Flexible and Mandatory Banking Supervision

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Abstract

The implementation of tighter regulation and more powerful supervision may impose large social costs due to the strong reliance on supervisory information that requires direct assessment by a supervisor (i.e. Mandatory Supervision). We show that by introducing a Flexible Supervision contract, which is designed to be chosen by those banks that have incentives to capture the supervisor and allows them to bypass Mandatory Supervision, the most efficient regulation under asymmetric information may be implemented. Benevolent regulators should introduce Flexible Supervision regimes for the less risky, more capitalized and transparent banks in addition to the traditional Mandatory Supervision regime.

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1 Introduction

Tighter regulation and more powerful supervision of the financial sector are being implemented in most countries after the global financial crisis. Notable examples are the Dodd-Frank Act in the United States and the Capital Requirements Directive IV in Europe. Although the new rules may imply positive welfare effects, many commentators have stressed that they may also impose large social costs.\(^1\) These costs may include legal and compliance direct costs, but also indirect costs which are related to the stronger reliance on supervisory information. Indeed, some of the measures being undertaken lead to a more intense supervision of banks and entail qualitative assessments of their organization and practices by the supervisor. A closer interaction of supervisees with more powerful supervisors and the dependence on supervisory information may backfire, paving the way for the capture of the supervisor by banks.\(^2\)

In this paper, we develop a formal model that explicitly takes into account the possibility that banks capture the supervisor to obtain more favorable regulatory requirements and study mechanisms to reduce the social welfare costs introduced by the threat of supervisory capture. In practice, supervisory capture may manifest in different ways ranging from the extreme case of illegal collusion between banks and the supervisor to softer forms other than corruption where there is not per-se illegality, e.g. post-career concerns like revolving doors, exchange of favors or presents, lobbying. In this paper we focus on the consequences of supervisory capture that are common to all its manifestations (i.e., an increase in the private benefits of the parties involved that may generate a negative externality to society) and use a modeling shortcut that allows us to take into account these effects while keeping the model tractable: Banks may capture the supervisor by giving the latter a side transfer in exchange for some action that benefits the former.\(^3\)

We show that complementing a supervisory regime where the direct assessment by a supervisor is mandatory (Mandatory Supervision) with a Flexible Supervision regime is the optimal supervisory architecture in the presence of capture concerns. In the model, a benevolent financial stability committee employs a supervisor to assess the banks’ riskiness, which is private information of the bankers. When supervision is always mandatory, this opens the possibility that banks capture the supervisor so that the latter misreports supervisory information. In

\(^1\)See, for instance, "Banks face pushback over surging compliance and regulatory costs" on The Financial Times, May 28, 2015 and Cochrane (2014).

\(^2\)The phenomenon of regulatory/supervisory capture has been long studied (see, for example, the seminal work by Stigler, 1971) and its pervasiveness in the financial sector has often been documented (see Woodward, 2000, and the references therein). Recent examples of the willingness of the financial sector to capture powerful supervisors are documented by Bloomberg ("Wall Street Lobbyists Besiege CFTC to Shape Derivatives Rules", October 14, 2010): “With power from Congress to oversee the previously unregulated $615 trillion market for over-the-counter derivatives, it [the Commodity Futures Trading Commission] has become one of the hottest lobbying spots in town.” David Beim ("Report on Systemic Risk and Bank Supervision", 2009) argues that the Federal Reserve Bank of New York was overly deferential to the banks being supervised and that such attitude could be seen as a (weak) form of supervisory capture (see David Beim’s Testimony "Before the Senate Committee on Banking, Housing and Urban Affairs Financial Institutions and Consumer Protection Subcommittee", November 21, 2014). Recent recordings of conversations among New York FED officials show that supervisors continue to adopt a non-confrontational style with the industry and are unwilling to speak up (see, for example, "New Scrutiny of Goldman’s Ties to the New York Fed after a Leak" on The New York Times, November 19, 2014).

\(^3\)Modeling supervisory capture as a side transfer may appear as a somewhat extreme assumption but it can easily accommodate more common forms of capture. For example, for post-career concerns and revolving doors the side transfer may be interpreted as the present value of future income from working for the bank.
order to avoid capture, the financial stability committee needs to reward the supervisor and apply a more stringent regulation to the riskier banks. As a result, the threat of supervisory capture implies a reduction in social welfare. On the contrary, a supervisory plan consisting of both Mandatory and Flexible Supervision dramatically reduces the social cost of implementing efficient bank regulation. Flexible Supervision allows some banks to bypass the supervisor’s direct assessment, provided that they self-select the regulatory contract (i.e., capital and other regulation) that has been designed for their level of risk. The optimal design of Flexible Supervision implies that only those banks which would otherwise have incentives to capture the supervisor decide to bypass supervision. The other banks prefer the traditional Mandatory Supervision regime that involves direct supervision and a regulation that depends on the outcome of the supervisor’s assessment. Therefore, the financial stability committee overcomes supervisory capture by reducing the interaction between supervisors and supervisees, without entailing any loss of information with respect to the case in which supervision is Mandatory for all banks. As a result, by implementing a supervisory plan that makes use of both Flexible and Mandatory supervision, the financial stability committee achieves the same outcome in terms of social welfare as when the supervisor is benevolent and therefore capture is not a concern.

Policy implications follow directly from the theoretical results: Benevolent financial stability committees should avoid the welfare costs due to the threat of supervisory capture by introducing a Flexible Supervision regime in addition to the traditional Mandatory one. Under these two regimes, the less risky banks are willing to signal their type by putting more capital at risk and being more transparent. In exchange, they are subject to a less stringent intervention by the supervisor which, in turn, reduces the scope for supervisory capture with welfare improving effects. This Flexible Supervision regime needs to be complemented with a more stringent, Mandatory Supervision regime applied to the rest of the banking system. Mandatory and Flexible Supervision may be interpreted as particular strategies in banking supervision. In practice, bank supervisors generally apply different supervisory strategies to banks according to their riskiness and other soundness indicators. For example, Eisenbach et al. (2016) document that more supervisory resources are spent on riskier banks in the United States. The theoretical results in this paper provide a rationale for these kinds of supervisory strategies.  

In the model we consider the problem of a benevolent Financial Stability Committee (FSC), an institution tasked with designing the supervisory architecture of the banking system to foster financial stability and maximize social welfare. The banking system consists of one representative bank. The choice of the optimal design depends on the riskiness of the bank’s portfolio, which is private information of a banker. To reduce the information asymmetry, the FSC may decide to use a supervisor. The supervisor applies a technology that generates evidence correlated with the riskiness of the bank. If used, the supervisor can either report the collected evidence to the FSC or pretend that she observed no informative evidence and submit

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4 Paragraph 43 of the Guide to banking supervision of the European Central Bank (see European Central Bank, 2014) provides a clear example of how supervisors use different strategies in practice: “The result of the SREP (Supervisory Review and Evaluation Process) is also a key input for the SSM (Single Supervisory Mechanism)’s strategic and operational planning. In particular, it has a direct impact on the range and depth of off-site and on-site activities that are carried out for a given institution.” Regarding on-site inspections, paragraph 71 is more specific: “... The scope and frequency of on-site inspections are proposed by the JST (Joint Supervisory Team), taking into account the overall supervisory strategy, the SEP (Supervisory Examination Programme) and the characteristics of the credit institution (i.e. size, nature of activities, risk culture, weaknesses identified). ...”
an empty report.

If the supervisor is benevolent, her incentives are aligned with those of the financial stability committee and she does not need to be motivated to report truthfully the collected evidence. In this case, supervisory capture does not represent a threat and the second best solution can be achieved.\(^5\) In contrast, if the supervisor is self-interested, she may be captured by banks. There are several reasons why supervisors may be willing to pursue other objectives than social welfare maximization. For simplicity, we assume that the supervisor is interested in the payment she gets when reporting supervisory information to the financial stability committee. Self-interest and the possibility to conceal information open the door for capture as some banker's types may be better-off when no information is reported. They may be willing to reward a supervisor for reporting uninformative evidence to the committee. More precisely, they may make side transfers to an informed supervisor to induce her to conceal evidence to the financial stability committee.

To prevent capture under the Mandatory Supervision regime, the financial stability committee must reward the supervisor when she provides evidence that may hurt bankers. In other words, the supervisor should be turned into a bounty-hunter, as in Tirole (1986), Laffont and Tirole (1991) and Kofman and Lawarree (1993). The salary of the supervisor should be such that she does not find it profitable to collude with the banker in order to conceal information. Given the interests at stake, this reward might be very large, thereby magnifying the distortions to the optimal regulatory policy that the committee may be able to implement. Hence, due to the threat of capture, social welfare will be lower than in the second best solution where the supervisor is benevolent. However, social welfare will be higher than in a situation in which supervision is not used.

