right]\geq 0.$$

Rearranging the terms, we get

$$(1-k)\Delta\theta-\varepsilon\left[(1-k)\Delta\theta+F\right]\geq 0.$$

We can observe that the standard collusion profit in the absence of accountability, $(1-k)\Delta\theta$, is reduced by the expected losses from investigation, where ε is the probability of being caught and F is the fine for the firm.

Regulator's decision

Similarly, the regulator can be affiliated to a pro-business government in which case no investigation will take place. There the value of collusion for the regulator will again be $\nu k\Delta\theta$ and the regulator will accept to collude when

$$\frac{1}{(1-\delta)}\nu k\Delta\theta\geq 0.$$

On the other hand, the leftist government will open an investigation whenever the report is $r=\bar{\theta}$ and will punish the regulator with $-R$ when the actual cost $c=\underline{\theta}$ is observed by the government, which happens with probability ε. This will reduce the discounted payoff for the regulator to

$$\frac{1}{(1-\delta)}\nu\left[(1-\varepsilon)k\Delta\theta-\varepsilon R\right]$$

and the condition becomes

$$k\Delta\theta - \varepsilon(k\Delta\theta + R) \geq 0.$$

Again, we have shown that the benefit from collusion for the regulatory authority, $k\Delta\theta$, is reduced by the expected loss from the investigation, which is given by $\varepsilon(k\Delta\theta + R)$.

The following proposition summarizes the results for the case of accountability.

Proposition 4. In the repeated game with accountability played by the leftist government, the affiliated regulator and the regulated firm, with the enforceable cost-contingent collusive agreement, the firm and the regulator, respectively, collude if and only if

$$F \leq \frac{(1-\varepsilon)}{\varepsilon}(1-k)\Delta\theta,$$

and

$$R \leq \frac{(1-\varepsilon)}{\varepsilon}k\Delta\theta.$$

Now, the agents take into account the level of punishment and the probability of being caught when taking the collusive decision. The collusion is less likely to occur, since in the absence of investigation the only requirement is having positive rents, i.e. $(1-k)\Delta\theta \geq 0$ for the firm, and $k\Delta\theta \geq 0$ for the regulator. We can also analyze the relation between F, R and ε. If $\varepsilon = 1$, even if the amount of the fine is zero for both agents, the collusion will be deterred since it is fully observed.

Once again, if we make the collusion contract based on constant bribe, when we consider the ruling of a pro-business government, we will have the same conditions as before, i.e. $\frac{1}{(1-\delta)}(\nu - k)\Delta\theta \geq 0$ for the firm, and $\frac{1}{(1-\delta)}k\Delta\theta \geq 0$ for the regulator. However, under a leftist government, the agency colludes when

$$\nu\left[(1-\varepsilon)k\Delta\theta - \varepsilon R\right] + (1-\nu)k\Delta\theta \geq 0,$$

which can be written as

$$k\Delta\theta - \nu\varepsilon(k\Delta\theta + R) \geq 0.$$

Recall that in absence of accountability, this condition was $k\Delta\theta \geq 0$. We can see that the probability of investigation reduces the payoff from a constant bribe agreement by $\nu\varepsilon(k\Delta\theta + R)$.

For the firm, the condition with a constant bribe agreement will be

$$\nu\left[(1-\varepsilon)(1-k)\Delta\theta - \varepsilon F\right] - (1-\nu)k\Delta\theta \geq 0,$$

and rearranging the terms, we get

$$\left[(\nu - k)\Delta\theta\right] - \nu\varepsilon\left[(1-k)\Delta\theta + F\right] \geq 0.$$

The first term coincides with the condition in absence of accountability, which is reduced by $\nu\varepsilon\left[(1-k)\Delta\theta + F\right]$, hence any positive ε will deter collusion. On the other hand, $\varepsilon = 1$ never allows for collusive behavior. The main difference from the previous type of contract is that ν also has a deterring effect here.

We state the results in the following proposition.

Proposition 5. In the repeated game with accountability played by the leftist government, the affiliated regulator and the regulated firm, with the enforceable constant bribe agreement, the regulator and the firm, respectively, collude if and only if

$$R \leq \frac{(1-\nu\varepsilon)}{\nu\varepsilon} k\Delta\theta,$$

and

$$F \leq \frac{(1-\nu\varepsilon)}{\nu\varepsilon}(1-k)\Delta\theta - \frac{(1-\nu)}{\nu\varepsilon}\Delta\theta.$$

Now, the decision depends also on the probability of being low-cost, where $\nu = 1$ coincides with the same equation under the cost-contingent agreement. Since $\frac{(1-\nu\varepsilon)}{\nu\varepsilon} \geq \frac{(1-\varepsilon)}{\varepsilon}$, the agency is more likely to collude with the firm with this type of agreement (which is more secure) rather than under the cost contingent contract.

The firm also considers the probability of being efficient. The first term is similar to the condition for the agency which makes collusion more likely, however; in addition, we have the second term that works in the opposite direction. This is intuitive since the firm prefers an agreement in which he does not have to pay when he does not gain any rent. If we take $\nu = 1$ where the firm will always be low cost, the condition to collude becomes the same as the cost-contingent contract.

Independent Regulators

The independent regulators keep the office whichever government is elected. Hence, as in Faure-Grimaud and Martimort (2005), we assume that the agency decides to collude before the type of the government is known. Therefore, we allow for deviation from the collusion after the government is elected. Here, we introduce β as the probability of having a leftist government elected and therefore investigations will take place.

