A Dynamic Theory of Regulatory Capture*

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Abstract

Firms have incentives to influence regulators' decisions. In a dynamic setting, we show that a firm may prefer to capture regulators through the promise of a lucrative future job opportunity (i.e., *the revolving-door channel*) than through a hidden payment (i.e., a bribe). This is because the revolving door publicly signals the firm's eagerness and commitment to reward friendly regulators, which facilitates collusive equilibria. Moreover, the revolving-door channel need not require an explicit agreement between the firm and the regulator, but may work implicitly giving rise to an industry norm. This renders ineffective standard anti-corruption practices, such as whistle-blowing protection policies. We highlight that closing the revolving door may give rise to other inefficiencies. Moreover, we show that cooling-off periods may make all players worse off if timed wrongly. Opening the revolving door conditional on the regulator's report may increase social welfare.

1 Introduction

Firms often have an incentive to sway the behavior of their regulators. Different channels can be used to capture regulators in an attempt to affect the regulatory outcome. Besides paying bribes, firms can promise friendly regulators lucrative future job opportunities. This practice, known as revolving door, appears to be rife in developed countries and has long been the subject of a lively debate over the opportunity of adopting measures to limit the transition of regulatory officials to the private sector. This is because regulatory

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capture is known to directly distort economic outcomes and undermine trust in markets and democratic institutions (e.g., see Stigler, 1971 and Laffont and Tirole, 1991, 1993). These different channels are often viewed as substitute tools for the firm to capture its regulators.

In this paper, we develop a dynamic model to shed light on a crucial distinction between the revolving door and hidden payments as means to influence the regulatory outcome, which is tied to their different informational content and that has been overlooked so far. The intuition is the following. Because formal exchanges of favors between regulatory officials and regulated firms are prohibited, rewarding a friendly official can only take the form of an informal promise. As there is no guarantee that the firm will keep its end of the bargain, the regulator may refuse to be swayed. Thus, a firm may tremendously benefit from publicly rewarding a compliant regulator, as this could signal to future regulators that being accommodating pays off. Since the firm need not conceal its hiring decisions, the revolving door can convey information about the firm's eagerness and commitment to reward friendly officials. Therefore, the public nature of the recruitment decision helps facilitate collusive equilibria. By contrast, bribes are inherently private in nature because of their illegality and, as such, do not help coordinate the firm's and the regulators' behavior.

There is an additional, related reason for why bribes may be a poor substitute for the revolving door: bribes necessarily require some explicit agreement between the collusive partners. This implies that general anti-corruption practices, such as a whistle-blowing protection policy or a close scrutiny of the firm-regulator interaction, can successfully deter bribery. By contrast, the revolving-door channel may as well work implicitly: observing past behavior and following industry norms suffice to inform the parties of the gains that can be obtained by colluding. The absence of smoking-gun evidence renders standard anti-corruption policies ineffective. Although closing the revolving door can solve the problem of regulatory capture, we caution that it can give rise to other inefficiencies, as already pointed out in the literature and by many observers (e.g., Che, 1995). Firstly, it might actually be socially efficient that some regulatory officials join the regulated firms as they could bring their industry know-how and expertise to the private sector. Secondly, regulators may demand a lower salary in the anticipation of landing highly-paid positions in the private sector after having gained regulatory experience. These benefits would not be enjoyed if the revolving door were closed. We put forward an alternative state-contingent revolving-door policy to mitigate these inefficiencies as it ensures that skilled regulators do not necessarily lose out on appealing career opportunities.

In the model, we consider an infinitely repeated game between a firm and a benevolent principal, where the latter can be thought of as the policymaker. In every period, a regulatory decision that affects the firm's payoff and social welfare must be taken. The principal designs the regulatory policy, but must delegate the collection of information about a time-varying state variable, which is critical for the regulatory decision, to a regulatory agency. To carry out its monitoring activities, the regulatory agency employs experts who, unlike the firm and the principal, only live for one period. The experts may sometimes be able to hide and not report the collected evidence. The firm can promise the experts a bribe or a post-agency employment. We allow for the principal to offer experts a bonus contract that rewards them for reporting evidence.

We demonstrate that the revolving door can be kept open if the firm-agency interaction is sporadic: if so, the firm's promise of rewarding a compliant expert is not credible. Conversely, when interaction is frequent, the promise of a future employment may allow the firm to influence the experts' reports. This is the case if the firm and the experts are sufficiently patient. The principal can deter regulatory capture by offering a high bonus for reporting evidence and will do so, unless it is too socially costly. However, if players are very patient, deterring regulatory capture is too expensive and the principal thus offers a flat wage. We formally highlight the key distinction existing between the revolving door and bribes: as recruiting former experts need not be kept hidden, the firm can use the revolving-door channel to signal its eagerness to reward friendly experts. This also acts as a commitment device: being publicly observed, the failure to reward a friendly expert would trigger collective punishment.

We analyze two extensions of the baseline model. In the first extension, we allow for an exogenous enforcement mechanism that compels the experts and the firm to abide by what they agree upon in an explicit side-contract. We find that the firm resorts to bribes to capture regulators whenever their associated transaction cost is sufficiently low, even when players are very patient so that the firm could also use the revolving-door channel. This may account for the prevalence of bribery in countries with less effective monitoring of experts' conduct and less social stigma associated with explicit corruption. In our basic model, experts are unproductive when employed at the firm. Hence, it is efficient to close the revolving door, unless the firm would use inefficient bribes in that case. This also implies that there is a complementarity between closing the revolving door and policies that make bribing more costly.

In a second extension, we consider the case in which some experts are skilled and are thus more likely to find evidence and also contribute to the firm once hired. It would be efficient if those more skilled experts joined the regulated firm once the regulatory decision has been taken. Thus, our model includes the two key elements over which the discussion concerning the pros and cons of revolving door practices has centered: regulatory officials add value to the firms, but they can take actions to favor their prospective employers. We show that keeping the revolving door open conditional on the information revealed by the expert increases social welfare compared to an unconditional ban on joining the industry after leaving the regulatory agency. When the expected cost of a wrong regulatory decision is higher, when the expert's productivity in the industry is smaller, and when the inefficiency of raising taxes is larger, selectively keeping the revolving door open is more likely to be superior to both tolerating regulatory capture and deterring capture via a reward scheme. Our results are qualitatively robust to the firm being able to observe the expert's information and to the expert having to exert effort for collecting any information. Moreover, we show that suboptimally-timed cooling-off periods may hurt all involved players. We caution that cooling-off periods uniform across many regulatory agencies and, hence, industries are unlikely to be optimal.

Related theoretical literature. The economics literature has long recognized how the risk of collusion between a firm and the regulator entrusted with its supervision can undermine the regulatory outcome. The contract-theory literature pioneered by Tirole (1986) shows that collusion can be prevented by rewarding the regulatory officials for revealing information which can hurt the firm.[1] In this strand of the literature, it is typically assumed that the firm and the agency can strike an enforceable collusive agreement.[2] One of the purposes of our model is to focus on one of the channels that can make such collusive agreement self-enforceable, namely reputation, and study in great detail its repercussions for regulation outcomes and for the design of policies to prevent capture or alleviate its most harmful effects. In this regard, our paper is linked to Martimort (1999), who also analyzes the dynamics of regulation. Like him, we consider self-enforcing agreements between the firm and the regulator and we posit that the principal cannot commit to future transfers to the regulator. There are some relevant modeling differences as Martimort (1999) assumes that all players are long-lived and characterizes the collusive-proof regulatory contract, whereas in our model the principal may prefer not to prevent capture and there is an infinite stream of short-lived regulators. More fundamentally, the goals of the papers are different. Martimort (1999) aims to explain why the regulatory process becomes less efficient over time and to endogenize the transaction costs of side-contracts. By contrast, we are interested in studying the mechanism whereby regulators are swayed by the firms and we highlight the trade-offs that preventing capture bring about.

Some theoretical papers have explicitly focused on both the upsides and the drawbacks of the revolving-door practice. Salant (1995) shows how revolving doors could facilitate cooperation between managers and regulators, leading to higher investments and increasing social welfare. Che (1995) studies the relationship between a regulator's performance and revolving doors. He shows how post-agency employment opportunities can affect the regulator's ex-ante incentives to acquire regulatory expertise and his ex-post incentives to favor the regulated firm. We also highlight the pros and cons of revolving door and we also come to the conclusion that tolerating collusion may be beneficial, though for different reasons. Specifically, allowing collusion may prompt monitoring effort in Che (1995), whereas it can reduce the regulatory cost in our paper. However, Che (1995) considers a one-off interaction between the players and the revolving door is only one of the possible mechanisms that the firm and the regulator can rely on to collude in his model, whereas

[1] Recent contributions to the design of regulation in the presence of corruption concerns include Drugov (2010), Hiriart et al. (2010), Hiriart and Martimort (2012), Angelucci and Russo (2017), Ortner and Chassang (2018), and De Chiara and Manna (2019).

[2] Mechanisms such as emotions, reciprocity, and reputation are often invoked to justify the enforceability of this side-contract (for instance, see Tirole, 1992, Vafaï, 2002, and Vafaï, 2010).

it plays a more prominent role in our paper, as formally shown by distinguishing between different channels.

There is also a link with two recent papers that develop dynamic games. First, Troya-Martinez and Wren-Lewis (2018) study relational contracts between an agent and a supervisor where there is room for corruption, highlighting the differences with more standards principal-agent models. Second, Barron and Guo (2019) study the related issue of extortion in a model where a principal interacts with an infinite stream of agents. The agents' ability to commit to public messages enables agents to blackmail the principal and can fully destroy cooperation.

Moreover, this paper contributes to the credence goods literature (Darby and Karni, 1973; Dulleck and Kerschbamer, 2006). In particular, it extends the small literature that views the policymaker as the party that is seeking advice from an expert (Dulleck et al., 2015). It also adds to the literature on commissions and kickbacks (Inderst and Ottaviani, 2012a,b,c, and Inderst, 2015) in the sense that another party – here the firm – may influence the expert's choice.

Empirical evidence. There is a growing body of empirical evidence investigating the effects of revolving door, thanks to the increasing availability of detailed datasets on workers' transition from regulatory agencies to the private sector (and vice versa). There is evidence that the revolving door is both associated with capture and incentives to acquire or signal expertise and skills that can result in superior regulatory outcomes. Concerning suggestive evidence of capture, Tabakovic and Wollmann (2018) study the career trajectory of examiners working for the USPTO who evaluate the patent applications filed by law firms on behalf of inventors. Among other things, they find that (i) examiners award more patents to the law firms they end up working for; (ii) the difference is significantly less pronounced when the likelihood of being hired is lower for exogenous reasons (e.g., recessions); (iii) the patents awarded to the law firms they later work for receive substantially fewer citations, indicating that these applications are held to a lower standard. Recently, suggestive evidence of regulatory capture has been found in the insurance solvency regulation (Tenekedjieva, 2019), for credit rating analysts (Cornaggia et al., 2016), and even for scientists working for the FDA advisory committees and panels (Piller, 2018). Notably, firms-regulators interaction is regular and relatively frequent in all these industries: over the 15 years considered by Tabakovic and Wollmann (2018), at least six law firms filed more than 10,000 applications (and at least 21 law firms filed more than 1,000); FDA advisory committees regularly meet with representatives of large pharmaceutical corporations, and credit rating analysts rate securities of large underwriting merchant banks. Lastly, while financial exams of insurance firms may be ordered less frequently, they must be performed at least once every five years.

Other papers have found evidence pointing to an incentive effect: for instance, Kempf (2020) finds that more accurate credit rating analysts working for Moody's are more likely to join the underwriters.[3] Focusing on Brazilian health procurement, Barbosa and Straub (2017) find that civil servants who later join private providers purchase products at a lower price, whereas the transition of workers from providers to the administration appears detrimental as it is associated with larger purchases from the connected provider at higher prices. DeHaan et al. (2015) find that more aggressive enforcement effort (e.g., collecting higher damages or seeking criminal proceedings against companies accused of accounting misrepresentation) are weakly associated with those SEC lawyers who later join law firms, especially those who specialize in SEC enforcement cases, although those lawyers who will be based in Washington, D.C. tend to be laxer.