The prevention of capture when supervision is always mandatory implies that in equilibrium the supervisor fully extracts the banker's information rent when they are jointly informed about the riskiness of the bank. This observation sets the stage for an alternative supervisory arrangement that can forestall supervisory capture without social costs. We call this alternative arrangement Flexible Supervision. Under Flexible Supervision, the financial stability committee offers the banker an additional regulatory contract. This provides the banker with at least the same payoff he would obtain if the riskiness of his bank were assessed by a self-interested supervisor. If the banker self-selects this regulation, then there is no need for the supervisor's report because the financial stability committee can infer the characteristics of the bank from the banker's decision. As a result, Flexible Supervision will not involve any loss of information. Moreover, it will allow the financial stability committee to save the supervisor's reward in equilibrium and, in turn, to implement the second-best optimal regulatory policy.\(^6\)

Therefore, the financial stability committee is strictly better off by implementing a supervisory plan that includes both Mandatory and Flexible supervision as two complementary regimes in which the banker self-selects depending on the riskiness of his bank and on the supervisory

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\(^5\)The first best solution cannot be achieved because asymmetric information determines that banks must get some information rents in order not to distort further efficiency.

\(^6\)In addition to reducing the welfare costs due to the threat of supervisory capture, Flexible Supervision may also save on compliance and on-site supervision costs. We do not consider these costs in the model but they are sizable in the real world. Their inclusion in the model would not affect the qualitative results but it might make it optimal to induce the financial stability committee to use the Flexible Supervision contract more often.
The advantages of Flexible Supervision are not limited to the efficient prevention of supervisory capture. In an extension, we relax the simplifying assumption that the bank’s riskiness is exogenous and we consider a setting in which the monitoring effort exerted by the banker in monitoring the quality of the bank’s borrowers affects the bank’s riskiness. We show that a supervisory setup that combines both Flexible and Mandatory supervision reduces the distortion to the monitoring effort of the banker compared to a situation in which supervision is always Mandatory.

We analyze the robustness of our main results to relaxing some of the assumptions of the baseline model. The simultaneous presence of Mandatory and Flexible Supervision allows the financial stability committee to achieve the second-best outcome both when (i) we consider more than two levels of bank riskiness, (ii) when the financial stability committee does not know whether the supervisor is benevolent or self-interested, and (iii) under different sequences of events where the banker and the supervisor may be unaware of the supervisory signal at the time of accepting a regulatory-supervisory contract. Conversely, the second-best outcome is no longer available when the supervisor-banker coalition can not only conceal but also forge evidence to the financial stability committee. Nevertheless, even in this case implementing a supervisory plan that makes use of both Mandatory and Flexible supervision strictly dominates a supervisory plan in which supervision is Mandatory for all banks. Finally, the implementation of Flexible Supervision crucially depends on the fact that the supervisor and the banker cannot credible collude ex-ante, i.e. before the supervisory information is collected, providing a rationale for the usual practice of continuously reassigning supervisors to supervisees.

**Related Literature.** This paper contributes to the literature on the design of banking regulation and supervision. Boot and Thakor (1993) and Giammarino et al. (1993) provide early contributions which have pursued an incentive approach to these issues. Closely related to our paper are the articles by Marshall and Prescott (2001, 2006). They study optimal contingent fees and capital requirements to induce the banks to report the level of risk truthfully. However, in their models there is no supervisor who collects a signal on the bank’s riskiness and, as a result, no capture opportunities may arise. Prescott (2004) shows that auditing of the bank’s riskiness should be stochastic so as to save on costly supervisory resources. We also propose a mechanism to drastically reduce the costs of implementing an effective supervision of the bank’s riskiness which entails that some banks will not be directly supervised. In contrast to our paper, Prescott (2004) finds that safest banks ought to be audited more frequently for incentive reasons.

Many recent studies focus on the allocation of supervisory tasks to centralized and decentralized supervisors. Agur (2013) highlights how competition between bank regulators may have dire consequences in the presence of regulatory arbitrage. Carletti et al. (2015) argue that centralizing supervision might have countervailing effect on banks’ risk taking behavior. This occurs when local supervisors, who are biased in favor of domestic banks, are charged with collecting supervisory information.\(^7\) Dell’Ariccia and Marquez (2006) compare two settings. One in which national regulators interested in their own domestic banking system set policies

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\(^7\)A conflict of interests between local and central supervisors is also analyzed by Colliard (2014).
non-cooperatively and one in which an international regulator sets the same policy for the banks of all countries. Within this strand of the literature, our paper is most closely related to Boyer and Ponce (2012). They argue that splitting supervisory responsibilities between independent supervisory authorities is a superior institutional arrangement than concentrating responsibilities in a single authority when supervisory capture is a concern. We use an extended version of their model to propose an alternative way to deal with the threat of supervisory capture, and conclude that the introduction of a flexible supervision contract overcomes capture and implements efficient regulation without entailing any loss of information for the financial stability committee.

This paper is also linked to the agency theory of regulation pioneered by Baron and Myerson (1982); Baron and Besanko (1984). This literature typically proposes a compensation policy for the supervisor when providing evidence which is unfavorable to the agent so as to prevent corruption (Laffont and Tirole, 1993). Recent contributions develop alternative or complementary tools to overcome the threat of capture. Felli and Hortala-Vallve (2016) focus on rewarding whistle-blowing as a mechanism design tool to deter collusion and extortion within organizations. They show how the principal can benefit from enlarging the message space of both the supervisor and the agent allowing them to leak information about collusive agreements or blackmail threats. De Chiara and Livio (2017) show how the timing of the supervisor’s report can be fruitfully used to minimize the cost of preventing corruption. The mechanism developed in this paper builds on that presented by Burlando and Motta (2015) in the context of the organization of a firm. They show that outsourcing can be the optimal organizational response to the threat of internal collusion. We apply a similar idea to the study of the optimal design of banking regulation and supervision showing how this may lead to a significant reduction of the social costs associated with supervisory capture. There are, however, some relevant modeling differences as we posit a different information structure which critically affects the feature of the optimal solution. Finally, our results are linked to the mechanism design literature on surplus extraction initiated by Cremer and McLean (1988), since it shows how to reduce the information rents given up to agents who hold private but correlated information.

The rest of the paper is organized as follows. In Section 2 we introduce the baseline model. Section 3 is devoted to the analysis of Flexible and Mandatory Supervision. There we derive the main results of the paper and policy implications. In Section 4 we study several extensions and check the robustness of the results. In Section 5 we make concluding remarks. Proofs and other technicalities are in Appendices A and B.

2 The Model

We consider a three-tier hierarchy consisting of a benevolent financial stability committee (FSC or it), a supervisor (she) and a banker (he). All parties are risk-neutral.

\footnote{Boyer and Ponce (2012) build on the intuition first proposed by Laffont and Martimort (1999).} \footnote{Specifically, the timing of information acquisition impacts on the design of the optimal contract and the sorting of the agents who choose to be supervised.}
2.1 Banker

There is a bank with a risk profile $r$, where $r$ is the probability of failure. Risk can be either low, $r = \underline{r}$, or high, $r = \bar{r}$, with $\underline{r} < \bar{r}$ and $P[r = \underline{r}] = \alpha \in (0, 1)$. The distribution of probabilities on $r$ is common knowledge, but the actual riskiness is private information of the banker. For simplicity only two levels of exogenously given riskiness are considered in the baseline model. The qualitative results are robust to considering more than two levels of risk and the possibility that the financial institution may affect the risk profile (see Section 4).

The bank provides financial services to customers. Its net income, $\pi$, depends on the market interaction with customers and on financial regulation. For simplicity, we assume that production costs are nil, so that the objective function of the banker is given by:

$$B = \pi - rk,$$

where $k$ is the internal financing put at risk by the banker. With probability $r$ the financial institution fails and the banker loses the equity capital. Under the assumption that the financial institution is only financed by the banker, $k$ is a measure of the its size. It is worth noticing that $\pi$ is related to $k$ because financial customers are willing to pay more for services provided by larger financial institutions, as it will be shown below. The reservation value of the banker is such that $B \geq 0$.

2.2 Supervisor

The financial stability committee can hire a financial supervisor to bridge its lack of information on the riskiness of the bank. The supervisor owns a supervisory technology that allows her to observe the bank’s riskiness with some positive probability. In order to motivate the supervisor to report the collected evidence, the FSC may pay the supervisor a salary $w$. This salary can be made contingent on the report because the information reported can be verified. The supervisor’s payoff must be sufficiently high so as to meet her reservation utility, which is normalized to zero. For simplicity we assume that the supervisor does not incur any cost to observe the riskiness of the financial institution. We assume that the supervisor can quit at any time.\(^\text{10}\) The supervisor’s participation constraint is:

$$S = w \geq 0. \tag{SPC}$$

The salary of the financial supervisor is financed through distortive taxes which create a social cost $\lambda > 0$.

2.3 Financial stability committee

A financial stability committee regulates the financial institution and designs supervision. As for the rationale for regulating financial institutions, we follow Dewatripont and Tirole (1994)’s argument that financial customers need to be “represented” because they are not able to exert control rights appropriately. Indeed, in the model asymmetric information about the riskiness of

\(^{10}\text{This would be equivalent to assuming that the supervisor is protected by limited liability.}\)
the financial institution gives rise to an adverse selection problem wherein a high-risk financial institution may mimic a low risk one.