Absence of Accountability

Timing of the game

- Stage 1. The firm and the regulatory authority choose whether or not to enter into a collusive agreement. If at least one agent chooses not to collude, then the true cost level is reported to the government, and the game ends for that period. If collusion is chosen, every period has the following structure:
- Stage 2. The elections take place and the political preference of the government is determined.
- Stage 3. The cost is realised for that period, the firm decides whether to pay the bribe as promised and then the authority reports to the government.

Firm's decision

Absent accountability, the type of the elected government will not have an effect, since there is no room for investigation. Again, the non-collusive strategy will give zero profits and the firm will offer to collude as long as

$$\frac{1}{1-\delta}\nu(1-k)\Delta\theta \geq 0$$

under a cost-contingent contract,

$$\frac{1}{1-\delta}(\nu - k)\Delta\theta \geq 0$$

with a constant bribe agreement, and

$$\frac{1}{1-\delta}(\nu - k)\Delta\theta \geq \frac{k}{\delta}\Delta\theta$$

when we allow for deviation.

Regulator's decision

Independent of the government's type and the form of the collusive agreement, the regulator will accept to collude as long as

$$\frac{1}{(1-\delta)}\nu k\Delta\theta \geq 0.$$

Implementing Accountability

Results will change in the case of accountability, since the government will be leftist with probability β, thus, the agents will be subject to investigation and with probability $(1-\beta)$, the case of no accountability will apply.

Timing of the game

- Stage 1. The firm and the regulatory authority choose whether or not to enter into a collusive agreement. If at least one agent chooses not to collude, then the true cost level is reported to the government, and the game ends for that period. If collusion is chosen, every period has the following structure:

- Stage 2. The elections take place and the political preference of the government is determined.

- Stage 3. The cost is realised for that period, the firm decides whether to pay the bribe as promised, and then the regulatory authority decides on the report to the government.

- Stage 4. If the report is $r = \bar{\theta}$, the leftist government observes the actual cost with probability ε and fines the agents.

Agents' decisions

In a *No Collusion (NC) equilibrium*, collusion does not arise in the industry and both agents get their outside options which are normalized to zero in these games. On the other hand, the value of *collusion (C)* for the firm and the regulator, respectively, with a cost contingent agreement is;

$$\begin{aligned} V_C^f &= \frac{1}{1-\delta}[\beta(\nu\left[(1-\varepsilon)(1-k)\Delta\theta - \varepsilon F\right]) + (1-\beta)\nu(1-k)\Delta\theta], \\ V_C^r &= \frac{1}{1-\delta}[\beta(\nu\left[(1-\varepsilon)k\Delta\theta - \varepsilon R\right]) + (1-\beta)vk\Delta\theta]. \end{aligned}$$

Rearranging the terms, we obtain

$$\begin{aligned} V_C^f &= \frac{1}{(1-\delta)}v(1-k)\Delta\theta - \beta\varepsilon v\frac{[(1-k)\Delta\theta + F]}{(1-\delta)}, \\ V_C^r &= \frac{1}{(1-\delta)}vk\Delta\theta - \beta\varepsilon v\frac{(k\Delta\theta + R)}{(1-\delta)}. \end{aligned}$$

We can see that standard collusion profits in absence of accountability are reduced by the expected losses from investigation, where now the ex-ante probability of being fined is $\beta\varepsilon$. The value of collusion decreases with the probability of having a leftist government, β, which is also considered as the probability of being investigated.

Hence, the conditions for the firm and the regulator to collude rather than no collusion in the first place are $V_C^f \geq 0$ and $V_C^r \geq 0$, which give:

$$\begin{aligned} \beta &\leq \frac{(1-k)\Delta\theta}{\varepsilon\left[(1-k)\Delta\theta + F\right]} \\ \beta &\leq \frac{k\Delta\theta}{\varepsilon(k\Delta\theta + R)} \end{aligned}$$

respectively, for the firm and the regulator.

We observe that β is decreasing in ε: a lower probability ε of being caught must be balanced by a higher probability β of being reviewed, in order to maintain the firm indifferent between collusion and no collusion.

The following proposition summarizes the results obtained above.

Proposition 6. In the repeated game with accountability played by the government, the independent regulator and the regulated firm, with the enforceable cost-contingent collusive agreement, the firm and the regulator, respectively, collude if and only if

$$\begin{aligned} F &\leq \frac{(1-\beta\varepsilon)}{\beta\varepsilon}(1-k)\Delta\theta, \\ R &\leq \frac{(1-\beta\varepsilon)}{\beta\varepsilon}k\Delta\theta. \end{aligned}$$

Recall these conditions with an affiliated agency, which were given by

$$\begin{aligned} F &\leq \frac{(1-\varepsilon)}{\varepsilon}(1-k)\Delta\theta \\ R &\leq \frac{(1-\varepsilon)}{\varepsilon}k\Delta\theta. \end{aligned}$$

We can see that the uncertainty about having a leftist principal, thus having an investigation deters collusion since $\frac{(1-\varepsilon)}{\varepsilon} < \frac{(1-\beta\varepsilon)}{\beta\varepsilon}$.

If we modify the game allowing for deviations by the firm and the regulator once the type of the government and the cost level is realised, one needs to analyze *Collude and Deviate (CD) equilibrium* in which the firm and the regulator collude and decide to deviate if the leftist government is chosen. From the timing of the game, we know that each period $t \geq 1$ the leftist government is elected with probability β, and if they are caught with the investigation, they are forced to act non-cooperatively for the current period and pay the fines R and F; then, the game restarts.