Also relevant for our paper is the empirical literature on the lobbying process which has shown that, besides their technical knowledge and expertise, lobbyists are valuable in that they bring connections, namely special interest access to legislators (Bertrand et al., 2014). Accordingly, prior experience in the federal government is especially sought-after because of the network of friends and colleagues that a revolving-door lobbyist may have developed (Blanes i Vidal et al., 2012). We put forward a complementary mechanism that renders the recruitment of former regulators or government employees particularly appealing: it enables the regulated firm to signal its intent to reward accommodating regulators (the creation of the industry norm) and ensures the monitoring of its promises, critical for the sustainment of a collusive equilibrium.

Post-employment restrictions. Title 18 of the U.S. Code in Section 207 establishes general post-employment restrictions on former officers, employees, and elected officials of the executive agencies of the United States. These include (i) a permanent ban on influencing any agency's or court's decision in connection with a particular matter in which the person participated personally; (ii) a two-year ban concerning those matters that were pending under the person's responsibility up to year after leaving office; (iii) a one-year ban on senior officials to influence the department or agency in which the person worked for any matters for which the person seeks official action. Procurement officers are subject to further restrictions: they cannot accept compensation from the contractor of a procurement of $\$10,000,000$ or more within one year of working on the procurement. There may also be different restrictions for specific regulators. For instance, Tenekedjieva (2019) documents quite some variation in the legal restrictions U.S. State commissioners (some of whom are appointed by the State governors) face when they leave office, such as temporary ban on lobbying or on assisting formerly regulated firms.

In the European Union (EU), the legislation is essentially decentralized to the single state members. This has resulted in a great deal of heterogeneity, as emphasized by a Transparency International report that focuses on lobbying (Mulcahy, 2015). The report assesses the regulation of the lobbying practice in the EU. Among the metrics taken into

[3] Kempf (2020) also finds some evidence of capture as more optimistic analysts on some specific deals, that is, those who give ratings that are biased upwardly as compared to their counterparts at Standard&Poor and Fitch, are more likely to be hired by one of the underwriting investment banks.

account, there is integrity, namely, the rules that govern the ethical conduct of lobbyists and public officials. The results are rather grim. First, lobbyists and public officials are not subject to clear and enforceable rules regarding their activity: some countries do not even have a code of conduct for public sector employees. Many countries have adopted cooling-off periods for some public officials. For instance, in France, the law requires a three-year cooling-off period before a public official could join a firm that he or she was previously responsible for in terms of surveillance or control activities. Only legislators in many states in the US are subject to cooling-off periods, whereas in Europe only Slovenia has rolled out a cooling-off period for MPs. Lastly, the report also finds that the provisions are generally poorly enforced.

Outline. The paper proceeds as follows. Section 2 develops the set-up of our model; Section 3 solves the baseline version, whereas Section 4 and Section 5 explore two variants, where we allow for enforceable side-contracts and benefits of revolving door, respectively. Section 6 provides some concluding remarks. All proofs are relegated to the technical appendix.

2 Model

An infinitely-lived, profit-maximizing firm can produce a new good in each period that generates a private benefit $G > 0$. The problem of the infinitely-lived, benevolent principal is to decide whether or not to authorize production, since this can cause unverifiable damages to third parties. Specifically, if the state is safe, i.e., $\theta = S$, damages do not occur. If the state is unsafe, i.e., $\theta = U$, production generates damages $D > 0$. The state is unsafe with probability $q > 0$. We assume that:

$$D > G > qD.$$

Therefore, it would be socially desirable if production were authorized only in the safe state and, without knowing the state, it would be better to authorize production. Whether production brings about damages is not known, whereas the probability distribution of the states of the world is common knowledge.

The principal regulates the firm through a dedicated agency. In every period, a wealth-constrained, short-lived expert is employed at the agency and tasked with collecting a signal about θ. If $\theta = S$, the signal is always uninformative, i.e., $s = \emptyset$. Conversely, if $\theta = U$, the signal reveals the true state of the world. The signal is privately observed by the expert, whereas the principal and the firm only know its distribution. The expert sends a public report r to the principal. We assume that the expert cannot forge information, that is, if $s = \emptyset$, $r = \emptyset$. This is the case if the expert needs to provide verifiable evidence along with a report r. However, if $s = U$, the expert can conceal information at a private concealment cost $c \in \{\underline{c}, \infty\}$, with $\underline{c} \geq 0$. This cost depends on the nature of the information and thus becomes known only after the expert has collected the signal. It is common knowledge that $c = \infty$ with probability $\eta \in (0, 1)$.[4]

At the beginning of the game, the principal commits to an authorization policy as a function of the report, and this decision is denoted $x_r \in \{0, 1\}$, where $x = 1$ if production is allowed and $x = 0$ if production is prohibited. The principal also pays a bonus β_r to the experts, which is contingent on the report.[5] This payment generates a social cost of $\lambda\beta_r$, where $\lambda \geq 0$, that can be due to inefficiencies in tax collection or to the political resentment over rewards paid to civil servants. We assume that the principal cannot commit to a sequence of regulatory transfers. Indeed, the wage policy can be modified more easily than the authorization policy. As a consequence, the principal cannot thwart capture by committing to future rewards following the expert's deviation.[6]

After sending the report, the expert can seek post-agency employment. The firm can make a wage offer w, possibly as a function of the report that the expert made. The expert's contribution to the firm is set to zero.[7]

The timing of the stage game is as follows:

0. The principal commits to the authorization decision as a function of the report $x_r \in \{0, 1\}$.

1. Nature draws the state of the world θ_t and the concealment cost c_t. The principal sets the bonus scheme for the experts, $\beta_t(r_t) \geq 0$.

2. If the expert accepts to work for the regulatory agency, he observes the signal s_t.

3. The expert sends a public report r_t to the principal who authorizes or not production according to x_r and pays the expert β_t.

4. The firm may make an offer w_t.

The repeated game we analyze involves the infinite repetition of the stage game starting at stage 1. The principal and the firm use the same discount factor $\delta < 1$, and we multiply each period's payoff by $1 - \delta$ so as to obtain per-period averages.

3 Analysis of the Baseline Model

First, note that the principal could obtain social welfare $W^{NO} = G - qD$ if she did not hire any expert. Regulation is thus valuable in that it may bring about a benefit equal to

[4]The value of this parameter may well be industry and country dependent: in countries where there is more stigma associated with immoral actions, η is probably higher. In industries where the expert's report is based on hard, objective evidence, information is more likely to be difficult to conceal.

[5]This reward can also come in the form of a promotion or a permanent salary increase.

[6]A similar assumption on the principal's limited commitment is made in Martimort (1999) and achieves the same purpose.

[7]We relax this assumption in Section 5.

$q(D-G)$, which is attained if the principal sets $x_U = 0 < 1 = x_\emptyset$ and the experts report truthfully.

If firm-experts interaction is infrequent, $W^{SB} = (1-q)G - qD$, where SB stands for second-best, is indeed the level of social welfare that regulation achieves and there is no need to reward experts to induce truthful revelation. To see this, solve the stage game backwards. In stage 4, the firm does not have an incentive to recruit the expert. In stage 3, the expert would choose the report that maximizes his utility, which depends on the bonus scheme and the concealment cost. To induce truthful revelation of the signal, the principal can offer $\beta_\emptyset = \beta_U = 0$ in stage 1 and can announce $x_\emptyset = 1$ and $x_U = 0$ in stage 0. The firm's expected profit is $\pi^{SB} = (1-q)G$.

If the interaction with the regulatory agency is more systematic, the firm may try to capture the experts so as to improve upon $\pi^{SB} = (1-q)G$. Consider the following *revolving-door implicit contract*, denoted by RD, starting at date t in which (i) experts with a low concealment cost, $c = \underline{c}$, always conceal unfavorable evidence; (ii) the firm rewards experts who report $r = \emptyset$ with improved post-agency job prospects; (iii) if at period $t+l$ the expert reported $r = \emptyset$ and the firm did not improve his job prospects, then at $t + l'$ with $l' \geq l$, the experts always reveal unfavorable evidence. The revolving-door implicit contract is self-enforcing if these strategies form a Perfect Bayesian Equilibrium of the continuation game.[8]

For the revolving door implicit contract to be an equilibrium, the post-agency salary must satisfy a set of participation and incentive constraints. In what follows, we restrict attention to stationary equilibria.[9] In addition, given that the expert's contribution to the firm's profits is normalized to zero, assuming that the expert is not hired when he reports $r = U$ is without loss of generality, which enables us to suppress the subscript r from w - the expert may be hired only if $r = \emptyset$. The revolving-door implicit contract is self-enforcing only if this firm's capture-incentive dynamic constraint is satisfied:

$$-(1-\delta)w + \delta\pi^{RD} \geq \delta\pi^{SB}, \tag{1}$$

where π^{RD} and π^{SB} are the expected values of the streams of payoffs the firm obtains if regulatory capture does and does not take place, respectively. In the latter case, the firm receives the second-best payoff in every period. If regulatory capture occurs, the firm obtains G also if there is evidence that production is unsafe but the signal can be manipulated. However, the firm must pay the salary w whenever the report is favorable:

$$\pi^{RD} = \Big(1 - q\eta\Big)(G - w).$$

It follows that:

$$\Delta_\Pi \equiv \pi^{RD} - \pi^{SB} = q(1-\eta)G - \Big(1 - q\eta\Big)w.$$

[8] The notion of Perfect Bayesian Equilibrium enables us to consider experts' beliefs about the salaries they expect to receive from the firm. In equilibrium, experts will correctly anticipate the salary the firm will offer for any bonus schedule provided by the principal and for any report they make.

[9] In Appendix A, we show that this is without loss of generality.

The maximum w that is self-enforcing is found from the firm's capture-incentive dynamic constraint:

$$w_{Max} = \frac{\delta q(1-\eta)G}{1-\delta q\eta}.$$

A second necessary condition for the revolving door implicit contract to describe an equilibrium is that the expert with a low concealment cost is willing to misreport evidence. We thus write the following expert's capture-incentive compatibility constraint:

$$w \geq \beta_U - \beta_\emptyset + \underline{c}. \tag{2}$$

First note that if $\underline{c} > w_{Max}$, deterring capture is costless. This condition can be rewritten as:

$$\delta < \tilde{\delta} \equiv \frac{\underline{c}}{q(1-\eta)G + q\eta\underline{c}}. \tag{3}$$

Now, suppose that capture is an issue because $\delta \geq \tilde{\delta}$. The principal must decide whether to deter or tolerate regulatory capture. If the principal does not prevent capture, it is better not to reward experts, namely, $\beta_U = \beta_\emptyset = 0$, and welfare is

$$W^{RDtolerate} = \eta(1-q)G + (1-\eta)[G - qD - q\underline{c}]. \tag{4}$$

To understand why, notice that the firm expects to get $(1-q\eta)(G-\underline{c})$, where $w = \underline{c}$ is the minimum salary that can induce a expert to conceal evidence. An expert expects to obtain $(1-q)\underline{c}$ if the evidence is not manipulable and $\underline{c} - q\underline{c}$ if evidence is manipulable. While w is merely a transfer from the firm to the experts, when evidence is concealed, the concealment cost enters the welfare expression. Note that if $\eta \to 0$, tolerating capture would be dominated by shutting down experts, as they would not improve the authorization outcome while giving rise to other inefficiencies.

If the principal deters capture, she sets $\beta_U = w_{Max} - \underline{c}$ and $\beta_\emptyset = 0$, and welfare is:

$$W^{RDdeter} = (1-q)G - \lambda q(w_{Max} - \underline{c}). \tag{5}$$

This approach restores authorization efficiency but comes at the cost of rewarding the experts. The following proposition describes the principal's favorite solution.