We consider financial customers in a broad sense, e.g. borrowers, credit card holders, small investors, etc. They enjoy a surplus from using the financial services that are provided by a financial institution of size $k$ and risk profile $r$ which is equal to $(1 - r)\Psi(k)$. We assume that $\Psi'(\cdot) > 0$ to capture the fact that the customers’ utility is increasing in the size of the financial institution. A larger financial institution may be able to offer a wider range of financial products and services which better fit the customers’ needs. We further assume that $\Psi''(\cdot) < 0$ since the marginal returns of an increase in the size of the financial institution are decreasing: Adding new products when a quite large set is already provided does not significantly affect the customers’ utility. Customers also bear the risk that the financial institution fails. In particular, (i) a higher level of risk decreases the benefits that the financial services provide and (ii) decreases the positive marginal impact on welfare due to more capital.

The FSC (i) regulates the size of the bank’s balance sheet, $k$, through capital regulation, mergers and acquisition regulation, downsizing policies and other tools; (ii) affects the net income of the bank, $\pi$, through tools such as taxes, fees, allowing or banning proprietary trading, capping the amount of loans the bank can issue, approving or objecting to planned dividend payments and stock repurchases, 11 controlling interest rates; and (iii) designs the supervisory contracts and arrangements.

Regulating and overseeing the financial sector entail both direct and indirect costs. The latter include the misallocation of resources which is engendered by the regulatory and supervisory processes. For simplicity, we assume that the total social costs of regulation is proportional to the bank’s net income and, for the sake of parsimony, we assume that is captured by the same parameter $\lambda > 0$ which represents the cost of using distortionary taxes to finance the supervisor’s salary. 12

The FSC is assumed to be benevolent so that it cares about the welfare of the banker, the supervisor, and the financial customers. Therefore, the FSC maximizes the expected value of the following social welfare function:

$$W = B + S + (1 - r)\Psi(k) - (1 + \lambda)(\pi + w),$$

which is useful to rewrite as follows:

$$W = (1 - r)\Psi(k) - \lambda w - \lambda[\pi - rk] - (1 + \lambda)rk.$$

### 2.4 Information, Supervisory Technology and Report Possibilities

The supervisor collects information about the bank’s riskiness through in situ inspections or by analyzing the bank’s data. We assume that she observes a signal $\sigma$ which provides conclusive information about the riskiness of the bank, i.e. $\sigma = r$, with probability $\varepsilon \in (0, 1)$ and inconclusive information, i.e. $\sigma = 0$, with probability $(1 - \varepsilon)$. The assumption that supervision does not

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11 In the United States, with the Comprehensive Capital Analysis and Review the Federal Reserve Board can either object to, or provide a non-objection to, the capital plans submitted by Bank Holding Companies with consolidated assets of at least $50$ billion.

12 Introducing two distinct parameters would not affect the results of the paper.
always generate conclusive evidence on the bank’s true level of riskiness is due to the imperfect and multifaceted nature of inspections or analyses of bank’s data.

The supervisor sends a message $m_s$ to FSC about the observed $\sigma$. We assume that the signal $\sigma$ is hard information. This implies that $\sigma$ is verifiable and that the supervisor is unable to falsify it with or without the bank assistance.\(^{13}\) This implies that if $\sigma = \emptyset$, then $m_s = \emptyset$ while if $\sigma = r$, $m_s \in \{r, \emptyset\}$ because the supervisor can conceal supervisory information to the FSC. The banker also sends a report concerning the bank’s level of risk, which we denote $m_b \in \{\overline{r}, \bar{r}\}$, and we assume that he can misreport.

Information is nested along the hierarchy: the banker has the finest information set as he knows exactly the bank’s riskiness and he is aware of the signal observed by the supervisor. The supervisor only observes $\sigma$ while the FSC observes neither $r$ nor $\sigma$ but receives the supervisor’s and the banker’s messages, denoted $m_s$ and $m_b$.

Based on $r$ and $\sigma$, there are four possible states of nature:

1. $r = \overline{r}$ and $\sigma = r$, which occurs with probability $p_1 = \alpha \varepsilon$;
2. $r = \overline{r}$ and $\sigma = \emptyset$, which occurs with probability $p_2 = \alpha (1 - \varepsilon)$;
3. $r = \bar{r}$ and $\sigma = \emptyset$, which occurs with probability $p_3 = (1 - \alpha)(1 - \varepsilon)$;
4. $r = \bar{r}$ and $\sigma = r$, which occurs with probability $p_4 = (1 - \alpha)\varepsilon$.

Thus, the bank is low-risk in states 1 and 2 and high-risk in states 3 and 4, while the supervisor has conclusive information in states 1 and 4 and inconclusive information in states 2 and 3.

### 2.5 Contracts

A regulatory-supervisory contract designed by the FSC is a triplet $\{k(m_b, m_s), \pi(m_b, m_s), w(m_b, m_s)\}$. Although we do not allow the banker to send a message on the signal he observes along with the supervisor, we show in Appendix A that this is without loss of generality as it would not raise welfare.

If the banker is directly supervised, the banker and the supervisor can engage in a side contract. The side contract specifies the report the supervisor sends and a side transfer from the banker to the supervisor, $b$, which is contingent on the supervisor’s report. As discussed in the Introduction, bankers may have a number of reasons to capture their supervisors and may use a broad set of tools to do it. We use the side transfer as a modeling shortcut. If the parties fail to agree on a side contract the report is made non-cooperatively. As is customary in the literature on capture, side contracts are assumed to be enforceable.\(^{14}\) However, we assume that it is costly to organize the transaction and therefore we introduce the parameter $\tau < 1$ which is meant to capture such depreciation.\(^{15}\) It is reasonable to suppose that $\tau$ is lower in

\(^{13}\)In Section 4.2 we study a framework wherein supervisor and the banker can cooperate to forge false evidence, i.e., the signal is a piece of soft information in this case.

\(^{14}\)For a discussion of this assumption, see Tirole (1992).

\(^{15}\)Note that often capture do not take a side transfer, monetary form so as to reduce the probability of being detected by the authorities. Namely, the banker may reward the supervisor through non-monetary gifts or favors and $1 - \tau$ would be equivalent to the difference between the monetary cost of such a present to the banker and
those countries in which the institutional setting is stronger. Stronger institutions may imply more efficient courts of law and more watchful media. The former may be better able to detect capture and may punish more severely who commits this felony. The latter may curb the phenomenon of revolving doors, making it harder for a supervisor to join a bank that she has previously supervised.

2.6 Timing

The sequence of events is as follows:\textsuperscript{16}

1. The supervisor observes the signal. The banker learns the bank’s riskiness and observes the supervisor’s signal. The probability distributions are common knowledge.

2. The FSC simultaneously proposes regulatory-supervisory contracts to the supervisor and the banker. If the banker self-selects the Flexible Supervision contract, then this contract is implemented. If the banker does not select the Flexible Supervision contract, then Mandatory Supervision continues as follows:

3. The banker and the supervisor can privately sign a side-contract.

4. The banker and the supervisor send their messages to the FSC. The regulatory-supervisory contract is implemented according to their reports.

2.7 Benchmarks

In what follows we solve for three benchmark cases: first, we consider a situation wherein FSC perfectly observes the riskiness of the bank, so that the first-best solution is attained; second, we consider a situation in which the objectives of the supervisor and the FSC are aligned, that is, the supervisor is benevolent, and we characterize the second-best optimal solution; finally, we consider a situation wherein the supervisor is not available and FSC solves a traditional adverse selection problem inducing the banker to reveal the bank’s riskiness through a direct revelation mechanism.

2.7.1 Benchmark 1: Symmetric Information - First-Best

When the FSC is perfectly informed about \( r \), it can offer the banker a risk-specific contract in which (i) the participation constraint of the banker binds irrespective of the bank’s riskiness, i.e. \( \pi^{fb} = r k^{fb} \) and \( \tilde{\pi}^{fb} = \tilde{r} \tilde{k}^{fb} \); and (ii) the marginal cost of the level of capital put at risk by a banker equals the marginal utility derived by the customers of the bank, i.e. \( \Psi'(k^{fb}) = (1 + \lambda) \frac{r}{1 - \tau} \) and \( \Psi'((\tilde{k})^{fb}) = (1 + \lambda) \frac{\tilde{r}}{1 - \tau} \).

In such a situation, the social welfare is maximized and no rent is given up to a banker irrespective of his bank’s riskiness: the first-best (fb) solution is attained.

\textsuperscript{16}In Section 4.4 we show that the qualitative results of the paper are robust to considering different sequences of events.
2.7.2 Benchmark 2: Asymmetric Information

The two benchmarks considered in this section provide useful reference points to evaluate the beneficial impacts of Flexible Supervision.