Under the cost-contingent contract, deviation does not benefit the firm since the regulator decides on the report after the bribe, and by backwards induction, we see that the regulator will punish the firm by deviating from the agreement as well.[6] Therefore, *Collude and NotDeviate (CND)* condition is the same where we considered the collusion strategy of the firm as opposed to no collusion, i.e. $V^f_{CND} = V^f_C$.

On the other hand, when we analyze the agency, we should consider also the *Collude and Deviate (CD) strategy* which gives the value

$$V^r_{CD} = \beta\nu k\Delta\theta + (1-\beta)\nu k\Delta\theta = \nu k\Delta\theta.$$

We have shown the value for the *Collude and NotDeviate (CND) strategy for the regulator as*

$$V^r_{CND} = V^r_C = \frac{1}{1-\delta}[\beta(\nu\left[(1-\varepsilon)k\Delta\theta - \varepsilon R\right]) + (1-\beta)vk\Delta\theta].$$

[6] In a simultaneous game, CD strategy would give the firm $\beta(\nu(1-\varepsilon)\Delta\theta - \varepsilon F) + (1-\beta)v\Delta\theta + \delta 0$. Then $V_{CND} \geq V_{CD}$ would require $\beta \leq \frac{[k-(1-\delta)]\Delta\theta}{\varepsilon\{[k-(1-\delta)]\Delta\theta + \delta F\}}$.

Therefore, $V^r_{CND} \geq V^r_{CD}$ implies

$$\beta \leq \frac{\delta k \Delta\theta}{\varepsilon(k\Delta\theta + R)}.$$

These results are summarized in the following proposition.

Proposition 7. In the repeated game with accountability played by the government, the independent regulator and the regulated firm, with the unenforceable cost-contingent collusive agreement, the agency sticks to the collusion if and only if

$$R \leq \frac{(\delta - \beta\varepsilon)}{\beta\varepsilon} k\Delta\theta.$$

Comparing this result to the case where there is no possibility of deviation, i.e. $R \leq \frac{(1-\beta\varepsilon)}{\beta\varepsilon} k\Delta\theta$, intuitively we observe that the agency is less likely to collude.

When we consider the constant bribe contract, the *Collude and NotDeviate (CND) strategy* gives to the regulator

$$V^r_{CND} = \frac{1}{1-\delta}\{\beta\{(\nu\left[(1-\varepsilon)k\Delta\theta - \varepsilon R\right] + (1-\nu)k\Delta\theta\} + (1-\beta)k\Delta\theta]\},$$

and the *Collude and Deviate (CD) strategy* gives

$$V^r_{CD} = k\Delta\theta.$$

Under this agreement, $V^r_{CND} \geq V^r_{CD}$ becomes

$$\beta \leq \frac{\delta k \Delta\theta}{\nu\varepsilon(k\Delta\theta + R)}.$$

The following proposition summarizes the final result of this section.

Proposition 8. In the repeated game with accountability played by the government, the independent regulator and the regulated firm, with the unenforceable constant bribe agreement, the agency sticks to the collusion if and only if

$$R \leq \frac{(\delta - \beta\nu\varepsilon)}{\beta\nu\varepsilon} k\Delta\theta.$$

Finally, we have again shown that the contract which removes the uncertainty about the cost levels for the regulator gives him more incentives to collude since $\frac{(\delta - \beta\nu\varepsilon)}{\beta\nu\varepsilon} \geq \frac{(\delta - \beta\varepsilon)}{\beta\varepsilon}$.

Leniency-like Mechanism

Motta and Polo (2003) show that entitling firms to fine discounts when they reveal after an inquiry is opened, save resources of the antitrust authority, thereby raising welfare. The question arises what happens if the government rewards the agency for revealing the collusion agreement once the government type, and hence the existence of investigation, is known. Taking this into account, this section proposes a mechanism like the leniency program where the regulator after receiving the bribe can reveal the collusion which has taken place in the initial stage of the game in order to be rewarded by the government. The reason that makes this mechanism different from the leniency is not only the agents who make the collusion but also the timing of the revelation. Here, the revelation game is not played simultaneously, i.e. the regulator can decide to reveal after receiving the bribe.

Timing of the game

- Stage 1. The firm and the regulatory authority choose whether or not to enter into a collusive agreement. If at least one agent chooses not to collude, then the true cost level is reported to the government, and the game ends for that period. If collusion is chosen, every period has the following structure:

- Stage 2. Elections determine the political preference of the government.

- Stage 3. The cost is realised for that period, the firm decides whether to pay the bribe as promised.

- Stage 4. The regulatory authority decides on the report to the government and whether to reveal the collusion agreement.

- Stage 5. If the regulator has not revealed, the leftist government opens an investigation if the report is $r = \bar{\theta}$, observes the actual cost with probability ε, and fines the agents. No investigation takes place if the agency reveals and he gets a reward while the firm is fined.

Here, we consider the independent agency case, where the government type is known after the collusion agreement, so the regulator will have incentive to deviate from the agreement if the elected government is leftist since investigation will take place.

In the previous section with an independent regulator, we have found the values of the strategies *CND* and *CD* for the regulator as

$$\begin{aligned} V^r_{CND} &= \frac{1}{1-\delta}\{\beta\{(\nu\left[(1-\varepsilon)k\Delta\theta - \varepsilon R\right] + (1-\nu)k\Delta\theta\} + (1-\beta)k\Delta\theta]\}, \\ V^r_{CD} &= \beta\nu k\Delta\theta + (1-\beta)\nu k\Delta\theta = \nu k\Delta\theta. \end{aligned}$$

This section proposes to reward the regulator with $R*$, whenever he deviates from the agreement and reveals information about the collusion to the government. This can be formalized as

$$V_{CD}^{r*} = \nu k \Delta\theta + R*,$$

where the reward is given by $R*$.