Proposition 1. *(a) If $\delta < \tilde{\delta}$, regulatory capture is not an issue and the principal sets $\beta_U = \beta_\emptyset = 0$;*

(b) if $\delta \geq \tilde{\delta}$, regulatory capture is an issue and the principal deters capture by setting $\beta_U = w_{Max} - \underline{c}$ and $\beta_\emptyset = 0$ if and only if:

$$\lambda \leq \hat{\lambda} \equiv \frac{(1-\eta)(1-\delta q\eta)(D-G+\underline{c})}{\delta q(1-\eta)G - (1-\delta q\eta)\underline{c}}, \tag{6}$$

where $\hat{\lambda}$ is decreasing in δ. Otherwise, the principal does not prevent capture and sets $\beta_U = \beta_\emptyset = 0$.

When the discount factor is low, regulatory capture is not a problem as the maximum salary the firm can credibly promise to offer is lower than the concealment cost. For intermediate values of δ, the implicit contract could be self-enforcing and this inevitably reduces welfare. The principal may decide to prevent capture by offering incentives to the experts. The principal may refrain from doing so when this is more costly, i.e., when λ is sufficiently high. Therefore, when paying high-powered incentives to experts faces more political opposition and/or creates more inefficiencies, regulatory capture is more likely. The threshold value of λ above which the implicit contract is tolerated is decreasing in δ. To understand why, notice that the maximum salary that the firm can credibly promise to pay to the experts is increasing in the discount factor, and so is the bonus that the principal would have to pay to an expert who makes an unfavorable report.

3.1 Revolving Door versus Implicit Bribes

To shed light on the critical role played by the revolving door, suppose that the firm implicitly promises to pay a bribe b to an expert who reports $r = \emptyset$. While, at first blush, this payment looks strikingly similar to the wage, there is a crucial difference: being illegal, the bribe cannot be made public. As a result, only the expert who receives the bribe and the firm observe it. Consider a *bribery implicit contract* akin to the revolving-door implicit contract described above, with the difference that a bribe is paid instead of a post-agency wage. We obtain the following result.

Proposition 2. *There does not exist a self-enforcing bribery implicit contract which induces the experts to conceal evidence.*

The reason why the implicit promise of a bribe cannot induce the experts to conceal evidence lies in the private nature of this illegal payment. As the period $t + l$ expert, with $l = 1, 2, ...$ observes the report sent by the period t expert but not whether or not he received the promised bribe, let alone its size, the period $t + l$ expert has no way of knowing whether the firm stands by its promise. As a result, the firm does not have an incentive to follow through on the promised payment because it would not affect future experts' beliefs and behavior. Hence, no positive bribe can credibly be promised.

This result is robust to contemplating a different timing of the bribe and, with some qualifications, to allowing experts to exchange messages. As for the first point, suppose that the firm pays the bribe before the expert sends the report. In this case, the expert who has already pocketed the bribe lacks the incentive to manipulate evidence whenever $\Delta_\beta \equiv \beta_U - \beta_\emptyset \geq 0$. Stated differently, it is the expert's capture-incentive compatibility constraint that would not be satisfied: no matter what he reports, this does not affect the payment he receives from the firm. Hence, the expert would only take into account the bonus differential and the manipulation cost in choosing his report. If $\Delta_\beta = 0$ and $\underline{c}$ is strictly positive, reporting truthfully the collected evidence would be strictly dominant.

As for the experts' ability to exchange messages, this could be used to coordinate punishments, facilitating capture by ensuring that a firm that deviates in a given period is punished in the continuation game. We obtain the following remark.

Remark 1. *Suppose that, in each period t, period t expert can send a message m_t that is observed by all future experts. Then, the bribery implicit contract may be self-enforcing.*

Note that it is not necessary that the message can be observed by all future experts: If only the next period's expert can observe each expert's message, a similar strategy as above works, in which the message sent also depends on the message by the previous expert.

There are some caveats to this logic, though. Firstly, the principal must not be able to observe or at least not be able to verify the messages that experts exchange. Otherwise, the principal could have proof that corruption has occurred and could then take some appropriate measures to tackle it. An obvious solution would be that of increasing the bribe, so as to make up for the risk of being caught by the principal. While in principle the bribery implicit contract could still be self-enforcing, it would not exactly replicate the equilibrium outcome described for the revolving door. It would be more costly to implement for the firm, which would thus prefer the revolving-door equilibrium. Secondly, if experts could commit to messages before sending the report to the principal, the regulatory capture equilibrium could unravel. This is because the experts could blackmail the firm, fully extracting the firm's surplus under the threat of spreading information that the firm deviated, as formally shown in a different setting by Barron and Guo (2019), to which we refer the interested reader.

An implication of Remark 1 is that what types of bribes are used depends on how authorities react to observing potential signals of bribes. If a visible bribe, such as an expert driving a fancy car he could hardly afford given his wage, triggers an investigation, bribes would likely be hidden. However, if authorities would not act upon such signals, one would choose very visible bribes in order to show everyone that one keeps promises.

This subsection has allowed us to highlight that bribes cannot substitute for the revolving door as a tool to sustain regulatory capture as an equilibrium phenomenon. The public nature of the recruitment decision enables the firm to signal its eagerness to reward friendly experts and acts as a commitment device. Being publicly observed, the firm has a powerful incentive to make good on its implicit promise. Importantly, the capture mechanism we have described works in a way that is not typically emphasized by academics, policy makers, and observers: a firm that provides friendly experts with lucrative job opportunities may be driven by the desire to signal to future experts that there are rents to be shared by being accommodating. Then, the existence of future rents is crucial for regulatory capture to occur.

In the next sections, we extend this baseline model in several distinct directions.

4 Explicit Capture

At the end of the previous section we have shown that the firm cannot generally use bribes to capture experts in an implicit contract. This is because the firm will not face any punishment if it reneges on the promised bribe. However, bribes may be used if the firm and the experts have access to a third-party enforcement mechanism. This would require an explicit (not necessarily formal) contract that binds the collusive parties to what they have agreed upon. Indeed, most of the existing literature on corruption in hierarchies has relied on the assumption of some exogenous enforcement mechanism. We now follow this literature by assuming the existence of some imperfectly enforceable mechanism the firm could resort to in order to capture the experts. This opens up the possibility of swaying the expert also in the absence of sufficiently frequent repeated interaction. However, the availability of this channel may thwart the use of superior implicit agreements in the repeated game.

In this section, we suppose that the firm can attempt to influence the reporting strategy by using bribes or the promise of a post-agency job. Specifically, the firm can approach the expert before he sends his report to the principal with a take-it-or-leave-it explicit side-contract: a bribe b to report $r = \emptyset$. The cost of arranging and enforcing the side-contract, $(1-\tau)b$, is lost, where $\tau \in [0, 1)$. Note that bargaining occurs under asymmetric information - as the expert privately knows the information he has collected and the manipulation cost - and the firm has the whole bargaining power, which implies that bargaining may not succeed even though there are potential gains that can be reaped by the collusive partners.

4.1 One-stage Game

Consider the firm's incentives to capture the expert via the side-contract in the absence of repeated interaction. If the firm does not bribe the expert and he reports truthfully the observed information, the firm's expected profit is $(1 - q)G$. Conversely, if the firm's bribe b leads the expert to hide unfavorable evidence when the concealment cost is low, the firm's expected profit is $(1 - q\eta)(G - b)$. This is because the expert would report $r = \emptyset$ and pocket the firm's bribe when either $s = \emptyset$ or $s = U$ and $c = \underline{c}$. It follows that the maximum bribe the firm would be willing to pay is such that the firm is indifferent between offering the bribe and not engaging in the side contract:

$$b_{Max} = \frac{q(1 - \eta)}{1 - q\eta} G.$$

This bribe is only worth τb_{Max} to the expert because of the transaction cost associated with organizing the side-contract.

The principal will then set the payment policy to either tolerate or fight corruption. Suppose the principal decides to prevent capture. If so, in order to induce the expert's participation, the following individual rationality constraint must be satisfied:

$$q\beta_U + (1-q)\beta_\emptyset \geq 0. \tag{7}$$

Preventing capture requires that the expert prefers to report evidence that production is unsafe when evidence is manipulable, that is:

$$\beta_U \geq \tau b + \beta_\emptyset - \underline{c}. \tag{8}$$

There is room for a profitable side-contract only if $\tau b_{max} \geq \underline{c}$. Given that $b_{max} = \frac{q(1-\eta)}{1-q\eta}G$, preventing corruption is an issue (because it inevitably reduces welfare) only if:

$$\tau \geq \tilde{\tau} \equiv \frac{(1-q\eta)\underline{c}}{q(1-\eta)G}.$$

That is, the side-contract cannot be overly inefficient. Suppose that $\tau \geq \tilde{\tau}$. If the principal wants to deter collusion at the minimum cost, she should set $\beta_U = \tau\frac{q(1-\eta)G}{1-q\eta} - \underline{c}$ and $\beta_\emptyset = 0$ and welfare would be:

$$W^{SGdeter} = (1-q)G - \lambda q \left(\tau\frac{q(1-\eta)G}{1-q\eta} - \underline{c}\right).$$

To understand the above expression, note that $(1-q)G$ is the firm's expected profit; the expert expects to get utility $u = q\beta_U > 0$ as the incentive constraint binds. In itself, this is merely a transfer and does not appear in the welfare expression. The last term only refers to the social cost of raising distortionary taxes to pay the expert.

If the principal tolerates capture, there is no need to pay the experts, that is, $\beta_U = \beta_\emptyset = 0$. Capture always takes place with the minimum bribe that induces the expert to conceal evidence as the firm holds all the bargaining power. The bribe is $b = \frac{c}{\tau}$. Welfare is:

$$\begin{aligned} W^{SGtolerate} =& \eta(1-q)G \\ &+ (1-\eta)\left[G - qD - q\underline{c}\right] - (1-\eta q)\frac{1-\tau}{\tau}\underline{c}. \end{aligned}$$

Under this option, capture is prevented only when $c = \infty$. To understand the second line, with a bribe equal to $\underline{c}/\tau$, the firm's profit is $(1-\eta q)(G - \underline{c}/\tau)$. The low-manipulation cost expert expects to get $\beta_\emptyset - q\underline{c} + \tau b = \underline{c}(1-q)$ whereas the high-manipulation cost expert expects to get $q\beta_U + (1-q)(\beta_\emptyset + \tau b) = (1-q)\underline{c}$. The manipulation cost $\underline{c}$ is incurred only with probability $(1-\eta)q$. However, bribery occurs with probability $(1-\eta q)$ bringing about a welfare loss due to the transaction costs of the side-contract. Lemma 1 describes the principal's optimal behavior.

Lemma 1. *(a) If $\tau < \tilde{\tau}$, capture is not an issue and the principal induces the expert's participation and truthful reporting by offering $\beta_U = \beta_\emptyset = 0$;*

(b) If $\tau \geq \tilde{\tau}$, capture is an issue: the principal deters capture by setting $\beta_U = \tau\frac{q(1-\eta)G}{1-q\eta} - \underline{c}$ and $\beta_\emptyset = 0$ if and only if:

$$\lambda \leq \tilde{\lambda} \equiv \frac{(1-\eta)q(D-G) + \underline{c}\left[(1-\eta)q + (1-\eta q)\frac{1-\tau}{\tau}\right]}{q\left[\tau\frac{q(1-\eta)G}{1-q\eta} - \underline{c}\right]},$$

where $\tilde{\lambda}$ is decreasing in τ. Otherwise, the principal does not prevent capture and $\beta_U = \beta_\emptyset = 0$.

Therefore, the higher τ, the more likely it is that capture is costly to prevent. A higher τ reduces welfare attainable when capture is prevented and may make the side-contract even too costly to prevent. If so, that is, if the side-contract is tolerated, a further increase in τ is welfare increasing, because it means that the welfare loss due to the occurrence of collusion decreases. An increase in λ makes it more likely that the principal foregoes to prevent the side contract. The threshold $\tilde{\lambda}$ is decreasing in τ. Intuitively, a higher τ increases the cost of preventing capture and simultaneously reduces the welfare loss suffered when the side-contract takes place. This also means that the principal might provide incentives for the expert for intermediate values of τ, but not for high and low values of τ.