**Benevolent Supervisor - Second-Best.** Consider now the benchmark case in which the FSC uses a benevolent supervisor to reduce the asymmetry of information. The FSC gets the supervisor’s superior information at a zero cost, that is, by paying the supervisor a constant wage that equates her reservation wage. Therefore, \( w_i = 0 \) in all the states of the world. Yet, the FSC learns the bank’s true riskiness with probability \( \varepsilon < 1 \) and, as a result, must give up some rent to the banker to induce truthful revelation of his private information.

When \( \sigma \) is informative (states 1 and 4), the FSC is perfectly informed about the riskiness of the bank. As a result, in state \( i \), for \( i \in \{1, 4\} \), the FSC maximizes

\[
\max_{k_i, \pi_i}(1 - r_i)\Psi(k_i) - \lambda(\pi_i - r_i k_i) - (1 + \lambda) r_i k_i
\]

only subject to the supervisor’s participation constraints (SPCi) and the banker’s participation constraints:

\[
\pi_i - r_i k_i \geq 0 \quad (PC_i)
\]

with \( r_1 = \bar{r} \) and \( r_4 = \hat{r} \). In equilibrium when the supervisor is benevolent (bs) the FSC manages to deprive the banker of his rent by setting \( \pi_1^{bs} = \bar{r} k_1^{bs} \), \( \pi_3^{bs} = \hat{r} k_3^{bs} \), \( \Psi'(k_1^{bs}) = (1 + \lambda) \frac{\bar{r}}{1 - \varepsilon} \), \( \Psi'(k_3^{bs}) = (1 + \lambda) \frac{\hat{r}}{1 - \varepsilon} \). Hence, since the FSC is fully informed, the first-best solution is implemented in states 1 and 4: \( \pi_1^{bs} = \pi_{fb}, \pi_3^{bs} = 0, k_1^{bs} = \frac{k_{fb}}{r_1} \) and \( k_3^{bs} = \frac{k_{fb}}{r_4} \).

When \( \sigma \) is uninformative (states 2 and 3), the first-best contract is not feasible. As information is inconclusive, the riskiness of a bank is the banker’s private information. In particular, if only a participation constraint were imposed in state 2, then a low-risk banker in state 2 would have an incentive to choose the contract designed for a high-risk banker in state 3. Hence, the FSC must ensure that the low-risk banker is unwilling to claim that the bank’s level of risk is high by imposing the following incentive compatibility constraint:

\[
\pi_2 - r_2 k_2 \geq \pi_3 - r_3 k_3 \quad (IC_{23})
\]

In contrast the high-risk banker does not want to claim that his bank is low-risk, as he would bear a loss. Yet, he must be induced to accept the supervisory-regulatory contract. Thus, the FSC imposes \( \pi_i - r_i k_i \geq 0 \) for \( i \in \{2, 3\} \).

\footnote{If the high-risk banker chose the regulatory-supervisory contract designed for the low-risk banker, the level of capital that the FSC would require him to put at risk would be such that he would incur a loss.}

The FSC solves:
subject to (IC23) and the participation constraints. The following Lemma characterizes the second-best solution.

**Lemma 1.** The optimal contract when the supervisor is benevolent entails the following salaries for the supervisor: $w_{bs}^i = 0$ for $i = 1, 2, 3, 4$. The bank’s profits are $\pi_{1}^{bs} = \pi_{2}^{bs} = \pi_{3}^{bs} = \pi_{4}^{bs} + \Delta r k_{3}^{bs}$, $\pi_{i}^{bs} = \tilde{r} k_{i}^{bs}$ for $i = 3, 4$. The bank’s required levels of capital at risk are such that $\Psi'(k_{i}^{bs}) = (1 + \lambda)\frac{\tilde{r}}{1-\alpha}$ for $i = 1, 2$, $\Psi'(k_{3}^{bs}) = (1 + \lambda)\frac{\tilde{r}}{1-\alpha} + \frac{\alpha}{1-\alpha} \lambda \frac{\Delta r}{1-\alpha}$, $\Psi'(k_{4}^{bs}) = (1 + \lambda)\frac{\tilde{r}}{1-\alpha}$.

Lemma 1 shows that optimal regulation under benevolent supervision entails more severe regulation for the most risky banks, that is:

1. high-risk banks face more stringent capital requirements than low-risk banks: $k_{1}^{bs} = k_{2}^{bs} > k_{3}^{bs} > k_{4}^{bs}$;

2. the banker of a low-risk bank may be strictly better off than the banker of a high-risk bank: $B_{2}^{bs} > B_{i}^{bs} = 0$ for $i \in \{1, 3, 4\}$.

The banker receives no rent in state 1, 3 and 4 and obtains a positive surplus in state 2, $B_{2} > 0$, due to the incentive-compatibility constraint (IC23) that is binding. As the supervisor has not observed the bank’s riskiness, the banker could pretend that his low-risk bank is in fact high-risk. To deter such behavior, the FSC must give up an informational rent to induce the banker to choose the regulatory contract which is socially optimal given his bank’s level of risk. To reduce such rent, the FSC imposes more stringent capital requirements on the bank in state 3 than in the first-best solution. The level of capital put at risk is not distorted away from efficiency in the other states of nature and low-risk banks face less severe capital regulation than high-risk banks. Note also that the supervisor need not be provided an informational rent to reveal the information she has gathered about the bank’s riskiness because we assumed that she is benevolent.

**No Supervision.** In the absence of supervision and in the presence of asymmetric information about $r$, the FSC sets up a direct revelation mechanisms wherein regulation is based on the announcement of its riskiness. The bank’s contract is either $(k, \pi)$ if it announces that it is low-risk or $(\tilde{k}, \tilde{\pi})$ if it announces that it is high-risk. To discourage a low-risk bank to mimic a high-risk bank, the FSC must impose the following incentive compatibility constraint:

$$\tilde{\pi} - r \tilde{k} \geq \bar{\pi} - r \bar{k} \quad (IC)$$

For the high-risk bank, the relevant constraint is the participation constraint:

$$\bar{\pi} - r \bar{k} \geq 0 \quad (PC)$$
The program the FSC maximizes can be written as:

$$\max_{\bar{\pi}, \bar{k}} \alpha [(1 - r) \Psi(k) - \lambda(\bar{\pi} - rk) - (1 + \lambda)rk] + (1 - \alpha) [(1 - \bar{r}) \Psi(\bar{k}) - \lambda(\bar{\pi} - \bar{r}\bar{k}) - (1 + \lambda)\bar{r}\bar{k}]$$ (2)

subject to (PC) and (IC).

The following lemma summarizes the result:

**Lemma 2.** In the optimal no supervision contract (ns), the bank’s profits are $\bar{\pi}_{ns} = \bar{r}\bar{k}_{ns}$ and $\pi_{ns} = rk_{ns} + \Delta r \bar{k}_{ns}$, where $\Delta r = \bar{r} - r$. The bank’s required levels of capital at risk are such that $\Psi'(k_{ns}) = (1 + \lambda)\frac{\bar{r}}{1 - \bar{r}}$ and $\Psi'(\bar{k}_{ns}) = (1 + \lambda)\frac{r}{1 - r} + \frac{\alpha}{1 - \alpha} \lambda \Delta r$.

The high-risk banker does not receive a rent in equilibrium, i.e. $\bar{B} = 0$, while the low-risk banker collects a positive rent, $B > 0$, which is increasing in the difference in the riskiness of the two types of bank, that we have denoted $\Delta r = \bar{r} - r$. As the FSC attempts to reduce the rent given up to the low-risk banker, the level of capital at risk required from the high-risk bank is distorted downwards relative to the first-best one and the magnitude of such distortion negatively depends on the fraction of high-risk banks. By contrast, the low-risk bank’s capital at risk is not distorted as it has no impact on the rent paid by the FSC.

**Comparison.** The benefits of benevolent supervision are apparent. The banker collects a rent only if his bank is low risk and this has not been discovered by the supervisor. Stated differently, he receives a positive surplus only in state 2 and not also in state 1 as when a supervisor is not available. In addition, the high-risk bank capital is distorted downwards only in state 3 and not also in state 4 thanks to the additional information provided by the supervisor. Otherwise stated since the use of a benevolent supervisor reduces the information rents to the banker at no additional cost for the FSC, welfare is higher under benevolent supervision than under absence of supervision, i.e. $W^{bs} > W^{ns}$.

### 3 Flexible and Mandatory Supervision

In this section we derive the optimal regulatory contract when the supervisor is self-interested and may be captured by the banker. We use a modeling shortcut by representing capture as a transfer from the banker to the supervisor to induce the latter to conceal conclusive evidence to the FSC. We first analyze a standard setting in which banking supervision is always used and the regulatory contract always entails a report sent by a supervisor. We call this supervisory option Mandatory Supervision. Then, we explore a regulatory option in which the bank is presented with the opportunity of bypassing the supervisory scrutiny. We call this complementary arrangement Flexible Supervision. With this arrangement the banker can accept a regulatory profile that requires a certain level of capital at risk without being subjected to supervision. Finally, we evaluate these arrangements in terms of welfare.