The following proposition states the results when a rewarding mechanism is implemented.

Proposition 9. In the repeated game with accountability played by the government, the independent regulator and the regulated firm, with the unenforceable cost-contingent agreement, the leftist government can deter collusion by setting $V_{CD}^{r*} \geq V_{CND}^{r}$, i.e.

$$R* \geq \frac{1}{1-\delta}\left[\frac{(\delta - \beta\varepsilon)}{\beta}\nu k \Delta\theta - \varepsilon\nu R\right].$$

If that is the case, the regulator will reveal collusion even after receiving the bribe; knowing this, the firm will choose to deviate and not give the bribe, which will terminate the collusion in the first place. Hence, we can conclude that deterrence is possible with this leniency-like rewarding mechanism in which the reward is used to deter the collusion and is actually never paid.

CHAPTER 3: OPTIMAL CONTRACTS

This part of the thesis extends the optimal contract framework by introducing the polarization of the government and the accountability of the agency. Section 3.1 presents the model and Section 3.2 solves for the first best under complete information. Section 3.2 introduces informational asymmetries and solves for the equilibrium with no mechanism, in absence of a regulator, with a benevolent regulator as opposed to a corruptible agency, respectively. Finally, the accountability of the authority is introduced and analyzed comparing to the case where no investigation takes place.

The Model

We consider a three-tier hierarchy: firm/agency/government. All parties are risk neutral.

The Consumers

Let q be the level of production which brings the consumers a utility $S(q)$, $S' > 0$, $S'' < 0$. The inverse demand function is denoted by $P(q)$. Thus, the net surplus of consumers is $S(q) - qP(q)$.

The consumers' net welfare is then

$$V = S(q) - qP(q).$$

The Firm

We consider a natural monopoly, which has private information about its cost function. The firm produces a marketable output q at cost

$$C = \theta q.^{7}$$

The marginal cost or technology parameter θ can take one of two values: "low" or "efficient" ($\underline{\theta}$), with probability v, and "high" or "inefficient" ($\bar{\theta}$), with probability $1 - v$. In other words, θ is an adverse selection parameter whose probability distribution is common knowledge with $v = \Pr(\theta = \underline{\theta})$. Let $\Delta\theta = \bar{\theta} - \underline{\theta} > 0$.

The government can use transfers to the firm, say $\hat{t}$. Therefore, the natural monopoly's welfare is written:

$$\Pi = \hat{t} + p(q)q - \theta q.^{8}$$

A participation constraint must be satisfied for all values of the information parameter θ, namely

$$\Pi = T - \theta q \geq 0,$$

where $T = \hat{t} + p(q)q$.

The Agency

The regulatory agency receives income w from the government and derives utility from its relationship with the government $R(w) = w - w^*$. That is, its reservation income is w^*. For simplicity, we assume that the government needs the agency to regulate the

[7] We ignore fixed costs.

[8] The government pays the cost, receives sales, and gives the firm a net transfer.

firm's price and cost. Thus, the government must pay at least w^* to the agency in each state of nature:

$$R(w) = w,$$

where $w \geq w^*$.[9]

The agency obtains information (a signal σ in $\{\underline{\theta}, \phi\}$) about the firm's technology. If $\theta = \underline{\theta}$, the agency observes $\sigma = \underline{\theta}$ with probability μ and observes nothing, $\sigma = \phi$, with probability $1 - \mu$. If $\theta = \bar{\theta}$, it does not observe anything.[10] The firm learns the signal which the agency receives. The agency is able to hide the signal from the government; the efficient firm can offer a bribe in order to be reported as inefficient. The agency reports $r \in \{\underline{\theta}, \phi\}$ the government the signal received depending on the collusive agreement.

The Government

The government's utility is the sum of producer, agency, and consumer surpluses.

$$W = (V + R) + \alpha\Pi.$$

The government can be rightist or leftist depending on the weight α_i that it assigns on the firm's profit. Both types of governments dislike giving rents to the firm but, as I have mentioned above, the rent extraction of the firm is less a concern for the rightist government. Let $\alpha \leq 1$ and $\alpha_R > \alpha_L$.[11]

[9] For simplicity, I take the reservation wage $w^* = 0$.

[10] Unlike the first part of the thesis, the agency here cannot fully observe the cost parameter.

[11] Here we exclude the case where $\alpha > 1$ and leave the case where the pro-business government prefers giving rents to the firm for further research.

Therefore, the social welfare function becomes:[12]

$$W = S(q) - \theta q - (1 - \alpha)\Pi.$$

Receiving the report from the regulator, the government decides on the level of the scrutiny.[13] The scrutiny can be considered as another signal received by the government in order to update the probability received by the regulator and hence to alter the level of production as well as the rent given to the firm.

This is formalized by assuming that the government observes another signal $\delta \in \{\underline{\theta}, \phi\}$. If $\theta = \underline{\theta}$, the government observes $\delta = \underline{\theta}$ with probability ε and nothing with probability $1 - \varepsilon$. If $\theta = \bar{\theta}$, it does not observe anything. Taking into account the expertise of the agency, we can assume $\varepsilon < \mu$.

Hence, the leftist government will choose to investigate whenever the report is $r = \bar{\theta}$ in order to see whether the firm is actually inefficient. He receives another signal and updates his beliefs to determine the production level, and has means to punish the agency and the firm. On the other hand, with a rightist government, the agency and the firm is less likely to be investigated.

Finally, the independence of the agency can be captured by another parameter β as the probability of being investigated by the government. It will depend on the report of the agency and the type of the government as I have mentioned above.