4.2 Interplay between Self-enforcing and Imperfectly Enforceable Capture

We now examine the repeated game, where the firm need not rely on an imperfectly enforceable side-agreement to capture the experts, but it can make use of the incentives that repeated interaction entails. In particular, the firm can exploit the public information provided by the report made by the expert and the ensuing firm's salary offer. The firm can make use of two distinct channels to sway the regulatory outcome: an imperfectly enforceable side-agreement (or, bribery) and implicit capture by paying higher post-agency salaries. In this subsection, we explore the interplay between the two channels.

We extend the definition of the *revolving-door implicit contract*, denoted by RC and starting at date t, as follows. It specifies that: (i) experts with a low concealment cost, $c = \underline{c}$, always conceal unfavorable evidence; (ii) the firm rewards experts who report $r = \emptyset$ with a bribe and/or improved post-agency job prospects; (iii) if at period $t + l$ the expert reported $r = \emptyset$ and the firm did not improve his job prospects, then at $t+l'$ with $l' \geq l$, the experts always reveal unfavorable evidence unless they receive a sufficiently high bribe. The revolving-door implicit contract is self-enforcing if these strategies form a Perfect Bayesian Equilibrium of the continuation game.

Consider the different constraints that must be satisfied in order for capture to be an equilibrium of the repeated game. First, the expert's capture-incentive compatibility constraint determines the condition under which an expert that has collected evidence unfavorable to the firm and has a low concealment cost is willing to report $r = \emptyset$:

$$\tau b + w + \beta_\emptyset - \underline{c} \geq \beta_U, \tag{9}$$

that is, the offered bribe and the expected wage must at least compensate for the differential bonus the expert will receive from the principal, $\Delta_\beta = \beta_U - \beta_\emptyset$, as well as the concealment cost.

The expert must expect a non-negative utility from accepting the job at the agency:

$$q\eta\beta_U + (1 - q\eta)(\tau b + w) - q(1 - \eta)\underline{c} \geq 0. \tag{10}$$

As for the firm's willingness to engage in capture, we have the following firm's capture participation constraint:

$$q(1 - \eta)G \geq (1 - q\eta)(w + b). \tag{11}$$

Lastly, there is the firm's capture incentive compatibility constraint:

$$-(1 - \delta)w + \delta\pi^{RC} \geq \delta\pi^D, \tag{12}$$

where

$$\pi^{RC} = (1 - q\eta)(G - w - b),$$

whereas π^D depends on τ and λ:

$$\pi^D = \begin{cases} (1-q)G, & \text{if } \tau < \tilde{\tau} \\ (1-q)G, & \text{if } \tau \geq \tilde{\tau} \text{ and } \lambda \leq \tilde{\lambda} \\ (1-q\eta)\left(G - \frac{\underline{c}}{\tau}\right), & \text{if } \tau \geq \tilde{\tau} \text{ and } \lambda > \tilde{\lambda}. \end{cases}$$

First, consider the case in which $\tau < \tilde{\tau}$: this means that $\pi^D = (1-q)G$. From (12) it follows that the maximum wage that the firm can commit to is

$$\tilde{w}_{Max} = \frac{\delta[(1-q\eta)(G-b) - (1-q)G]}{1 - \delta q\eta}.$$

By comparing π^{RC} and π^D, this implies that the firm wants to pay a bribe of at most

$$\tilde{b}_{Max} = \frac{Gq(1-\eta)}{1-q\eta}.$$

Thus, deterring capture comes at no cost if $\delta < \tilde{\delta}$. If both the efficiency of the bribing technology and the firm's patience are low, capture is not an issue. Otherwise, the cheapest way to deter capture is setting

$$\beta_U = \frac{Gq\delta(1-\eta)}{1-\delta q\eta} - \underline{c}.$$

The principal then optimally deters capture if and only if

$$\lambda \leq \hat{\lambda} \text{ if } \delta \geq \tilde{\delta}.$$

If the principal does not prevent capture, $w = \underline{c}$ and $b = 0$ as in the case without any bribing technology. An inefficient bribing technology does not help the company because increasing the bribe further tightens (12) for $\delta < \tilde{\delta}$; and for $\delta \geq \tilde{\delta}$, the firm finds it cheaper to use the wage.

Next, consider that the case in which $\delta < \tilde{\delta}$ and $\tau \geq \tilde{\tau}$ is analogous to the case in which the principal cannot effectively use the revolving door and Lemma 1 applies. The intuition is that, for $\tau \geq \tilde{\tau}$, the firm uses the bribe rather than the wage because the firm lacks commitment off the equilibrium path. This also implies that, if the principal does not deter capture, $w = 0$ and $b = \frac{\underline{c}}{\tau}$.

Lastly, consider the case in which $\tau \geq \tilde{\tau}$ and $\lambda \leq \tilde{\lambda}$. Therefore, off-the-equilibrium path the principal would deter collusion. Let us see whether the firm can leverage the revolving door to improve on the profit of the equilibrium game. If the principal tolerates capture in the repeated game, she sets $\beta_U = \beta_\emptyset = 0$ and the firm will choose b and w to satisfy (9): $\tau b + w = \underline{c}$. If $\delta \geq \tilde{\delta}$, then $w = \underline{c}$ and $b = 0$, as that salary can credibly be promised to the experts. Bear in mind that the firm prefers to use the salary instead of the bribe to influence the experts' reports, as there is no difference between what the firm pays and what the expert receives. Therefore, if (12) is slack, the firm will only use w to capture the experts and set $b = 0$: if b were positive, the firm could reduce b and increase w by a smaller amount and continue to satisfy the constraint while increasing its profits. Suppose that the principal wants to prevent capture. If so, $\beta_\emptyset = 0$ and β_U must be set in such a way as to make capture not individually rational or incentive compatible for the coalition firm-expert. In this regard, it is useful to determine the value of the maximum payment that the firm can offer to the expert. In the following lemma, we identify a threshold function $\hat{\tau}(\delta)$ such that the maximum payment be given only in form of a wage (respectively, a bribe) when τ is below (above) that cutoff.

Lemma 2. *There exists a threshold function*

$$\hat{\tau}(\delta) := \frac{\delta(1 - q\eta)}{1 - \delta q\eta},$$

increasing in δ, such that for τ above (below) the threshold the firm would only use the bribe (salary) to capture the expert.

Therefore, if $\tau > \hat{\tau}(\delta)$, the maximum payment that the firm can offer to the expert is b_{Max}. Given that $\lambda < \tilde{\lambda}$, the principal would deter capture by setting $\beta_U = \tau b_{Max} - \underline{c}$. By contrast, if $\tau < \hat{\tau}(\delta)$, the maximum payment that the firm can offer to the expert is w_{Max} and the principal would deter capture by setting $\beta_U = w_{Max} - \underline{c}$ if $\lambda \leq \hat{\lambda}$ and would tolerate capture otherwise.

Suppose now that $\tau > \tilde{\tau}$ and $\lambda > \tilde{\lambda}$. Then $\pi^D = (1 - q\eta)(G - \underline{c}/\tau)$. Intuitively, the firm could always resort to the imperfectly enforceable side-contract to capture the experts. Note that this represents the firm's fall-back position as there is a stream of experts. Therefore, if the firm deviates from the proposed equilibrium strategies, there will always be the possibility to capture future experts with bribes. As the experts are distinct players, they cannot coordinate their punishment and commit to move to the worst equilibrium outcome (i.e., the one in which there is no side-contract) following the firm's deviation in one period. As a consequence, the firm cannot obtain less than

$\Big(1 - q\eta\Big)(G - \underline{c}/\tau)$ in each period following a deviation. The profit differential is

$$\Delta_\pi = (1 - q\eta)\left[\frac{\underline{c}}{\tau} - (w + b)\right],$$

and the (12) is written as:

$$w \leq \frac{\delta(1 - q\eta)(\underline{c}/\tau - b)}{1 - \delta q\eta}. \tag{13}$$

If the principal does not prevent capture, the firm would set $w = \underline{c}$ and $b = 0$ to induce the experts to conceal evidence. Only w will be used if (12) is satisfied:

$$\tau \leq \frac{\delta(1 - q\eta)}{1 - \delta q\eta} = \hat{\tau}(\delta).$$

Therefore, for

$$\tau \in \left[\frac{(1 - q\eta)\underline{c}}{q(1 - \eta)G}, \frac{\delta(1 - q\eta)}{1 - \delta q\eta}\right],$$

$w = \underline{c}$ and $b = 0$ suffice to induce implicit capture. Note that the upper bound of the interval is greater than $\tilde{\delta}$, so this interval may exist. For τ above the threshold, the firm will only use the bribe. In Figure 1, we graphically represent the parameter regions where capture is tolerated or deterred and which kind of policies the principal uses to deter capture or which channel the firm uses. Note that we have defined:

$$\hat{\delta} = \frac{(1 - \eta)(D - G + \underline{c}) + \lambda\underline{c}}{q(1 - \eta)\eta(D - G + \underline{c}) + q\lambda[(1 - \eta)G + \eta\underline{c}]},$$

and is derived from $\hat{\lambda}$, whereas $\bar{\tau}$ is the positive root that we can obtain from $\tilde{\lambda}$. The figure is drawn from the following parameter values: $q = 0.5$, $\eta = 0.8$, $\underline{c} = 0.5$, $G = 20$, $D = 30$, $\lambda = 1$.

An interesting corollary which follows from the above characterization of the interplay between explicit and implicit capture is provided below.

Corollary 1. *More efficient bribery may prevent the firm from using superior implicit incentives to capture the experts.*

The intuition is that the implicit promise of a post-agency salary is not credible if the firm will be able to resort to a slightly inefficient third-party enforcement mechanism in the future that enables explicit capture. Note that when either τ or δ are sufficiently high, the principal will refrain from preventing capture.

Importantly, policies other than the bonus scheme that can prevent capture, such as those which affect τ, like whistle-blowing protection policies or higher-quality monitoring, and w_{Max}, like cooling-off periods should be designed bearing in mind how capture is enforced. The policies seem to be complementary: a substitution between the two means of capture may take place if the policy maker only changes one policy.

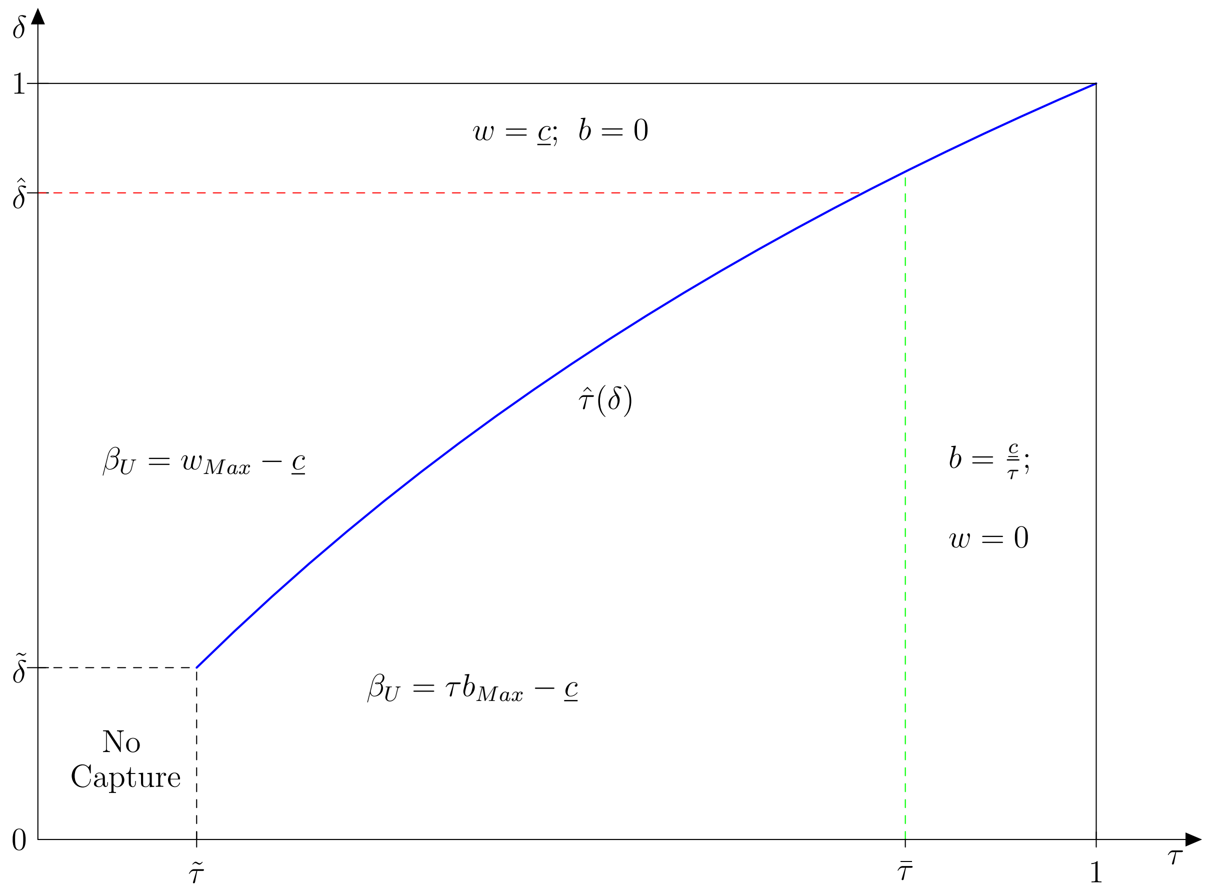

Figure 1: Equilibria and Interplay between τ and δ.