#### 3.1 Mandatory Supervision

Consider an institutional arrangement in which the supervisor is always engaged to report on the bank’s riskiness (Mandatory Supervision). With Mandatory Supervision the FSC offers
the banker and the supervisor a menu of regulatory-supervisory contracts that specify capital requirements, profits and salaries as functions of the messages.

Since the supervisor can act opportunistically, the benevolent-supervisor solution cannot be implemented, since the banker and the supervisor would engage in a lucrative collusive agreement. This would happen when the bank is low-risk and the signal is informative about the bank’s riskiness, that is in state 1. The banker would have an incentive to convince the supervisor to send an uninformative report so that the FSC is uninformed and the banker can earn an information rent.

We now characterize the optimal capture-proof contract, namely the optimal scheme which prevents collusive agreements in equilibrium and motivates the supervisor to report truthfully the information she collects. In the proof of Lemma 3 we establish that restricting attention to capture-proof schemes is without loss of generality.\(^{18}\)

Note that the maximum side transfer the banker is willing to pay to induce the supervisor to report \(m_s = \emptyset\) when \(\sigma = r\) is equal to the difference between his payoff in state 2 and that in state 1, namely \(B_2 - B_1\). Recall however that each side-transfer \(b\) paid by the banker increases the supervisor’s utility by only \(\tau_b\), with \(\tau \in (0, 1)\). Moreover, when the supervisor reports \(m_s = \emptyset\), she foregoes salary \(w_1\) and receives instead salary \(w_2\) from the FSC. Therefore, the supervisor is willing to conceal information in state 1 if and only if \(w_2 + b > w_1\). The following capture-incentive compatibility (CIC) constraint must then be imposed to ensure truthful-reporting:\(^{19}\)

\[
    w_1 - w_2 \geq \tau[B_2 - B_1] \quad \text{(CIC)}
\]

The FSC maximizes the following objective function

\[
    W = \sum_{i=1}^{4} p_i[(1 - r_i)\Psi(k_i) - \lambda w_i - \lambda(\pi_i - r_i k_i) - (1 + \lambda) r_i k_i]
\]

subject to \((CIC), (IC_{23}), (SPCi)\) and \((PCi)\) for all \(i = 1, 2, 3, 4\).

The following lemma characterizes the optimal capture-proof contract:

**Lemma 3.** The optimal capture-proof contract under Mandatory Supervision (ms) entails the following salaries for the supervisor: \(w_i^{ms} = 0\) for \(i = 2, 3, 4\), \(w_1^{ms} = \tau \Delta r k_3^{ms}\). The bank’s profits are \(\pi_1^{ms} = rk_1^{ms}\), \(\pi_2^{ms} = rk_2^{ms} + \Delta r k_3^{ms}\), \(\pi_i^{ms} = \tau k_i^{ms}\) for \(i = 3, 4\). The bank’s required levels of capital at risk are such that \(\Psi'(k_i^{ms}) = (1 + \lambda) \frac{r}{1-\tau}\) for \(i = 1, 2\), \(\Psi'(k_3^{ms}) = (1 + \lambda) \frac{r}{1-\tau}\) + \(\frac{\alpha}{1-\alpha} \frac{1-\epsilon(1-r)}{1-\tau} \lambda \Delta r_{1-\tau}\), \(\Psi'(k_4^{ms}) = (1 + \lambda) \frac{r}{1-\tau}\).

Lemma 3 shows how the bank’s regulation and the supervisor’s compensation are affected by the possibility of capture when supervision is mandatory for all banks. As compared to the benevolent supervisor case, the Mandatory Supervision solution entails a more severe regulatory scheme for high-risk banks in state 3, namely \(k_3^{ms} < k_3^{bs}\) and \(\pi_3^{ms} < \pi_3^{bs}\). The reason is the following. When capture is a concern, the FSC has to reward the supervisor to achieve truthful-reporting in state 1. The size of this reward is linked to the maximum transfer the banker

\(^{18}\)We also prove that the FSC cannot gain from more complex mechanisms which, for instance, entail a bank’s announcement about \(\sigma\).

\(^{19}\)Implicit is the assumption that the supervisor reports evidence truthfully when indifferent.
is willing to make in order to induce the supervisor to conceal evidence in that state. By tightening the capital requirements of the high-risk banks in state 3, the FSC gives up a smaller informational rent to the banker in state 2, thereby minimizing the stake for collusion and in turn the social cost of acquiring information.\textsuperscript{20}

Lemma 3 highlights how preventing capture is not without costs when supervision is mandatory. As compared to the benevolent supervisor benchmark, inducing truthful revelation involves a higher distortion to the size of the high-risk banks and a higher cost of supervision. Together these distortions reduce the welfare with respect to the second best: $W^{ms} < W^{bs}$.

### 3.2 Flexible Supervision

We now illustrate an alternative institutional arrangement in which rather than just presenting the banker and the supervisor with a menu of regulatory-supervisory contracts, the FSC also offers the banker the option of accepting a specific regulatory scheme $(k_0, \pi_0)$ without being subjected to a supervisory assessment. In this case, we say that the FSC proposes a menu of regulatory options that induces Flexible Supervision.

The intuition as to why the introduction of Flexible Supervision may be welfare improving can be easily illustrated. If we compare the solutions when the supervisor is benevolent and when she is self-interested, we observe that the banker continues to receive a rent of $\Delta rk_3$ only in state 2. In contrast, it is the supervisor who benefits from the possibility of being captured as she collects a rent in state 1 equal to $\tau \Delta rk_3$. As the banker does not receive any rent in state 1, the FSC can costlessly induce him to opt for an alternative regulatory option. This additional regulatory option can just guarantee the banker the same utility he would obtain if he accepted to be scrutinized by a supervisor. The FSC need not reward the supervisor in state 1, since her report does not provide further information about the bank’s riskiness. Stated differently, if the banker accepts the Flexible Supervision contract he is signaling his riskiness to the FSC. As a consequence, the supervisor’s report is not needed and she does not receive any payment.

In this richer setting there are five contractual options: 1 to 4 refer to the same regulatory-supervisory contracts discussed before while contract 0 refers to the Flexible Supervision contract.\textsuperscript{21} Having this menu of regulatory options involves further constraints which reflect the willingness of the FSC to ensure that the banker chooses Flexible Supervision in state 1. To this end, the following incentive-compatibility constraint is set:

$$\pi_0 - \pi_0 k_0 \geq \pi_1 - \pi_3 k_1$$

(\text{IC01})

This condition ensures that a banker who knows that the supervisor has learnt that his bank is low-risk is (weakly) better off choosing not to be supervised. The FSC also wants the contract to be separating so that neither a low-risk bank in state 2 (i.e., when the supervisor

\textsuperscript{20}It is also worth noting that the stake for collusion is greater the larger is $\tau$. This implies that there are benefits from pursuing policies which make it more difficult for the parties to exchange side-payments. These are policies which make courts of law more effective so as to increase the likelihood that such side transactions are detected and the parties involved prosecuted. Additionally, also those campaigns which raise the civil servants’ awareness of the dire social consequences of engaging in opportunistic behaviors can increase the moral cost that supervisors incur if they collude with the banks.

\textsuperscript{21}Note that while 1,...,4 refer to both the contractual options and the states of the world, 0 only refers to the Flexible-Supervision contract.
is not informed about the riskiness of the bank) nor a high-risk bank (in both states 3 and 4) are willing to choose the Flexible Supervision contract. To this end, the following collection of incentive compatibility constraints is imposed:

\[
\begin{align*}
\pi_2 - r^{k_2} &\geq \pi_0 - r^{k_0} \quad \text{(IC20)} \\
\pi_3 - r^{k_3} &\geq \pi_0 - r^{k_0} \quad \text{(IC30)} \\
\pi_4 - r^{k_4} &\geq \pi_0 - r^{k_0} \quad \text{(IC40)}
\end{align*}
\]

The FSC maximizes the following objective function:

\[
\max_{k_i, \pi_i, w_i, i \in \{0, 2, 3, 4\}} \alpha \varepsilon [(1 - r) \Psi(k_0 - \lambda (\pi_0 - r^{k_0})) - (1 + \lambda) r^{k_0}] + \sum_{i=2}^{4} p_i [(1 - r_i) \Psi(k_i) - \lambda (\pi_i - r_i k_i) - (1 + \lambda) r_i k_i - \lambda w_i]
\]

subject to (PCi), (SPCi), (IC20), (IC30), (IC40), (CIC), \(i \in \{0, 1, 2, 3, 4\}\).

Proposition 1 states the main contribution of the paper. It characterizes the optimal contract when supervision is flexible.