[12] We can rearrange the social welfare function as:
$W = S(q) - T - w + R(w) + \alpha\Pi$
$W = S(q) - \Pi - \theta q + \alpha\Pi$ since $T = \Pi + \theta q$ and W and $R(w)$ cancel out each other.
For simplicity, we assume the transfers to the firm do not create a social cost.

[13] For simplicity, I initially ignore the costs of auditing.

Timing of the game

t=0. Nature chooses the type of the firm.

t=1. The regulatory agency gets the signal which is observed by the firm. Collusion can take place.

t=2. The regulator reports the cost level of the firm to the government.

t=3. The government decides to scrutinize or not, if so it gets another signal from the firm in a way to change the decision taken by the agency.

t=4. Payoffs are received.

The Full Information Benchmark

If the cost parameter θ is observable by the government, there is no need to appoint a regulatory agency and the government is constrained only by the participation constraint of the firm. The government maximizes

$$\begin{aligned} W &= S(q) - \theta q - (1-\alpha)\Pi \\ &\text{subject to } \Pi \geq 0. \end{aligned}$$

The results for the full information case are stated in the following proposition.

Proposition 10. Optimal regulation under complete information requires:

$$\begin{aligned} \Pi &= 0, \text{ i.e. no rent is given up to the firm;} \\ T &= \theta q, \\ S'(q*) &= \theta. \end{aligned}$$

First of all, we observe that under complete information, the quantity produced; hence the surpluses obtained do not depend on the political polarization of the government.[14] The participation constraint of the firm which is binding in equilibrium makes the maximization problem independent of α.[15] This is similar to the case in Laffont and Tirole (1991), where the social welfare function is utilitarian and no rent is given to the firm nor to the consumers. As in that case, marginal cost of production is equal to the marginal benefit of the consumers.

Second, as $\overline{\theta} > \underline{\theta}$ and $S'' < 0$, in the optimum, the firm is made to produce more if it is efficient, i.e. $\overline{q}* < \underline{q}*$.

The social welfare becomes:

$$W(q*) = S(q*) - \theta q*$$

Finally, it is intuitive that the social welfare is less with an inefficient firm. To see that:

$$W(\bar{q}*) = S(\bar{q}*) - \overline{\theta}\overline{q}* \;<\; S(\bar{q}*) - \underline{\theta}\overline{q} \;\leq\; S(\underline{q}*) - \underline{\theta}\underline{q}* = W(\underline{q}*)$$

since $\underline{q}*$ maximizes $S(q) - \underline{\theta}q$.

Therefore, $W(\bar{q}*) < W(\underline{q}*)$.

[14] When the participation constraint is not binding, this becomes $S'(q*) = \alpha\theta$, which is intuitive. If $\alpha = 0$, the production is made where the consumer utility is maximized. $\alpha = 1$ is the case of a utilitarian government and $\alpha > 1$ benefits the firm at the expense of consumers. This analysis is left for further research.

[15] As mentioned before if we consider the case where $\alpha > 1$, we can no more impose the participation constraint as binding. That case, some rent will be given up to the firm at the expense of consumers.

Asymmetric Information Case

No Mechanism

When contracts $(\underline{T}*, \underline{q}*)$and $(\overline{T}*, \overline{q}*)$ are offered, the efficient firm will also prefer the latter since

$$\begin{aligned}
\underline{\Pi}(\overline{T}*, \bar{q}*) &= \overline{T} - \underline{\theta}\overline{q} \;=\; \overline{\theta}\overline{q} - \underline{\theta}\overline{q} \;=\; \Delta\theta\overline{q} \;>\; 0 \\
\underline{\Pi}(\underline{T}*, \underline{q}*) &= 0 \\
\overline{\Pi}(\overline{T}*, \bar{q}*) &= \overline{T} - \overline{\theta}\overline{q} \;=\; 0 \\
\overline{\Pi}(\underline{T}*, \underline{q}*) &= -\Delta\theta\underline{q} \;<\; 0
\end{aligned}$$

Under asymmetric information, when these contracts are offered, the expected social welfare becomes:

$$W^a = \nu\left[S(\overline{q}*) - \underline{\theta}\overline{q} * -(1-\alpha)\Delta\theta\overline{q}*\right] + (1-\nu)\left[S(\overline{q}*) - \overline{\theta}\overline{q}*\right],$$

which is less than the ex-ante social welfare with perfect information:

$$W* = \nu\left[S(\underline{q}*) - \underline{\theta}\underline{q}*\right] + (1-\nu)\left[S(\overline{q}*) - \overline{\theta}\overline{q}*\right]$$

since $S(\underline{q}*) - \underline{\theta}\underline{q}* \geq S(\bar{q}) - \underline{\theta}\overline{q}$ as argued in the full information case. In addition, $(1-\alpha)\Delta\theta\overline{q} \geq 0$.[16]

Therefore, $W* > W^a$.

[16]Note that $\alpha > 1$ will make it negative.