If players are patient, which could also be interpreted as a frequent interaction between a firm and a regulatory agency, the revolving door is the favorite (and possibly unique) channel used by firms to capture experts. However, a more efficient bribing technology or an authority that does not monitor or ignores bribes leads to bribes being used rather than the revolving door. This scenario appears to best fit (large parts of) the developing world. Uncertainty about firms' survival prospects and scarce resources available to monitoring and implementing regulation (as argued by Estache and Wren-Lewis, 2009) contribute to making bribes so notoriously rife in less developed countries. By contrast, in most richer countries, thanks to superior monitoring and better enforcement of well-established policies, explicit capture is a less pressing issue. However, as firms typically have a longer life-span, the credibility of their promises to reward accommodating experts is reinforced, making implicit capture the chief concern.

5 Should We Close the Revolving Door?

One implication of the first part of the analysis is that closing the revolving door could be welfare improving. In particular, this is always the case in our analysis above if capture can only be implicit. However, closing the revolving door may have negative welfare repercussions if the experts may make a genuinely valuable contribution to the firms they join. To make this point forcefully, in this section we assume that the side-contract is so inefficient that the only way for the firm to influence the expert's report is through implicit capture. This implies that τ is sufficiently small.

We amend the baseline model by assuming that there are high-ability experts (H) and low-ability experts (L) and it is common knowledge that the fraction of high-ability experts in the population is $h \in (0, 1)$. Only high-ability experts can observe whether $\theta = U$ and they are the only ones who can make a positive contribution to the industry after having gathered experience in the regulatory agency .[10] Specifically, a high-ability expert increases the firm's profits by v and could yield an outcome $\bar{u}$ to other public or private institutions in the industry, with $v > \bar{u} > 0$. Plausibly, while both the regulated firm and other organizations in the same industry would be eager to employ a talented worker who has extensive knowledge of the regulatory procedures, the former may especially value the expert's relative familiarity with the firm's production process. Experts do not know their ability ex-ante. Thus, at the beginning of each period, there is symmetric uncertainty about the expert's ability. As the expert privately observes the signal, he may learn his ability, and the public report may convey information about his type.

5.1 One-shot game

In the one-shot game where the side-contract is not an issue, keeping the revolving door open is socially beneficial. The wage will be a function of r. If the report is informative, that is $r = U$, every player in the industry learns that the expert is of high ability. If the report is uninformative, the market does not know the identity of the expert with certainty. The prior belief that the expert is of the high-ability type will be updated according to the Bayes' rule. Define by $\mu_{H\emptyset}$ the industry's expectation that the expert is of high ability given that the report is uninformative. An expert anticipates that the industry would pay $\bar{u}$ to employ experts known to be of high ability and only $\mu_{H\emptyset}\bar{u}$ to those who have reported $r = \emptyset$. Therefore, if $\beta_U = \beta_\emptyset = 0$, an expert who has collected informative evidence is always better off truthfully revealing it. It follows that:

$$\mu_{H\emptyset} := Pr[H|r = \emptyset] = \frac{h(1-q)}{1-hq} < h.$$

The firm would always hire the expert and

$$\pi^{SG} = (1 - qh)G + h(v - \bar{u}).$$

Welfare is:

$$W = (1 - qh)G + hv.$$

[10]Similarly, in the model of Bond and Glode (2014), working in a regulatory agency leads to the accumulation of human capital that firms value. There is also some empirical evidence supporting the human-capital accumulation formation hypothesis (Blanes i Vidal et al., 2012).

The following remark immediately follows from noticing that closing the revolving door would not affect the expert's incentive to report truthfully, but would lead to a welfare loss of hv_H. This is the case under the assumption that closing the revolving door means that an expert is forbidden to join the firms operating in the industry.[11]

Remark 2. *If the firm and the principal have a one-off interaction, then opening the revolving door is socially optimal.*

Further note that, even if an explicit side-contract could be made to enforce collusion, standard anti-corruption policies could prevent regulatory capture, without affecting the conclusion that keeping the revolving door open is desirable when the firm sporadically interacts with the regulatory agency.

5.2 Repeated Game

Consider now the repeated game (RG). As usual, one solution entails the infinite repetition of the equilibrium described in the stage game. As before, the firm may find it profitable to engage in tacit capture by promising rosier job prospects to experts who are accommodating. Not only does a expert who conceals evidence obtain a different payment from the principal ($\beta_\emptyset$ instead of β_U) and bears a concealment cost c, but he also worsens his job prospect as he cannot signal that he is of high ability. Consider the new firm's capture-incentive compatibility constraint:

$$(1-\delta)[\mu_{H\emptyset}^{RG} v - w_\emptyset] + \delta\pi^{RG} \geq (1-\delta)\mu_{H\emptyset}^{RG}(v - \bar{u}) + \delta\pi^{SG}, \tag{14}$$

where

$$\mu_{H\emptyset}^{RG} = \frac{h(1-\eta q)}{1-h\eta q}.$$

The following expert's capture incentive compatibility constraint must hold for tacit capture to be an equilibrium:[12]

$$\max\{w_\emptyset, \mu_{H\emptyset}^{RG}\bar{u}\} + \beta_\emptyset - \underline{c} \geq \max\{w_U, \bar{u}\} + \beta_U. \tag{15}$$

There are four possible policy options that we describe below.

[11]To be truly effective, closing the revolving door should prohibit former experts from receiving any direct or indirect compensation from firms in the regulated industry - not just the ones the expert directly interacted with. Otherwise, experts may join or set up law firms, think tank, or consulting firms and still receive payments from previously regulated firms as reward for their friendliness. Coalition of firms may also take turns in hiring each other's experts to avoid more lenient employment restrictions.

[12]In the Perfect Bayesian Equilibrium, the experts form a belief about the salary, and this belief is always correct.

Tolerating capture. If so, by using techniques similar to those adopted in Section 3, it can be shown that $w_U = \bar{u}$ and $w_\emptyset = \underline{c} + \bar{u} + \Delta_\beta$, where $\Delta_\beta = \beta_U - \beta_\emptyset$. The firm's expected stream of profits is then:

$$\begin{aligned}\pi^{RG} =& (1 - q\eta h)(G - \bar{u} - \underline{c} - \Delta_\beta + \mu^{RG}_{H\emptyset} v) + q\eta h(v - \bar{u}) \\ =& (1 - q\eta h)(G - \Delta_\beta - \underline{c}) + hv - \bar{u}.\end{aligned}$$

Therefore, the firm will be willing to engage in capture only if $\pi^{RG} \geq \pi^{SG}$, that is, only if:

$$qh(1 - \eta)G \geq \bar{u}(1 - h) + (1 - q\eta h)(\Delta_\beta + \underline{c}).$$

Condition (14) is satisfied as long as:

$$\frac{\delta qh(1 - \eta)}{1 - \delta\eta qh} G \geq \frac{\delta(1 - h)}{1 - \delta qh\eta} \bar{u} + \Delta_\beta + \underline{c}. \tag{16}$$

As capture is tolerated, $\Delta_\beta = 0$, and welfare is:

$$W^{RGtolerate} = (1 - qh\eta)G - q[1 - h(1 - \eta)]D - qh(1 - \eta)\underline{c} + hv.$$

By engaging in capture, the firm produces more often, but must give up part of the rent to the experts. In particular, low-ability experts obtain a rent as they do not need to conceal evidence to receive a reward.

Reward scheme. The principal may decide to prevent capture by setting a reward for $r = U$. This is achieved with the following bonus schedule: $\beta^{RGdeter}_\emptyset = 0$ and

$$\beta^{RGdeter}_U = \max\left\{ \frac{\delta qh(1 - \eta)G}{1 - \delta\eta qh} - \frac{(1 - h)\bar{u}}{1 - \eta qh} - \underline{c}, 0 \right\}.$$

Welfare is:

$$W^{RGdeter} = (1 - qh)G - q(1 - h)D + hv - \lambda qh\beta^{RGdeter}_U.$$

Blanket ban. An alternative option to deter capture is that of banning experts from joining the industry once they leave the regulatory agency. There is no need to offer rewards to the experts to induce truthful reporting. This solution gives:

$$W^{RGclosing} = (1 - qh)G - q(1 - h)D.$$

Like the high-reward option, closing the revolving door restores authorization efficiency. However, this comes at the cost of losing the experts' contribution to the industry.

Selective ban. An alternative option the principal should entertain is that of opening the revolving door conditionally on the information the expert reveals in his report. Specifically, suppose that only an expert who reports $r = U$ can later accept positions in the industry. This induces an expert who has unfavorable information to reveal it, preventing capture: a firm cannot promise a future job to an accommodating expert, since the expert can be later hired only if his report does not benefit the firm. This solution would ensure authorization efficiency while alleviating the ex-post welfare cost that employment restrictions entail. Welfare under this solution would be:

$$W^{RGselectivelyclosing} = (1 - qh)G - q(1 - h)D + qhv,$$

which is strictly higher than $W^{RGclosing}$. The principal prefers to keep the revolving door open if:

$$(1 - q)v > \lambda q \beta_U^{RGdeter}.$$

The higher the concealment cost $\underline{c}$, the probability that the state is safe $1 - q$, and the fraction of low-ability experts $1 - h$, and the larger the expert's contribution to the firm, v, and to the other market participants, $\bar{u}$, the more likely it is that the principal leans towards keeping the revolving door open. Intuitively, it is less costly to offer a reward that induces the expert to truthfully reveal $s = U$ when these variables are higher and the larger $(1 - q)v$ the larger the opportunity cost of closing, albeit partially, the revolving door.

The following proposition pins down the principal's favorite solution.

Proposition 3. *Suppose high-ability experts positively contribute to industry profits. If*

$$qh(1 - \eta)G > qh\eta D + qh(1 - \eta)\underline{c} - \max\{(1 - q)hv, \lambda qh\beta_U^{RGdeter}\}, \tag{17}$$

then the principal tolerates regulatory capture. By contrast, if (17) does not hold, the principal deters capture with a high bonus if $(1 - q)v > \lambda q\beta_U^{RGdeter}$ *and by selectively closing the revolving door otherwise.*

Deterring capture is worthwhile when the damages that an unsafe activity can give rise to are substantial relative to the gains of prohibiting production. We have shown different alternatives the principal should entertain when fighting capture. This can be achieved directly by rewarding the expert who reports unfavorable evidence with a monetary bonus. In this way, the expert acts as a bounty hunter, looking for bad evidence. Capture can also be prevented indirectly, by prohibiting the firm from using the revolving door to reward a friendly expert. This does not necessarily imply that experts cannot join the private sector under any circumstances. In fact, the principal should leave the door open for those experts who reveal evidence that hurts the regulated firm. In that case, it would be difficult to argue that the firm's recruitment of the expert is part of a shady *do ut des* scheme.