**Proposition 1.** The optimal contract when the FSC uses Flexible in addition to Mandatory Supervision (fs) entails the following profits and capital requirements in equilibrium:

\[
\begin{align*}
\pi_{fs0} &= r^{k_{fs0}}, \\
\pi_{fs2} &= r^{k_{fs2}} + \Delta r k_{fs3}, \\
\pi_{fs3} &= r^{k_{fs3}}, \\
\pi_{fs4} &= r^{k_{fs4}}, \\
\psi'(k_{fs0}) &= (1 + \lambda) \frac{r}{1 - r}, \\
\psi'(k_{fs2}) &= (1 + \lambda) \frac{r}{1 - r}, \\
\psi'(k_{fs3}) &= (1 + \lambda) \frac{r}{1 - r} + \frac{\alpha k}{1 - r}, \\
\psi'(k_{fs4}) &= (1 + \lambda) \frac{r}{1 - r}.
\end{align*}
\]

The supervisor is paid \(w_i = 0\) for all \(i \in \{0, 2, 3, 4\}\). Off-the-equilibrium path, \(\pi_{fs1} = \pi_{fs0}\), \(w_{fs1} = \tau \Delta r k_{fs3}\), \(k_{fs1} = k_{fs0}\).

Proposition 1 shows that regulatory capture can be deterred at no cost with Flexible Supervision since the banker of the low-risk bank is induced to choose the Flexible Supervision contract is state 1. As a result, the distortion of the capital requirement imposed on the high-risk banks in state 3 is reduced with respect to the case in which supervision is always mandatory. It is important to stress that this mechanism is sustained by the FSC’s promise to pay the supervisor a reward \(w_1 = \tau \Delta r k_{fs3}\) off-the-equilibrium path. If \(w_1 < \tau \Delta r k_{fs3}\), then in state 1 the banker would prefer to be subjected to supervision, anticipating that he could strike a mutually beneficial agreement with the supervisor.

The intuition behind the welfare improving effects of Flexible Supervision is as follows: To minimize the dire consequences of regulatory capture, the screening of the riskiness of banking institutions does not necessarily require the involvement of a supervisor. Those banks which would have an incentive to capture a supervisor, namely those banks that could be certified as low-risk by a supervisor, should not be subjected to supervision and they should be able to opt for a self-certification of their riskiness. By doing so, the FSC would not need to pay a substantial reward to prevent regulatory capture. In turn, it would not need to distort downwards the capital invested by banks.
Moreover, it is worth noting that although banks are not always subjected to supervision, preventing regulatory capture through Flexible Supervision does not entail any loss of information. In other words, through this institutional arrangement, the FSC can elicit the same information as when supervision is always mandatory, without incurring any cost to deter regulatory capture. It follows that Flexible Supervision enables the FSC to achieve the same outcome as in the benevolent supervisor benchmark:

**Corollary 1.** *Optimal Flexible and Mandatory Supervision achieves the second best outcome.*

Moreover, it is worth pointing out that the second-best outcome is achieved irrespective of the quality of the institutional setting, namely, for all values of \( \tau \). It follows that higher gains from implementing Flexible Supervision can be achieved in those countries characterized by weak institutions or by the presence of a powerful banking lobby because the social cost of the distortions introduced by Mandatory Supervision in order to avoid capture increase with \( \tau \) (see Lemma 3).

Another important feature of Flexible Supervision is that it allows banks to choose whether or not to be subjected to supervision, which in turn allows some sorting of banks. In particular, the banks that would be subjected to supervision would be characterized by either a high or a low level of risk, while banks that would decide to bypass supervision would always have a low-risk profile.\(^{22}\)

It also has implications when considering some positive and small supervisory cost. Then, implementing Flexible Supervision would generate additional benefits as it would allow to screen the banks saving this supervisory cost in some states of nature. In state 1 the FSC would induce the banks not to be subjected to supervision so as to save the rent paid to the supervisor as well as the cost of supervision.

### 3.3 Policy Implications

The previous theoretical results imply that the second best outcome may be implemented via the introduction of a Flexible Supervision contract. Otherwise stated, when the supervisor is self-interested and her capture by the industry is a concern, then Flexible Supervision allows the achievement of the same outcome that would be obtained under benevolent supervision. It follows that, given the asymmetry of information, social welfare is maximal when the financial stability committee presents the banker with a menu of contracts in which both Mandatory and Flexible Supervision are present. This provides a rationale for enacting Flexible Supervision.

Mandatory and Flexible supervision may be interpreted as particular strategies in banking supervision. In practice, bank regulators generally apply different supervisory strategies to banks according to their riskiness and other soundness indicators. In general, riskier, more opaque and less capitalized banks deserve more attention by supervisors, with more on-site inspections and relatively more resources dedicated to their supervision. Eisenbach et al. (2016) find that more FED supervisory resources are spent on larger, more complex, and riskier banks.

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\(^{22}\)This fact has implications when considering a different timing of the model. Specifically, it does not matter if the FSC proposes the contract to the banker and the supervisor sequentially rather than simultaneously, as in the baseline model. If the banker opts for supervision, the FSC cannot infer with certainty whether the bank is high or low risk and finds it optimal to employ the supervisor to collect additional information.
One could associate this kind of supervisory regime with Mandatory Supervision. In this case, the focus of attention is on the application of the right regulation and requirements according to the characteristics of banks. Alternatively, less risky, more transparent and well capitalized banks are more likely to being supervised on distance (through what is called off-site supervision) and with a compliance focus, where supervision is less stringent as long as banks fulfill certain criteria. This kind of supervisory regime may be associated with what is called flexible supervision in this paper.

Indeed, when the Flexible Supervision contract is introduced in the model, then only the less risky (i.e. \( r = r^* \)), more capitalized banks (in particular those banks with the highest level of capital, i.e. \( k^{fs}_0 \)) such that \( \Psi'(k^{fs}_0) = (1 + \lambda) \frac{r^*}{1 - \lambda} \) and those banks that do not get any information rent because \( \pi^{fs}_0 = r_k^{fs} \) (i.e. transparent banks that reveal their type) are willing to self-select this supervisory contract. In such a case, the role of the supervisor is minimal. In turn, the self-selection of the supervisory regime by the bank and the less intense role of the supervisor is what allows averting the negative welfare effects of the capture of the supervisor by banks. More risky, less capitalized and more opaque banks do not choose the Flexible Supervision contract and are subject to the mandatory, more stringent supervisory regime.

Policy implications of these results are straightforward. Financial stability committees should avoid the welfare costs due to the threat of supervisory capture by enacting a Flexible Supervision regime in addition to the traditional Mandatory regime. Under these two regimes, the less risky banks are willing to signal their type by putting more capital at risk and being more transparent. In exchange, they are subject to a less stringent intervention by the supervisor which, in turn, reduces the scope for supervisory capture with welfare improving effects. This Flexible regime needs to be complemented with a more stringent, Mandatory Supervision regime applied to the rest of the banking system. Of course, the calibration of the thresholds to separate these regimes is an empirical, open question.

4 Extensions

In this section we consider several extensions to the baseline model and discuss their implications for the robustness of the previous section results. Proof and technicalities are in Appendix B. In particular, we show that the advantages of Flexible Supervision hold up when we consider (i) more than two levels of banks’ riskiness (Section 4.1); (ii) that the banker-supervisor coalition can forge information in addition to conceal it (Section 4.2); (iii) the simultaneous presence of benevolent and self-interested supervisors (Section 4.3); (iv) different timings of information (Section 4.4); (v) the possibility of ex ante collusion as long as the supervisor and the banker cannot credible commit to a side-contract (Section 4.5); and (vi) a monitoring effort that the banker can make to affect the riskiness of his bank’s portfolio (Section 4.6).

4.1 Multiple Levels of Bank’s Riskiness

One simplifying assumption that we have maintained throughout the paper is that there are only two levels of bank’s riskiness. In this section we discuss the main features of an extension to multiple levels of risks. The baseline model can be easily adapted to consider \( N \) possible
levels of risk $r \in \{r_1, r_2, ..., r_N\}$, with $r_i < r_j$ for any $i < j$. Denote by $\alpha_i$ the probability that $r = r_i$ with $\alpha_i \in (0, 1)$ for all $i$ and $\sum_{i=1}^{N} \alpha_i = 1$. As before, the supervisor observes a signal correlated with the bank’s true level of risk. The signal $\sigma$ can be either informative, i.e., $\sigma = r$, with probability $\varepsilon > 0$, or uninformative, i.e., $\sigma = \emptyset$, with probability $1 - \varepsilon$.

As in the baseline model, supervision mitigates the information gap existing between the FSC and banks. In Appendix B we derive optimal regulation for the multiple levels of riskiness case when the supervisor is benevolent (Lemma 6) and when there is no supervision (Lemma 7). These results are benchmarks for the results in this section.