Incentive Mechanism in Absence of Regulation

If θ is not observable by the government and there is no regulator, the government will maximize expected social welfare under the participation and incentive constraints, i.e.

$$\begin{aligned} Max \quad & v\left[S(\underline{q}) - \underline{\theta q} - (1-\alpha)\underline{\Pi}\right] + (1-v)\left[S(\overline{q}) - \overline{\theta}\overline{q} - (1-\alpha)\overline{\Pi}\right] \\ s.t \quad & (PC_H)\ \overline{\Pi} \geq 0 \\ & (PC_L)\ \underline{\Pi} \geq 0 \\ & (ICC_H)\ \overline{\Pi} = \overline{T} - \overline{\theta}\overline{q} \geq \underline{T} - \overline{\theta}\underline{q} \text{ (add\&subtract } \underline{\theta q}) \\ & (ICC_L)\ \underline{\Pi} = \underline{T} - \underline{\theta q} \geq \overline{T} - \underline{\theta}\overline{q} \text{ (add\&subtract } \overline{\theta}\overline{q}) \end{aligned}$$

The incentive constraints can be rewritten as

$$\begin{aligned} \overline{\Pi} &\geq \underline{\Pi} - \Delta\theta\underline{q}\ (ICC_H) \\ \underline{\Pi} &\geq \overline{\Pi} + \Delta\theta\overline{q}\ (ICC_L) \end{aligned}$$

where $\Delta\theta = \overline{\theta} - \underline{\theta}$.

We know and it is straightforward to show that, the participation constraint of the high-cost firm and the incentive constraint of the low-cost firm are the binding ones. Then, $\overline{\Pi} = 0$ and $\underline{\Pi} = \Delta\theta\overline{q}$.

Substituting these expressions in the objective function and maximizing with respect to $\underline{q}$ and $\overline{q}$, we find

$$\begin{aligned} \overline{q} &: -v(1-\alpha)\Delta\theta + (1-v)\left[S'(\overline{q}) - \overline{\theta}\right] = 0 \\ \underline{q} &: v\left[S'(\underline{q}) - \underline{\theta}\right] = 0 \end{aligned}$$

The following proposition summarizes the results obtained above.

Proposition 11. Optimal contracts $(\underline{T}, \underline{q})$, $(\overline{T}, \overline{q})$ under incomplete information in absence of a regulator are given by

$$\begin{aligned} S'(\overline{q}) &= \overline{\theta} + \frac{v}{1-v}(1-\alpha)\Delta\theta \\ \overline{T} &= \overline{\theta}\overline{q} \\ S'(\underline{q}) &= \underline{\theta} \\ \underline{T} &= \underline{\theta}\underline{q} + \Delta\theta\overline{q} \end{aligned}$$

We observe that in the optimal contract, for the low-cost firm we obtain the same production level (and therefore the cost level) as under complete information. However, the production level of the high-cost firm is distorted downwards since $\frac{v}{1-v}(1-\alpha)\Delta\theta \geq 0$. In addition to that, as $\overline{\Pi} = \overline{T} - \overline{\theta}\overline{q} = 0$, the high-cost firm gets no rent, while low cost firm gets an *information rent* $\underline{\Pi} = \Delta\theta\overline{q}$.

Finally, comparing the outcomes with regard to the weight assigned to the firm's profit, we see that as α decreases and gets closer to 0, the quantity produced by the high-cost firm decreases leading to higher distortions.

Intuitively, since the rent given to the low-cost firm is a function of $\overline{q}$, extreme leftist government would prefer a lower $\overline{q}$, given these outcomes.

Benevolent Regulator

Since the regulator is benevolent, collusion of the firm and the regulator is still not a concern for the government. When the report is $r = \sigma = \underline{\theta}$, complete information will

be chosen. However, when $r = \sigma = \phi$, the government will update his beliefs:

$$\hat{v} = \Pr(\theta = \underline{\theta} \backslash \sigma = \bar{\theta}) = \frac{v(1-\mu)}{1-\mu v} < v$$

The government will use this probability in order to maximize the social welfare:

$$Max\ \hat{v}\left[S(\underline{q}) - \underline{\theta}\underline{q} - (1-\alpha)\underline{\Pi}\right] + (1-\hat{v})\left[S(\overline{q}) - \overline{\theta}\overline{q} - (1-\alpha)\overline{\Pi}\right]$$

subject to PC's and ICC's.

The solution to the optimization problem with a benevolent regulator is stated in the following proposition.

Proposition 12. Optimal contracts $(\underline{T}*, \underline{q}*)$, $(\overline{T}*, \overline{q}*)$ under incomplete information with a benevolent regulator are characterized by[17]

$$\begin{aligned}
\underline{T} &= \underline{\theta}\underline{q} + \Delta\theta\overline{q} \\
\overline{T} &= \overline{\theta}\overline{q} \\
S'(\underline{q}) &= \underline{\theta} \\
S'(\overline{q}) &= \overline{\theta} + \frac{\hat{v}}{1-\hat{v}}(1-\alpha)\Delta\theta = \overline{\theta} + \frac{v}{1-v}(1-\alpha)(1-\mu)\Delta\theta
\end{aligned}$$

The transfers imply that the high-cost firm gets no rent since $\overline{\Pi} = 0$, while the firm gets the information rent $\underline{\Pi} = \Delta\theta\overline{q}$ if the production is made with a low-cost firm.

We can see that there is less distortion with a benevolent regulator than no regulatory agency under asymmetric information. If we assume full observability by the

[17] Since, the optimal contracts are calculated for each case, only the production level of the high cost firm will be changing. Hence, the other equations will be skipped in the rest of the paper and the comparisons will be based on the production of the inefficient firm.

regulator, i.e. $\mu = 1$, the complete information outcome is reached with a benevolent regulator.

One thing to point here is that if the government decides to regulate the firm itself instead of appointing an agency, the calculations here will be the same except we will need to change μ with ε. Since we have assumed $\varepsilon < \mu$ taking into account the expertise of the agency, the distortions will be more with direct government control. This justifies the assumption that the government needs the agency to regulate the firm.

Corruptible Regulator

No Accountability

Now, the regulator has a utility function

$$R(w) = w,$$

where $w \geq 0$ is his income.