In the analysis, we have abstracted away from any costs of collecting a signal. Tolerating capture and keeping the revolving door open can save on the social cost of compensating the expert. Regulatory capture may also lead to a misallocation of human resources if the capturing firm hires experts who would be better placed in other firms or institutions.[13]

[13]A formal analysis of the cost of collecting signals and the misallocation of human resources that regulatory capture can give rise to is available upon request.

5.3 Firm Able to Observe Signal

What if the firm also observes the same signal as the expert?[14] Then, if $\theta = U$, the firm knows which experts have a high ability and would only want to hire those (without loss of generality). We assume, however, that the firm cannot condition its wage on the state of the world (which seems plausible in a real-world setting in which damages might be rare and only revealed in the long-run, even if $\theta = U$).

Thus, the firm's capture-incentive compatibility constraint becomes hardest to satisfy if $\theta = U$ and the firm knows that it faces a expert with low ability:

$$-w_{\emptyset}(1-\delta) + \delta\pi^{RG'} \geq \delta\pi^{SG'}. \tag{18}$$

The following expert's capture incentive compatibility constraint must hold for tacit capture to be an equilibrium:

$$\max\{w_{\emptyset}, \mu_{H\emptyset}^{RG}\bar{u}\} + \beta_{\emptyset} - \underline{c} \geq \max\{w_U, \bar{u}\} + \beta_U.$$

The following proposition pins down the principal's favorite solution. It is the same as Proposition 3 except for the different bonus when the principal deters capture because the firm finds it harder to commit to hire all experts with an empty report.

Proposition 4. *Suppose high-ability experts positively contribute to industry profits and the firm can observe the expert's signal. If*

$$qh(1-\eta)G > qh\eta D + qh(1-\eta)\underline{c} - \max\{(1-q)hv, \lambda qh\beta_U^{RGdeter'}\}, \tag{19}$$

$$\text{where } \beta_U^{RGdeter'} = \max\left\{\frac{\delta qh(1-\eta)G - (1-\delta h)\bar{u}}{1-\delta\eta qh} - \underline{c}, 0\right\} < \beta_U^{RGdeter}, \tag{20}$$

then the principal tolerates regulatory capture. By contrast, if (19) does not hold, the principal deters capture with a high bonus if $(1-q)v > \lambda q\beta_U^{RGdeter}$ and by selectively closing the revolving door otherwise.

5.4 Effort Necessary for Expert to Observe Signal

So far, we have assumed that high-ability experts automatically observe if $\theta = U$. We now analyze the case in which the high-ability expert only observes this if he exerts effort $e = 1$ at a cost c_e (that is, before he learns his concealment cost c). If he does not exert effort ($e = 0$), the signal is always uninformative. If the principal wants to implement $e = 1$, she needs to motivate the expert sufficiently. If there are no employment restrictions, this constraint is:[15]

$$\frac{c_e}{q} \leq \eta[\bar{u} + \beta_U] + (1-\eta)[\max\{\bar{u} + \beta_U, \max\{w_{\emptyset}, \mu_{H\emptyset}^{RG}\bar{u}\} + \beta_{\emptyset} - \underline{c}\}].$$

[14] Note that explicit capture would become more attractive for the firm if it could observe the signal.

[15] If there are employment restrictions, the according wages become zero.

Naturally, the principal would not want to implement $e = 1$, if the unsafe state is very unlikely, the effort cost is very high, or she tolerates capture anyway. The principal can provide incentives via β_U or let them be provided by future wages.

Welfare is not directly comparable to the previous subsections, of course. Either the principal induces $e = 1$, in which case effort costs occur; or the principal does not do so, in which case there are not only no effort costs but also no concealment costs for experts who do not report unfavorable evidence.

The following proposition pins down the principal's favorite solution for the case in which the expert has an effort cost for acquiring information. Preventing the capture only by means of a reward scheme may be more expensive in that case. This makes the policy of opening the revolving door conditional on an unfavorable evidence more desirable.

Proposition 5. *Suppose high-ability experts positively contribute to industry profits and the expert has to exert effort to potentially signal. If*

$$qhG + hc_e > qhD - \max\{(1-q)hv + \lambda qh\beta_U^{RGselectivelyclosing}, \lambda qh\beta_U^{RGdeter'''}\}, \tag{21}$$

$$\textit{where } \beta_U^{RGdeter'''} = \max\left\{\frac{c_e}{q}, \frac{\delta qh(1-\eta)G}{1-\delta\eta qh} - \frac{(1-h)\bar{u}}{1-\eta qh} - \underline{c}, 0\right\} \geq \beta_U^{RGdeter}, \tag{22}$$

$$\textit{and } \beta_U^{RGselectivelyclosing} = \max\{c_e/q - \bar{u}, 0\}, \tag{23}$$

then the principal tolerates regulatory capture. By contrast, if (21) does not hold, the principal deters capture with a high bonus if $(1-q)v > \lambda q(\beta_U^{RGdeter'''} - \beta_U^{RGselectivelyclosing})$ *and by selectively closing the revolving door otherwise.*

5.5 Cooling-off Periods

In this subsection, we examine how post-employment restrictions affect the results of our analysis. In many countries, after leaving governmental agencies, experts are temporarily prohibited from joining firms or organizations in the industry they used to regulate. An implication of such restrictions, which are also known as *cooling-off periods*, is that firms' and experts' benefits from employment are delayed. To account for this effect in our set-up, we now assume that the payoffs that the firm (or other industry players) and the expert can obtain from the employment relationship in stage 4 are evaluated by the factor $\frac{1}{1+\gamma}$ in stage 2. The term $\gamma \in [0, \infty)$ reflects the employment restrictions, which is the principal's choice variable. Thus far, we have confined attention to two polar policies: that in which the expert can freely join other firms or organizations once his term at the regulatory agency is over (i.e., $\gamma = 0$), and that in which the expert is banned from joining the industry after leaving the agency ($\gamma = \infty$).

It is immediate to see that employment restrictions should not be imposed if interaction is infrequent, as they would only reduce welfare: $W = (1 - qh)G + \frac{1}{1+\gamma}hv$ is decreasing in γ. Recall that capture requires an explicit agreement when regulatory interaction is infrequent. As such, it is better prevented by other anti-corruption policies which rely on seeking out some hard evidence that can be used as a smoking gun.

Consider (frequently) repeated interaction now. The firm has the opportunity to renege on the implicit understanding once the cooling-off period is over. As a result, the firm's capture-incentive compatibility constraint is unchanged:

$$(1-\delta)[\mu_{H\emptyset}^{RG} v - w_\emptyset] + \delta\pi^{RG} \geq (1-\delta)\mu_{H\emptyset}^{RG}(v-\bar{u}) + \delta\pi^{SG}.$$

Conversely, the expert's capture incentive compatibility constraint must be amended because at the time the expert can conceal evidence, he anticipates that he will not be able to immediately join the industry after leaving the agency:

$$\frac{1}{1+\gamma}\max\{w_\emptyset, \mu_{H\emptyset}^{RG}\bar{u}\} + \beta_\emptyset - \underline{c} \geq \frac{1}{1+\gamma}\max\{w_U, \bar{u}\} + \beta_U. \tag{24}$$

Now compare the alternatives available to the principal who faces the threat of regulatory capture. Tolerating capture implies setting $\gamma = 0$, as there is no point in delaying the time at which the firm can hire the expert if capture is not to be prevented. Conversely, if the principal sets out to thwart capture, besides the blanket or selective ban, she may decide to set γ high enough, and can use this policy tool in combination with the reward scheme. In particular, the principal chooses γ to maximize welfare.

$$W^{RGdeter} = (1-qh)G - q(1-h)D + \frac{hv}{1+\gamma} - \lambda qh\beta_U^{RGdeter}(\gamma).$$

The following proposition illustrates how the cooling-off period can be used.

Proposition 6. *The principal may use the cooling-off period only to reduce the social cost of the bonus scheme. The optimal cooling-off period is increasing in G and λ and decreasing in $\bar{u}$ and v.*

It is immediate to see that, if $\beta_U^{RGdeter} = 0$, an increase in γ would decrease welfare exactly as in the case when there is no repeated interaction. By itself, a finite cooling-off period does not affect the firm's willingness to make good on the promise to hire the accommodating expert. Thus, the only reason why the principal may want to use this type of post-agency employment restriction is to reduce the bonus she has to pay to an expert who reports $r = U$. However, a longer cooling-off period has counteracting effects on the bonus that the principal must pay to prevent capture. To illustrate this effects, note that

$$\frac{\partial \beta_U^{RGdeter}}{\partial \gamma} = \frac{1}{1+\gamma}\frac{\partial w_\emptyset^{Max}}{\partial \gamma} - \frac{w_\emptyset^{Max} - \bar{u}}{(1+\gamma)^2}.$$

The second term is negative, reflecting how a longer cooling-off period blunts the influence of future industry payments on the expert's report. The expert discounts the lure of receiving a higher salary from the regulated firm compared to what he could receive from other employers in the industry. However, a longer cooling-off period increases the maximum salary the firm would be willing to pay, that is, the first term. This is because the longer cooling-off period actually increases the gap between the continuation payoffs,

π^{RG} and π^{SG}, by deferring the payment of the salary to the accommodating expert. As a result, a longer cooling-off period can make the firm more willing to keep its promises. Only when the second effect dominates, the principal may want to opt for a positive γ.

When used, the cooling-off period positively depends on G and λ as these parameters can increase the benefit of reducing the social cost of paying a bonus. Conversely, higher $\bar{u}$ and v magnify the lost opportunity of letting experts join the industry right away, and lead to lower γ. Because the optimal length of the cooling-off period depends on various factors, it seems unlikely that a uniform cooling-off period across regulatory agencies is optimal.

Also note that the expert always suffers from a higher γ because his outside option, to which he is held, will decrease as only at a later period, he could take up a job in which his prior expertise is valuable. Similarly, the firm's profit will decrease because it can only employ the high-ability experts later. If the cooling-off period is very long, these effects will outweigh the efficiency improvements due to a lower bonus payment. Thus, a poorly-chosen length of a cooling-off period can make everyone worse off.

6 Concluding Remarks

In this paper we have studied how firms can use the revolving-door channel to capture experts. So far, the informative role played by the revolving door has been overlooked. We have shown that this channel is more efficient than bribes to sway regulatory outcomes. Recruiting former regulators can be a very powerful commitment device, signaling to current and future experts the firm's eagerness to reward lenient behavior. It is also more efficient than bribes in that the revolving door can emerge as an industry norm that does not require an explicit and illegal agreement between the firm-regulators coalition. However, the more efficient the explicit side-contract, the less likely it is that the firm can use implicit agreements.

We have highlighted that the desirability of keeping the revolving door open depends on the frequency of the firm-regulatory agency interaction. When this is sporadic, the revolving door should better be open. As capture would require an explicit agreement, standard anti-corruption policies, such as whistle-blowing protection, could be used to deter collusion. If interaction is frequent, an implicit understanding between regulators and the regulated firm can sustain capture via the revolving door. The lack of smoking-gun evidence means that regulatory capture could be deterred either by generously rewarding experts who report information that is unfavorable to the firm or by closing the revolving door. The pros and cons of closing the revolving door should be weighed against each other. If the regulatory experts' contribution to the industry or their opportunity cost of working for the agency is high, it may be socially beneficial to tolerate capture. This is especially the case if the likelihood that the experts can actually misreport information is low. In this regard, we have shown that opening the door selectively, namely, conditionally on the information revealed by the experts can be welfare improving.

In the model, we have assumed that the experts' reports are used to determine whether the firm can be authorized to produce. While this better fits the case of experts charged with assessing a firm's eligibility for patents of licenses, the framework can be adapted to analyzed other contexts where regulatory capture is a concern, from public procurement to tax auditing, to financial supervision and to tax auditing. It could be even reinterpreted to analyze the transition of politicians to the private sector - in this case, the citizenry would be the principal and the politicians would be the experts.