Under Mandatory Supervision, avoiding the risk of capturing a self-interested supervisor exacerbates the distortion of the level of capital a bank puts at risk whenever the collected evidence is non-informative (the only exception is for the case of the lowest-risk bank as we will see next). Hence, the second-best solution, i.e. the optimal regulation when the supervisor is benevolent, cannot be attained under Mandatory Supervision. In this case, the FSC must promise a positive wage to the supervisor when she reports informative evidence about the bank’s riskiness. This salary is optimally set equal to the value to the supervisor of the maximum bribe a banker may be willing to pay to have the informative signal concealed, that is:

$$w^i_\sigma \geq \tau [B^i_\emptyset - B^i_i]$$

where the subscript denotes the level of risk reported by the banker and the superscript denotes the signal reported by the supervisor (henceforth, we follow this convention). The above capture-proof incentive compatibility constraint implies that preventing regulatory capture is costly and magnifies the distortion of the required levels of capital put at risk by the banks. In particular, the FSC maximizes the following objective function

$$W = \varepsilon \sum_{i=1}^{N} \alpha_i \left( (1 - r_i) \Psi(k^i) - \lambda w^i_\sigma - \lambda B^i_i - (1 + \lambda) r_i k^i \right)$$

subject to \((CIC_i)\), the supervisor’s participation constraints, and the following constraints. There are $2N$ participation constraints for the banker:

$$B^i_i = \pi^i_i - r_i k^i_i \geq 0$$

and

$$B^i_\emptyset = \pi^\emptyset_i - r_i k^\emptyset_i \geq 0$$

At the optimum the participation constraint of bank $N$ binds, since the highest-risk banker never finds it profitable to choose the contract designed for a different banker (See, for instance, Bolton and Dewatripont, 2005). Since the Spence-Mirrless single-crossing condition is satisfied, monotonicity holds and we can focus on local incentive compatibility constraints, that is it suffices that the FSC makes banker $i$ unwilling to choose the regulatory contract designed for
The local incentive compatibility constraints for each banker $i=1,\ldots,N-1$ may now be written as follows:

$$B_i^0 = \pi_i^0 - r_i k_i^0 \geq \pi_i^0 - r_i k_{i+1}^0 = B_{i+1}^0 + \frac{(r_{i+1} - r_i) k_i^0}{\Delta r_{i+1}}$$  \hfill (IC_i^0)$$

The following Lemma characterizes the optimal capture-proof contract under Mandatory Supervision.

**Lemma 4.** The optimal capture-proof contract under Mandatory Supervision entails the following salaries for the supervisor: $w_j^0 = 0$ for $j=1,\ldots,N$, and $w_i^j = \tau[B_i^j - B_i^j]$ for $i=1,2,\ldots,N$. The banker’s utility is $B_i^j = 0$, for $i=1,\ldots,N$, $B_j^0 = B_j^0 + \Delta r_{j+1} k_{j+1}^0$, for $j=1,\ldots,N-1$ and $B_N^0 = 0$. The bank’s required levels of capital at risk are such that $\Psi(k_i^0) = (1 + \lambda) \frac{r_i}{1 - r_i}$ for $i=1,\ldots,N$, $\Psi'(k_i^0) = (1 + \lambda) \frac{r_i}{1 - r_i}$, $\Psi'(k_j^0) = (1 + \lambda) \frac{r_j}{1 - r_j} + \frac{\sum_{i=1}^j \alpha_i}{\alpha_j} \lambda \frac{\Delta r_{j+1}}{1 - r_j}$, for $j=2,\ldots,N$.

Following the same reasoning as in the rest of the analysis, it is straightforward to see how the benefits of Flexible Supervision hold in this extended setting. Under Mandatory Supervision, banker $i$, with $i<N$, collects a rent only if $\sigma=\emptyset$, whereas if $\sigma=r_i$ a rent must be paid to the supervisor to avoid capture. Therefore, banker $i$ can be induced to bypass supervision when he is aware that the signal is informative. This can be achieved by simply offering the banker a rent at least equal to zero. The FSC should offer $N-1$ supervisor-free contracts $\{B_i^0, \pi_i^0\}$ to the banker, one for each possible level of risk, with the exception of the highest one. If the banker chooses one of the supervisor-free contracts, his bank bypasses supervision. This supervisor-free contract is set in such a way that banker $i$ is as well-off choosing it as he would have been had his bank been subjected to direct supervision. As this allows the FSC to overcome supervisory capture without causing any information loss, the level of welfare that can be achieved through Flexible Supervision is the same as when the supervisor is benevolent.

Formally, to induce banker $i$, with $i=1,\ldots,N-1$, to accept the supervisor-free contract when he is aware that the signal is informative, the FSC must impose the following incentive compatibility constraint:

$$B_i^0 = \pi_i^0 - r_i k_i^0 \geq \pi_i^0 - r_i k_{i+1}^0 = B_{i+1}^0$$  \hfill (IC_i^0)$$

The FSC must also make sure that other bankers are willing to choose the supervisor-free contract designed for banker $i$. This is achieved by setting two additional set of incentive constraints. The first one ensures that bankers whose signal is not informative cannot gain from choosing any supervisor-free option:

$$\pi_j^0 - r_j k_j^0 \geq \pi_i^0 - r_i k_i^0$$  \hfill (IC_{i,j}^0)$$

for all $i=1,\ldots,N-1$ and $j=1,\ldots,N$, with $j \neq i$. The second set of incentive constraints ensures that a banker $j$ whose signal is informative cannot gain from choosing the supervisor-free

[^23]: Monotonicity refers to the allocation rule, i.e. $k_i > k_j$ if $r_j > r_i$ for $j > i$. That the Spence-Mirrless condition is satisfied can be seen from:

$$\frac{\partial}{\partial r} \left[ \frac{\partial B/\partial k}{\partial B/\partial \pi} \right] > 0$$

Note that in this setting a higher type means a lower $r$. This must be taken into account when verifying that the single-crossing condition is verified.
option designed for banker $i$:  
$$\pi^j_i - r_j k^j_i \geq \pi^0_i - r_j k^0_i$$  
\((IC^0_{j,i})\) 

for all $i = 1, \ldots, N - 1$ and $j \neq i$. The FSC maximizes the following objective function:

$$W = \varepsilon \sum_{i=1}^{N-1} \alpha_i \left( (1 - r_i) \Psi(k^0_i) - \lambda B^0_i - (1 + \lambda) r_j k^0_i \right)$$

$$+ \varepsilon \alpha_N \left( (1 - r_N) \Psi(k^N_N) - \lambda w^N_N - \lambda B^N_N - (1 + \lambda) r_N k^N_N \right)$$

$$+ (1 - \varepsilon) \sum_{i=1}^{N} \alpha_i \left( (1 - r_i) \Psi(k^0_i) - \lambda w^0_i - \lambda B^0_i - (1 + \lambda) r_j k^0_i \right)$$

\((6)\) 

subject to \((IC^0_i), (IC^0_{0,i}), (IC^0_{j,i}), (CIC_i), (IC^0_j), (PC^i_j), (PC^0_i)\) and the supervisor’s participation constraints. The following Proposition characterizes the optimal capture-proof contract under Flexible Supervision.

**Proposition 2.** The optimal capture-proof contract when the FSC uses Flexible Supervision in addition to mandatory supervision entails the following salaries for the supervisor: $w^N_j = w^0_j = 0$ for $j = 1, \ldots, N$. The banker’s utility is $B^0_i = 0$ for $i = 1, \ldots, N - 1$; $B^0_j = B^0_{j+1} + \Delta r_j k^0_{j+1}$, for $j = 1, \ldots, N - 1$; and $B^0_N = B^N_N = 0$. The bank’s required levels of capital at risk are such that $\Psi'(k^0_i) = (1 + \lambda) r_i$ for $i = 1, \ldots, N - 1$, $\Psi'(k^1_i) = (1 + \lambda) \frac{r_i}{1 - r_i}$, $\Psi'(k^0_j) = (1 + \lambda) \frac{r_j}{1 - r_j}$, and $\sum_{j=1}^{i-1} \alpha_i \lambda \frac{\Delta r_j k^0_{j+1}}{1 - r_j}$, for $j = 2, \ldots, N$. $\Psi'(k^1_N) = (1 + \lambda) \frac{r_N}{1 - r_N}$.

*Off-the-equilibrium path, $w^i_i = \tau[B^0_i - B^1_i]$ for $i = 1, \ldots, N - 1$; $B^i_i = 0$, for $i = 1, \ldots, N - 1$; $\Psi'(k^i_i) = (1 + \lambda) \frac{r_i}{1 - r_i}$ for $i = 1, \ldots, N - 1$.*

Hence, in this more general setting regulatory capture can be costlessly prevented through Flexible Supervision. A banker can be presented with the possibility of bypassing direct supervision by accepting a specific regulatory profile which is design for his bank’s level of risk. These regulatory profiles are designed in such a way that the interaction between the banker and the supervisor is averted in those cases where otherwise the incentives for capture are the strongest. As a result, social welfare is the same as when regulatory capture is not a concern because the supervisor either cannot or does not want to conceal evidence.