When $\sigma = \underline{\theta}$, the firm may offer to the regulator to hide his signal in exchange for a bribe. This bribe is at most the information rent $\Delta\theta\bar{q}$. However, the fear of being caught or because of the inefficiency of side contracting or because of some respect for norms of behavior, the regulator enjoys only a fraction k in $(0, 1)$ of this bribe.

To avoid collusion, it is then enough for the government to reward the regulator with an income $\underline{w}$ such that

$$\underline{w} \geq k\Delta\theta\bar{q}.$$

However, the need to reward the regulator creates an additional cost of

$$v\underline{w} = vk\Delta\theta\bar{q}.$$

The government must then redesign his regulation to take into account this cost. The government must solve

$$Max\ v\mu\left[S(\underline{q}) - \underline{\theta q} - (1-\alpha)\underline{\Pi}\right] + v(1-\mu)\left[S(\underline{q}) - \underline{\theta q} - (1-\alpha)\underline{\Pi}\right] +$$

$$(1-v)\left[S(\overline{q}) - \overline{\theta q} - (1-\alpha)\overline{\Pi}\right]$$

subject to PC's and ICC's.

The following proposition states the result with a corruptible regulator in absence of accountability.

Proposition 13. Optimal regulation under incomplete information with a corruptible regulator in absence of accountability is characterized by

$$S'(\overline{q}) = \overline{\theta} + \frac{v}{1-v}(1-\alpha)\left[(1-\mu) + \mu k\right]\Delta\theta$$

We can observe that the distortion is higher when the regulator is corruptible as long as $\mu k > 0$.

If we impose $k = 0$, meaning that the regulator cannot enjoy the bribe at all, we have the benevolent regulator case that is

$$S'(\overline{q}) = \overline{\theta} + \frac{v}{1-v}(1-\alpha)(1-\mu)\Delta\theta,$$

and when $k = 1$, we have the same outcome as there was no regulator:

$$S'(\overline{q}) = \overline{\theta} + \frac{v}{1-v}(1-\alpha)\Delta\theta.$$

The corruptible agency benefits from $k\Delta\theta\overline{q}$ completely, if he can fully observe the cost level of the firm, i.e. $\mu = 1$.

Implementing Accountability Mechanism

Whenever there is the possibility of collusion, the government can legitimize its scrutiny and can have an opportunity to update the signal in accordance with his interest since the nature determines the signal received by the government with probability $\varepsilon \in (0,1)$. As I have mentioned before, β is the probability of investigation and along with the assumptions we have made, the leftist government has an incentive to scrutinize whenever the report $r = \bar{\theta}$ is received. For the rightist government $\beta = 0$.

Therefore, the government maximizes

$\max v\mu\left[S(\underline{q}) - \underline{\theta q} - (1-\alpha)\underline{\Pi}\right] + v(1-\mu)\beta\varepsilon\left[S(\underline{q}) - \underline{\theta q} - (1-\alpha)\underline{\Pi}\right] + v(1-\mu)(1-\beta)\left[S(\underline{q}) - \underline{\theta q} - (1-\alpha)\underline{\Pi}\right] + v(1-\mu)\beta(1-\varepsilon)\left[S(\underline{q}) - \underline{\theta q} - (1-\alpha)\underline{\Pi}\right] + (1-v)\beta\left[S(\overline{q}) - \overline{\theta q} - (1-\alpha)\overline{\Pi}\right] + (1-v)(1-\beta)\left[S(\overline{q}) - \overline{\theta q} - (1-\alpha)\overline{\Pi}\right]$,

subject to the same constraints gives the result which is stated in the following proposition.

Proposition 14. Optimal regulation under incomplete information with a corruptible regulator in case of accountability requires

$$S'(\overline{q}) = \overline{\theta} + \frac{v}{1-v}(1-\alpha)\left[(1-\mu)(1-\beta\varepsilon) + \mu k\right]\Delta\theta.$$

When $k = 0$, since the regulator will be benevolent, there will be no need to scrutinize, hence $\beta = 0$. Plugging in these values, the results in the same equation as in the case of a benevolent regulator which I have shown above. When $k = 1$, we have the case of no regulator and the signal is received only by the government, which is less precise and hence less efficient.

If the regulator is corruptible, the investigation by the government decreases the severity of the distortions by the term $(1 - \beta\varepsilon)$. In order to have the same outcome as the case of a benevolent regulator, we should have

$$(1 - \mu)(1 - \beta\varepsilon) + \mu k = (1 - \mu).$$

The final result obtained is given in the following proposition.

Proposition 15. The level of accountability required to ensure the production level same as the benevolent regulator satisfies

$$(1 - \beta\varepsilon) = \frac{1}{\mu k}.$$

This condition allows us to see the trade-off between the corruptibility of the agency and the investigation that should be taken by the government as long as the government is politically biased, i.e $\alpha \neq 1$. First of all, as k increases, the agency benefits more from the bribe, therefore, he is more likely to collude. In that case, β should be made higher to satisfy the condition. This is also the case when ε is lower, meaning that if the government can poorly observe the cost level, he should be monitoring the agency more often. Second, as the government is more leftist -as α

decreases- in order to prevent the rents given to the firm which is a function of $\overline{q}$, the level of production decreases much below the optimal level, which is the case when $\alpha = 1$.