One might argue that firms may hire experts to get a more direct and efficient access to their (then former) colleagues (e.g., see Blanes i Vidal et al., 2012). According to this view, a policy preventing former experts from interacting with their previous colleagues, or working on cases directly related to their previous job, would make the firm less likely to hire experts, whereas in our model, this policy should not have any effect. If direct access to experts is problematic, such a policy could be complementary to selectively closing the revolving door. As employment restrictions reducing access are already in place in some agencies, it would be possible to test the relative importance of either channel empirically (signaling/monitoring versus access).

A Proofs

Proof of Proposition 1

In the second-best solution, the principal sets $\beta_U = \beta_\emptyset = 0$. Suppose first that the principal does not alter the bonus policy. The maximum salary that the firm can credibly promise to pay, w_{Max} is derived from making (1) bind. This must be at least as large as $\underline{c}$ to induce low-concealment cost experts to hide evidence. Therefore,if $\delta < \tilde{\delta}$ there is no room for capture - part (a) of the proposition.

To show part (b) of the proposition, suppose now that $\delta \geq \tilde{\delta}$ so that capture may occur. If the principal decides to tolerate capture, it is better not to reward experts because $\lambda > 0$. It follows that the firm will offer the minimum wage that induces capture, i.e., $w = \underline{c}$ and $W^{RDtolerate}$ is obtained. Alternatively, the principal will prevent capture by setting $\Delta_\beta = \beta_U - \beta_\emptyset > w_{Max} - \underline{c}$. To minimize the cost of capture deterrence, $\beta_\emptyset = 0$ and $W^{RDdeter}$ is obtained. The principal prefers to deter capture when $W^{RDdeter} \geq W^{RDtolerate}$, that is, when $\lambda \leq \hat{\lambda}$. The threshold $\hat{\lambda}$ is decreasing in δ. To see this, note that

$$\frac{\partial \hat{\lambda}}{\partial \delta} = \frac{-q(1-\eta)^2 G(D - G + \underline{c})}{[\delta q(1-\eta)G - (1 - \delta q \eta)\underline{c}]^2} < 0.$$

□

Proof of Proposition 2

For a bribery implicit contract that induces experts to conceal evidence to be self-enforcing it must be that the following expert's capture incentive compatibility holds, that is, a low concealment cost expert must prefer to manipulate evidence that the state is unsafe:

$$\mu_b b \geq \beta_U - \beta_\emptyset + \underline{c},$$

where μ_b is the expert's belief that the firm will make good on the promise. The firm's capture-incentive compatibility constraint requires that:

$$-(1-\delta)b + \delta\frac{1-\delta}{1-\delta\mu_b}[\mu_b \pi^{RD} + (1-\mu_b)\pi^{SB}] \geq \delta\frac{1-\delta}{1-\delta\mu_b}[\mu_b \pi^{RD} + (1-\mu_b)\pi^{SB}].$$

Paying the bribe does not affect future experts' belief that the firm makes good on the promises. Therefore, the only credible bribe is $b = 0$, but this cannot induce experts to manipulate evidence if $\Delta_\beta \geq 0$ and $\underline{c} \geq 0$, with at least one strict inequality. □

Proof of Remark 1

Suppose that at the end of each period, the period t expert can send a message $m_t \in \{C, NC\}$ that is observed by all future experts. A expert sends message C if the firm has paid the implicitly agreed-upon bribe and NC, otherwise. A low-concealment cost expert who has observed $s = U$ conceals information only if C has been reported by all previous experts. Then, it is possible to construct an equilibrium where capture is self-enforcing if δ is high enough. Suppose that $\Delta_\beta = 0$ and $b = \underline{c} \geq 0$, if $r = \emptyset$, and no bribe is paid otherwise. Then, if

$$\begin{aligned} \delta(\pi^{RD} - \pi^{SB}) \geq& (1-\delta)\underline{c} \\ \Leftrightarrow G \geq& \frac{1-\delta q\eta}{\delta q(1-\eta)}\underline{c}, \end{aligned}$$

then neither the firm nor the experts are willing to deviate. If a deviation has occurred, the experts will not conceal evidence anymore: they earn the same irrespective of what they do and can force the firm to its min-max payoff. □

Proof of Lemma 1

Part a) - suppose that the principal sets $\beta_U = \beta_\emptyset = 0$. The maximum bribe that the firm is willing to offer, b_{Max}, is such that the firm is indifferent between capturing or not the experts. This must be at least as large as $\underline{c}$ to induce low-concealment cost experts to hide evidence. Therefore,if $\tau b_{Max} < \underline{c}$, capture never takes place. This inequality holds as long as $\tau < \tilde{\tau}$.

Part b) Suppose now that $\tau \geq \tilde{\tau}$ so that capture may occur. If the principal decides to tolerate capture, it is better not to reward experts because $\lambda > 0$. It follows that the firm will offer the minimum bribe that induces capture, i.e., $b = \frac{\underline{c}}{\tau}$ and $W^{SGtolerate}$ is obtained. Alternatively, the principal will prevent capture by setting $\Delta_\beta = \beta_U - \beta_\emptyset > \tau b_{Max} - \underline{c}$. To minimize the cost of capture deterrence, $\beta_\emptyset = 0$ and $W^{SGdeter}$ is obtained. The principal prefers to deter capture when $W^{SGdeter} \geq W^{SGtolerate}$, that is, when $\lambda \leq \tilde{\lambda}$. The threshold $\tilde{\lambda}$ is decreasing in τ. To see this, note that:

$$\frac{\partial\tilde{\lambda}}{\partial\tau} = \frac{q(\tau\frac{q(1-\eta)}{1-q\eta}G - \underline{c})\underline{c}(1-\eta q)\left[\frac{-1}{\tau^2}\right] - \frac{q^2(1-\eta)G}{1-q\eta}\left[(1-\eta)q(D-G) + \underline{c}\left[(1-\eta)q + (1-\eta q)\frac{1-\tau}{\tau}\right]\right]}{[q(\tau qG - \underline{c})]^2} < 0.$$

□

Proof of Lemma 2

To determine the value of the maximum payment that can be received by the experts, consider this constrained maximization problem:

$$\max_{b\geq 0, w\geq 0} \tau b + w \tag{A1}$$

subject to (FCIC) and (FCPC) and let μ_1 and μ_2 be the Lagrangian multipliers associated with such constraints. Consider the solution where $b > 0$, $w > 0$ and (FCIC) binds. From complementary slackness conditions, we get:

$$\begin{aligned} &\tau - \mu_1\delta(1-q\eta) = 0; \\ &1 - \mu_1(1-\delta q\eta) = 0; \\ &(1-\delta q\eta)w + \delta(1-q\eta)b - \delta q(1-\eta)G = 0. \end{aligned}$$

From the first two conditions we get that $\tau = \frac{\delta(1-q\eta)}{1-\delta q\eta}$, and then in the third equation:

$$w + \tau b = \frac{\delta q(1-\eta)G}{1-\delta q\eta}.$$

For $\tau \neq \hat{\tau}(\delta)$, if (FCIC) binds, then either $b = 0$ or $w = 0$.[16] If $\tau > \hat{\tau}(\delta)$ paying only a bribe is desirable. To see this, substitute $w = \frac{\delta(1-q\eta)b}{(1-\delta q\eta)} - \frac{\delta q(1-\eta)G}{(1-\delta q\eta)}$ from (FCIC) into program (A1) and derive with respect to b. The derivative is strictly positive whenever $\tau > \hat{\tau}(\delta)$. □

Proof of Corollary 1

Suppose that (FCIC) does not hold when $w = \underline{c}$ and $b = 0$ and set $w = \underline{c} - \epsilon$ and $b = \frac{\epsilon}{\tau}$, with $\epsilon > 0$ so that (RCIC) binds in an attempt to satisfy (FCIC):

$$\begin{aligned} w =& \underline{c} - \epsilon \leq \frac{\delta(1-q\eta)(\underline{c}-\epsilon)}{\tau(1-\delta q\eta)} \\ \Leftrightarrow& \tau(1-\delta q\eta) \leq \delta(1-q\eta), \end{aligned}$$

which is never the case because τ is, by assumption, higher. □

Proof of Proposition 3

It directly follows from comparing welfare expressions. □

Proof of Proposition 4

The principal again has four different options.

Tolerating capture. In this case, the principal does not offer a bonus and welfare is:

$$W^{RGtolerate'''} = G - qD + hv.$$

Note that the principal does not induce effort and thus no expert acquires information. If the principal wanted to provide enough incentives without closing the revolving door at least selectively, this would be equivalent to the reward scheme case below (in which there is no capture).

Reward scheme. The principal may decide to prevent capture by setting a reward for $r = U$. This is achieved with the following bonus schedule: $\beta_{\emptyset}^{RGdeter'''} = 0$ and

$$\beta_U^{RGdeter'''} = \max\left\{\frac{c_e}{q}, \frac{\delta qh(1-\eta)G}{1-\delta\eta qh} - \frac{(1-h)\bar{u}}{1-\eta qh} - \underline{c}, 0\right\} \geq \beta_U^{RGdeter},$$

which may be more expensive than if high-ability experts detect the unsafe state automatically. Welfare is:

$$W^{RGdeter} = (1-qh)G - q(1-h)D + hv - \lambda qh\beta_U^{RGdeter'''} - hc_e.$$

[16] Notice also that if both constraints bind, either b or w is strictly positive.

Blanket ban. A blanket ban only makes sense if the principal also induces effort. This solution gives:

$$W^{RGclosing'''} = (1-qh)G - q(1-h)D - \lambda qh\beta_U^{RGclosing} - hc_e, \text{where}$$

$\beta_\emptyset^{RGclosing} = 0$ and $\beta_U^{RGclosing} = c_e/q$.

Selective ban. Also a selective ban only makes sense if effort induced.

$$W^{RGselectivelyclosing'''} = (1-qh)G - q(1-h)D + qhv - \lambda qh\beta_U^{RGselectivelyclosing} - hc_e,$$

which is strictly higher than $W^{RGclosing'''}$, where $\beta_\emptyset^{RGselectivelyclosing} = 0$ and $\beta_U^{RGselectivelyclosing} = \max\{c_e/q - \bar{u}, 0\}$. The principal does not have to pay such a high bonus if the inspector is also motivated by future wages. The principal prefers to keep the revolving door open if:

$$(1-q)v > \lambda q(\beta_U^{RGdeter'''} - \beta_U^{RGselectivelyclosing}).$$

If c_e is small, this is the same condition as in the case in which the high-ability expert automatically learns the unsafe state.

It directly follows from comparing welfare expressions. □

Proof of Proposition 5

There are four possible options that we describe below.

Tolerating capture. Again, by using techniques similar to those adopted in Section 3, it can be shown that $w_U = \bar{u}$ and $w_\emptyset = \underline{c} + \bar{u} + \Delta_\beta$, where $\Delta_\beta = \beta_U - \beta_\emptyset$. The firm's expected stream of profits is then:

$$\pi^{RG'} = (1-q\eta h)(G - \Delta_\beta - \underline{c}) + hv - \bar{u} = \pi^{RG}.$$

It follows that (18) is satisfied as long as:

$$\frac{\delta qh(1-\eta)}{1-\delta\eta qh}G \geq \frac{1-\delta h}{1-\delta qh\eta}\bar{u} + \Delta_\beta + \underline{c}. \tag{A2}$$

Note that this condition is tighter than the according one of the case in which the firm cannot observe the signal. The reason is that the firm can distinguish between an empty report by different types of experts, which makes committing to hire the (low-ability) expert after an empty report harder. As capture is tolerated, $\Delta_\beta = 0$ and welfare is the same as in the case in which the firm cannot observe the signal:

$$W^{RGtolerate'} = (1-qh\eta)G - q[1-h(1-\eta)]D - qh(1-\eta)\underline{c} + hv = W^{RGtolerate}.$$

Reward scheme. The principal may decide to prevent capture by setting a reward for $r = U$. This is achieved with the following bonus schedule: $\beta_{\emptyset}^{RGdeter'} = 0$ and

$$\beta_U^{RGdeter'} = \max\left\{\frac{\delta qh(1-\eta)G - (1-\delta h)\bar{u}}{1-\delta\eta qh} - \underline{c}, 0\right\} < \beta_U^{RGdeter}.$$

Because it is harder for the firm to commit, deterring capture is cheaper when the firm can observe the expert's signal. Thus, welfare is higher:

$$W^{RGdeter'} = (1-qh)G - q(1-h)D + hv - \lambda qh\beta_U^{RGdeter'} > W^{RGdeter}.$$

Blanket ban and selective ban. Those are unaffected by whether the firm can observe the expert's signal because this only impacts the FCIC.

The proposition directly follows from comparing welfare expressions. □

Proof of Proposition 6

Let us find the maximum salary the firm would be willing to pay to an expert who is accommodating. If there is regulatory capture:

$$\pi^{RG} = (1-q\eta h)G - (1-q\eta h)\frac{w_{\emptyset}}{1+\gamma} + \frac{hv - q\eta h\bar{u}}{1+\gamma}.$$

If regulatory capture cannot be sustained:

$$\pi^{SG} = (1-qh)G + \frac{h(v-\bar{u})}{1+\gamma}.$$

Therefore,

$$\delta(\pi^{RG} - \pi^{SG}) = \delta qh(1-\eta)G - \delta(1-q\eta h)\frac{w_{\emptyset}}{1+\gamma} + \frac{\delta h(1-q\eta)\bar{u}}{1+\gamma}.$$

The maximum salary the firm would be willing to pay satisfies:

$$\delta(1-q\eta h)\frac{w_{\emptyset}}{1+\gamma} + (1-\delta)w_{\emptyset} \leq \delta qh(1-\eta)G + \frac{\delta h(1-q\eta)\bar{u}}{1+\gamma} + (1-\delta)\frac{h(1-\eta q)}{1-h\eta q}\bar{u}.$$

Then, the maximum salary is:

$$\begin{aligned} w_{\emptyset}^{Max} =& \frac{(1+\gamma)\delta qh(1-\eta)G}{1-\delta q\eta h + \gamma(1-\delta)} + \frac{\delta(1-q\eta)h\bar{u} + (1-\delta)(1+\gamma)\frac{h(1-\eta q)}{1-h\eta q}\bar{u}}{1-\delta q\eta h + \gamma(1-\delta)} \\ =& \frac{(1+\gamma)\delta qh(1-\eta)G}{1-\delta q\eta h + \gamma(1-\delta)} + \frac{(1-q\eta)h\bar{u}}{1-hq\eta}. \end{aligned}$$

To prevent capture, the principal could set $\beta_{\emptyset}^{RGdeter} = 0$ and $\beta_U^{RGdeter} = \frac{w_{\emptyset}-\bar{u}}{1+\gamma} - \underline{c}$. As a result,

$$\beta_U^{RGdeter}(\gamma) = \max\left\{\frac{\delta qh(1-\eta)G}{1-\delta\eta qh + \gamma(1-\delta)} - \frac{(1-h)\bar{u}}{(1+\gamma)(1-\eta qh)} - \underline{c}, 0\right\}.$$

The effect of an increase in γ on $\beta_U^{RGdeter}$ is negative if and only if

$$\frac{hq\delta(1-\delta)(1-\eta)G}{(1+\gamma(1-\delta)-\delta hq\eta)^2} > \frac{(1-h)\bar{u}}{(1+\gamma)^2(1-hq\eta)}. \tag{A3}$$

If $\beta_U^{RGdeter} > 0$, consider the first order condition for an interior optimum:

$$Z(\gamma) \equiv -\frac{hv}{(1+\gamma)^2} - \lambda qh\frac{\partial \beta_U}{\partial \gamma} = 0.$$

This requires that $\frac{\partial \beta_U}{\partial \gamma} < 0$ (that is, satisfaction of inequality (A3)) and λ sufficiently high. The second order condition is:

$$\frac{\partial^2 W^{RGdeter}}{\partial \gamma^2} = \frac{2hv}{(1+\gamma)^3} - 2\lambda hq\left[\frac{hq\delta(1-\delta)^2(1-\eta)G}{(1+\gamma(1-\delta)-\delta hq\eta)^3} - \frac{(1-h)\bar{u}}{(1+\gamma)^3(1-hq\eta)}\right].$$

This is negative if and only if:

$$\frac{hq\delta(1-\delta)^2(1-\eta)G}{(1+\gamma(1-\delta)-\delta hq\eta)^3} > \frac{(1-h)\bar{u}}{(1+\gamma)^3(1-hq\eta)} + \frac{v}{(1+\gamma)^3\lambda q}.$$

We now use the implicit function theorem to study how changes in the primitives affect γ at the interior optimum. As the second-order condition must be satisfied, the sign of $\frac{\partial \gamma^*}{\partial \lambda}$ will coincide with the sign of $\frac{\partial Z}{\partial \lambda}$:

$$\frac{\partial Z}{\partial \lambda} = -qh\frac{\partial \beta_U}{\partial \gamma} > 0,$$

as β_U must be decreasing in γ at the interior solution. Consider now the impact of an increase in G on the equilibrium value of γ:

$$\frac{\partial Z}{\partial G} = -\lambda qh\frac{\partial^2 \beta_U}{\partial \gamma \partial G} > 0,$$

because $\frac{\partial^2 \beta_U}{\partial \gamma \partial G} < 0$. Consider now the impact of an increase in $\bar{u}$ on the equilibrium value of γ:

$$\frac{\partial Z}{\partial \bar{u}} = -\lambda qh\frac{\partial^2 \beta_U}{\partial \gamma \partial \bar{u}} < 0.$$

because $\frac{\partial^2 \beta_U}{\partial \gamma \partial \bar{u}} = \frac{1-h}{(1+\gamma)^2(1-hq\eta)} > 0$. Lastly, consider the impact of an increase in v on the equilibrium value of γ:

$$\frac{\partial Z}{\partial v} = -\frac{h}{(1+\gamma)^2} < 0.$$

□

Proof of Stationarity

First note that the firm cannot influence experts with $c = \infty$. Now consider a situation in which the firm manages to let the low manipulation cost expert misreport the signal in period t in the derived stationary equilibrium. Because the expert does not care about any future periods and is just indifferent between misreporting or not in t, there is no cheaper way for the firm to influence this expert. Moreover, the firm could not benefit from a different report and, because we look at an equilibrium, the cost for the firm does not exceed its benefit from misreporting. Now consider a situation in which the firm does not to let the low manipulation cost expert misreport the signal in period t in the derived stationary equilibrium. Trivially, the equilibrium wage is the cheapest wage the firm can offer. If the firm wanted to influence the experts, the cheapest way would be using the w (and b, if the firm can use bribes) as in the analysis for the stationary equilibrium because the expert does not care about any future periods and would just be indifferent. However, by the optimality of the equilibrium, the cost for the firm exceeds its benefit from misreporting. Thus, there is no situation in which the firm could do better. □

References

Angelucci, C. and Russo, A. (2017). Petty corruption and citizen reports. *CESifo Working Paper Series*, (5528).

Barbosa, K. and Straub, S. (2017). The value of revolving doors in public procurement. *TSE Working Paper*, (17-873).

Barron, D. and Guo, Y. (2019). The use and misuse of coordinated punishments. Technical report, Working Paper.

Bertrand, M., Bombardini, M., and Trebbi, F. (2014). Is it whom you know or what you know? an empirical assessment of the lobbying process. *American Economic Review*, 104(12):3885–3920.

Blanes i Vidal, J., Draca, M., and Fons-Rosen, C. (2012). Revolving door lobbyists. *The American Economic Review*, 102(7):3731.

Bond, P. and Glode, V. (2014). The labor market for bankers and regulators. *The Review of Financial Studies*, 27(9):2539–2579.

Che, Y.-K. (1995). Revolving doors and the optimal tolerance for agency collusion. *The Rand journal of economics*, pages 378–397.

Cornaggia, J., Cornaggia, K. J., and Xia, H. (2016). Revolving doors on wall street. *Journal of Financial Economics*, 120(2):400–419.

Darby, M. R. and Karni, E. (1973). Free competition and the optimal amount of fraud. *Journal of Law and Economics*, 16:67–88.

De Chiara, A. and Manna, E. (2019). Corruption and the regulation of innovation.

DeHaan, E., Kedia, S., Koh, K., and Rajgopal, S. (2015). The revolving door and the sec's enforcement outcomes: Initial evidence from civil litigation. *Journal of Accounting and Economics*, 60(2-3):65–96.

Drugov, M. (2010). Competition in bureaucracy and corruption. *Journal of Development Economics*, 92(2):107–114.

Dulleck, U., Gong, J., and Li, J. (2015). Contracting for infrastructure projects as credence goods. *Journal of Public Economic Theory*, 17(3):328–345.

Dulleck, U. and Kerschbamer, R. (2006). On doctors, mechanics, and computer specialists: The economics of credence goods. *Journal of Economic Literature*, 44:5–42.

Estache, A. and Wren-Lewis, L. (2009). Toward a theory of regulation for developing countries: Following jean-jacques laffont's lead. *Journal of Economic Literature*, 47(3):729–70.

Hiriart, Y. and Martimort, D. (2012). How much discretion for risk regulators? *The RAND Journal of Economics*, 43(2):283–314.

Hiriart, Y., Martimort, D., and Pouyet, J. (2010). The public management of risk: Separating ex ante and ex post monitors. *Journal of Public Economics*, 94(11-12):1008–1019.

Inderst, R. (2015). Regulating commissions in markets with advice. *International Journal of Industrial Organization*, 43:137–141.

Inderst, R. and Ottaviani, M. (2012a). Competition through commissions and kickbacks. *The American Economic Review*, 102:780–809.

Inderst, R. and Ottaviani, M. (2012b). Financial advice. *Journal of Economic Literature*, 50:494–512.

Inderst, R. and Ottaviani, M. (2012c). How (not) to pay for advice: A framework for consumer financial protection. *Journal of Financial Economics*, 105:393–411.

Kempf, E. (2020). The job rating game: The effects of revolving doors and analyst incentives. *Journal of Financial Economics*, 135(1):41–67.

Laffont, J.-J. and Tirole, J. (1991). The politics of government decision-making: A theory of regulatory capture. *The quarterly journal of economics*, 106(4):1089–1127.

Laffont, J.-J. and Tirole, J. (1993). *A theory of incentives in procurement and regulation*. MIT press.

Martimort, D. (1999). The life cycle of regulatory agencies: Dynamic capture and transaction costs. *The Review of Economic Studies*, 66(4):929–947.

Mulcahy, S. (2015). *Lobbying in Europe*. Transparency International.

Ortner, J. and Chassang, S. (2018). Making corruption harder: asymmetric information, collusion, and crime. *Journal of Political Economy*, 126(5):2108–2133.

Piller, C. (2018). Hidden conflicts? *Science*, 361:16–20.

Salant, D. J. (1995). Behind the revolving door: A new view of public utility regulation. *The Rand journal of economics*, pages 362–377.

Stigler, G. J. (1971). The theory of economic regulation. *The Bell journal of economics and management science*, pages 3–21.

Tabakovic, H. and Wollmann, T. G. (2018). From revolving doors to regulatory capture? evidence from patent examiners. Technical report, National Bureau of Economic Research.

Tenekedjieva, A.-M. (2019). The revolving door and insurance solvency regulations. Technical report, Mimeo.

Tirole, J. (1986). Hierarchies and bureaucracies: On the role of collusion in organizations. *Journal of Law, Economics, & Organization*, 2(2):181–214.

Tirole, J. (1992). Collusion and the theory of organizations. In *Advances in Economic Theory, Vol. 2*. Cambridge University Press.

Troya-Martinez, M. and Wren-Lewis, L. (2018). Managing relational contracts. *CEPR Discussion Paper 12645*.

Vafaï, K. (2002). Preventing abuse of authority in hierarchies. *International Journal of Industrial Organization*, 20(8):1143–1166.

Vafaï, K. (2010). Opportunism in organizations. *Journal of Law, Economics and Organization*, 26(1):158–181.