Finally, one can also get some intuition thinking what would have happened if we allow for a pro-business government, i.e. $\alpha > 1$. However, one should keep in mind that the calculations would have differed since we would not be imposing the participation constraint of the firm to bind. As mentioned in the complete information case, the condition for the first best would be then $S'(\overline{q}) = \alpha\overline{\theta}$ and $\alpha > 1$ will make the term $\frac{v}{1-v}(1-\alpha)\left[(1-\mu)(1-\beta\varepsilon)+\mu k\right]\Delta\theta$ negative. So the government would prefer the term $[(1-\mu)(1-\beta\varepsilon)+\mu k]$ being larger in absolute terms which can occur with less investigation. This confirms our discussion that the ruling of a pro-business government who is less likely to investigate, causes the high cost firm produce too much output at an inefficient level and leave higher rents to the efficient firm.

CHAPTER 4: CONCLUSION

We have analyzed the trade-off between independence and accountability of a regulatory authority who is appointed by a politically-biased government. In order to do so, we have taken two approaches. First, we explored and analyzed the problem with different repeated games, and proposed a leniency-like mechanism in order to deter collusive activities. We have considered, separately, the games where the status of the agency is independent or affiliated. We solved both type of games and obtained the conditions for the absence of accountability and compared the results to the case with accountability. We have also considered cost contingent collusive agreements as opposed to constant bribe commitments.

We have shown that in absence of accountability, independent of the political polarization of the government, the agency is very likely to collude. When accountability is a concern, collusion is partly deterred, however less with an affiliated agency. Independence introduces uncertainty about the polarization of the government to be elected, and hence ensures less incentives for collusive behavior. This effect is diminished with a pro-business political principal for whom the rent given to the firm is not a concern, which rules out the possibility of being investigated. We also show the trade-off between the frequency of investigations and the expertise of the government to detect the collusive activity. Intuitively, lower probability of being caught must be balanced by a higher probability of being reviewed. The other way to balance the incompetence of the government is to set higher fines for the colluding agents. Finally, when we implement a rewarding mechanism for the deviating regulator, we observe that it works effectively in deterring collusion. Not surprisingly, we have also found

that the firm prefers a collusive agreement which is based on the realised cost level in the relevant period, whereas the regulator is more likely to collude when he is offered a constant bribe each period.

Second, we analyzed the optimal contracts for the games studied and tried to interpret the results which turned out to be similar to the previous game theoretical analysis. We have shown that implementing the optimal contracts, such that the firm always produces the efficient output level if it is low-cost, causes downward distortions of output for the high-cost firm, decreasing social welfare. These distortions are less with a benevolent regulatory authority and vanish if the regulator can fully observe the cost level of the firm. Introducing the possibility of corruption has enabled us to show the trade-off between the corruptibility of the agency and the level of investigation to be taken. Similar to the first part, we have found that if the government can poorly observe the cost level, thus detect collusion, he should be monitoring the agency more often. Certain amount of accountability is necessary to reach the optimum as long as the regulator is not benevolent. However, we have found that the politically-polarized government can use the accountability as a tool to change the report by the regulator in order to benefit a certain group by distorting the output level and hence the social welfare.

This research could be pursued further along several lines. In the first approach, one could change the sequence of the game so that the regulator gives the report to the government and depending on his report, receives the bribe from the firm. This analysis will enable the firm (instead of the regulator) to deviate from the collusive agreement once the report is given. Analyzing this case may give other insights regarding these games.

More interestingly, one could analyze a game very similar to the leniency mechanism in which the firm is regulated by two authorities who can collude on the reports given to the government. Here, the revelation game can be designed as a simultaneous game between the two regulatory agencies and by offering fine reductions or rewards to the revealing agency, the government will be able to deter collusion even more.

The principal-agent analysis for optimal policy implementation could be extended in various ways. The first analysis has to do with the parameter α which measures the political polarization of the government. In this thesis, by imposing $\alpha \leq 1$, we allow for governments that both dislike giving rents to the firms, which is very restrictive when one considers the pro-business government which tries to benefit the producer side at the expense of consumers with election concerns. Therefore, the first thing to do would be to set up a general model allowing for both of the extreme cases in which either the consumer or the producer surplus is maximized by the government. This will complicate the computations, but it will give results with more insights.

One can also endogenize the probability of observing the actual cost of the firm by introducing an effort parameter to the agency. The higher effort that the regulator provides, the more likely he will observe the actual cost and the more bargaining power he will have on the bribe. In this setup, it will be necessary to introduce the cost of effort which will lead to a trade-off for the regulator.

As in Laffont and Tirole (1991), it is also possible to introduce social cost of transfers and moral hazard for the firm, which were ignored here for simplicity.

In addition, Laffont and Martimort (1999) have analyzed the separation of regulators where two agencies regulate the firm, and they find that this deters

collusion. One could extend this research by adding another regulator and compare the results with two regulatory powers to the results of the accountability mechanism with regard to distortions and social welfare.

Finally, one may want to test the results suggested by the theoretical models analyzed here. The model suggests that as the agency becomes more independent the scope for collusion increases leading to higher transfers given to the firms. This is also the case when the government is more pro-business, in other words rightist. Therefore, an empirical model could be written to analyze the correlations between the profits of these affiliated firms with the level of independence of the regulatory agencies and the political stance of the governments. In this regard, the latter could be easily captured as a measure taking into account the vast literature of political science. The way to proceed in order to capture the independence of the agency is to benefit from the existing literature which attempt to design indices for the regulatory agencies to compare their independence levels (see Giraldi, 2002). The questionnaires for the agencies are designed to obtain information about: the agency head's and board members' term of office, the way they are appointed/dismissed, whether they can hold other offices in the government, whether the appointment is renewable, the source of the budget of the agency and the way it is controlled, the agency's formal obligations vis-à-vis the parliament and the government. These questions can be improved upon to measure and compare the independence level of the agencies which will allow us to test the theoretical models we have provided, which attempts to analyze the trade-off between independence and accountability.

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