From a qualitative standpoint, there are few differences with the baseline model. The bank which has the highest level of risk, i.e. $r = r_N$, is always scrutinized by a supervisor. Conversely, the other banks may or may not be subjected to a supervisory assessment. The regulatory profiles are such that a banker who knows that the supervisor would collect informative evidence about the true level of risk of his bank decides to bypass direct supervision by self-selecting the regulatory profile that has been designed for his bank. Flexible Supervision enables the FSC to alleviate the capital distortion as compared to a setting in which supervision is solely mandatory. Moreover, the second-best optimal regulation may be implemented. Although some banks choose not to be subjected to a supervisory assessment, there is no loss of information because the banker’s decision not to be scrutinized by the supervisor reveals information about his bank’s riskiness.
4.2 Soft Information

Thus far we have considered a setting in which the supervisor-banker coalition is only able to conceal evidence to the FSC because supervisory information was assumed to be hard. However, the riskiness of a bank may be non-verifiable by third parties because it may be based on soft information obtained during the asset quality assessment process by the supervisor. In this case supervisory information is soft and the banker and the supervisor may also be able to engage in manipulation of the bank’s documentation so as to produce bogus evidence. In this section, we study whether the benefits of Flexible Supervision carry over to a setting in which the supervisor-banker coalition can forge evidence, namely when information is soft for the coalition.

To study this situation we extend the baseline model by assuming that the supervisor can send a message \( m_s \in \{\bar{r}, r, \emptyset\} \) irrespective of the signal collected as long as the banker cooperates. It follows that forging evidence must be in the interest of both members of the coalition. Conversely, if the banker does not cooperate, the supervisor can send a message \( m_s \in \{r, \emptyset\} \) if \( \sigma = r \) and \( m_s = \emptyset \) if \( \sigma = \emptyset \). This is consistent with the idea that the banker’s cooperation is critical for the supervisor to manipulate evidence.

In practice, these assumptions give rise to additional capture opportunities. More precisely, the coalition has now a clear incentive to forge evidence and report that the bank is high-risk when the risk is actually low. By doing so, the banker would earn a rent that he could split with the supervisor. To prevent this type of capture, FSC must impose the following capture-incentive-compatibility constraints:

\[
(w_2 - w_4) \geq \tau (B_4 - B_2 + \Delta r k_4) \quad (CIC24)
\]

\[
(w_1 - w_4) \geq \tau (B_4 - B_1 + \Delta r k_4) \quad (CIC14)
\]

It is important to note that when \((CIC)\) and \((CIC24)\) are satisfied, \((CIC14)\) automatically holds.\(^{25}\)

We first characterize the optimal capture-proof contract when the FSC wants to implement Mandatory Supervision. We then show the welfare gains that can be achieved when the FSC adopts Flexible Supervision.

The following Lemma characterizes the optimal capture-proof contract under Mandatory Supervision.

**Lemma 5.** The optimal capture-proof contract when information is soft and supervision is mandatory (mss) entails:

If \( \tau < \frac{\varepsilon}{1 + \varepsilon} \):

(i) the following salaries for the supervisor \( w_i^{mss} = 0 \) for \( i = 3, 4 \), \( w_1^{mss} = \tau \Delta r k_4^{mss} \), and \( w_2^{mss} = \tau \Delta r (k_4^{mss} - k_3^{mss}) \);

(ii) the following profits for the bank: \( \pi_1^{mss} = \bar{r} k_1^{mss} \), \( \pi_2^{mss} = \bar{r} k_2^{mss} + \Delta r k_3^{mss} \), and \( \pi_j^{mss} = \bar{r} k_j^{mss} \) for \( j = 3, 4 \);

\(^{24}\)To put it differently, the banker has a veto power which limits the falsification ability of the supervisor.

\(^{25}\)We show this in Appendix B.
(iii) the following required bank’s levels of capital at risk: \( \Psi'(k_i^{\text{mass}}) = (1 + \lambda) \frac{\tau}{1-\eta} \) for \( i = 1, 2 \), 
\[ \Psi'(k_3^{\text{mass}}) = (1 + \lambda) \frac{\tau}{1-\eta} + \frac{\alpha}{1-\eta} (1-\tau) \lambda \frac{\Delta \tau}{1-\eta}, \] and 
\[ \Psi'(k_4^{\text{mass}}) = (1 + \lambda) \frac{\tau}{1-\eta} + \frac{\alpha}{(1-\eta)\epsilon} \tau \lambda \frac{\Delta \tau}{1-\eta}. \]

If \( \tau \geq \frac{\epsilon}{1-\eta} \):

(i) the following salaries for the supervisor \( w_i^{\text{mass}} = 0 \) for \( i = 2, 3, 4 \), \( w_1^{\text{mass}} = \tau \Delta r k_1^{\text{mass}} \) for \( j = 3, 4 \);

(ii) the following profits for the bank: \( \pi_1^{\text{mass}} = \tau k_1^{\text{mass}} \), \( \pi_2^{\text{mass}} = \tau k_2^{\text{mass}} + \Delta r k_j^{\text{mass}} \) for \( j = 3, 4 \), and 
\[ \pi_3^{\text{mass}} = \tau k_4^{\text{mass}} \] for \( j = 3, 4 \);

(iii) the following required bank’s levels of capital at risk: \( \Psi'(k_i^{\text{mass}}) = (1 + \lambda) \frac{\tau}{1-\eta} \) for \( i = 1, 2 \), 
\[ \Psi'(k_3^{\text{mass}}) = (1 + \lambda) \frac{\tau}{1-\eta} + \frac{\alpha}{1-\eta} \epsilon \tau + (1-\epsilon) \lambda \frac{\Delta \tau}{1-\eta} \] for \( j = 3, 4 \).

There are two alternative ways that the FSC can pursue to discourage all the capture opportunities. Their optimality critically depends on the weakness of the institutional setting, \( \tau \). In either case, as compared to the hard-information scenario, the presence of soft information gives rise to a distortion from the efficient level of the capital put at risk by the banker in state 4.

When \( \tau < \frac{\epsilon}{1+\epsilon} \), the institutions are relatively strong and the FSC prefers to deter capture in state 2 by rewarding the supervisor \( w_2^{\text{mass}} = \tau \Delta r k_2^{\text{mass}} - k_3^{\text{mass}} \). This increases the payment the supervisor receives in state 1, making it more costly to prevent the coalition from concealing evidence of low-risk. Note that in this region of the parameter values the FSC distorts the capital put at risk in state 4 less than in state 3.

When \( \tau \geq \frac{\epsilon}{1+\epsilon} \), the institutions are relatively weak and the rewards that should be paid to the supervisor to deter capture according to the previous mechanism would be inefficiently high. Therefore the FSC prefers to distort capital in state 4 as much as in state 3, i.e., \( k_2^{\text{mass}} = k_3^{\text{mass}} \). By doing so, a low-risk banker is indifferent between state 4 and state 3 and he will never try to capture the supervisor to forge evidence of high riskiness as long as (IC23) holds. As a result, the supervisor collects no rent in state 2 (\( w_2^{\text{mass}} = 0 \)).

We show in the Appendix B that welfare strictly decreases in the weakness of the institutional setting.

Irrespective of the strength of the institutional setting, we now show that Flexible Supervision improves social welfare. The intuition is that Flexible Supervision can be tailored in such a way that the banker decides not to be subjected to supervision in state 1, that is when the supervisor would collect a rent while the banker would not.\(^{26}\) This would allow the FSC to pay the supervisor’s reward only off-the-equilibrium path and mitigate the distortion of capital when the bank is high risk. However, when information is soft, flexible supervision does not fully eliminate the inefficiencies brought about by the threat of capture.

The FSC maximizes (3) subject to (PCI), (IC23), (IC01), (IC20), (IC30), (IC40), (CIC), (CIC24), with \( i \in \{0, 1, 2, 3, 4\} \). Proposition 3 characterizes the optimal contract when supervision is flexible and information is soft.
Proposition 3. The optimal capture-proof contract when information is soft and the FSC uses flexible supervision in addition to mandatory supervision (fss) entails:

If $\tau < \varepsilon$:

(i) the following salaries for the supervisor $w_i^{fss} = 0$ for $i = 3, 4$, and $w_2^{fss} = \tau \Delta r(k_4^{fss} - k_3^{fss})$;

(ii) the following profits for the bank: $\pi_0^{fss} = \tau k_0^{fss}$, $\pi_2^{fss} = \tau k_2^{fss} + \Delta r k_3^{fss}$, and $\pi_j^{fss} = \bar{r} k_j^{fss}$ for $j = 3, 4$;

(iii) the following required bank’s levels of capital at risk: $\Psi(k_i^{fss}) = (1 + \lambda) \frac{\bar{r}}{1 - \tau} + \frac{\alpha}{1 - \tau} (1 - \tau) \lambda \frac{\Delta r}{1 - \tau}$, and $\Psi'(k_4^{fss}) = \frac{\alpha}{1 - \alpha} \frac{1 - \varepsilon}{\varepsilon} \tau \lambda \frac{\Delta r}{1 - \tau}$; for $i = 0, 2$,

(iv) off-the-equilibrium path, $w_i^{fss} = \tau \Delta r k_4^{fss}$, $\pi_i^{fss} = \tau k_1^{fss}$, and $k_i^{fss} = k_0^{fss}$.

If $\tau \geq \varepsilon$:

(i) the following salaries for the supervisor $w_i^{fss} = 0$ for $i = 2, 3, 4$;

(ii) the following profits for the bank: $\pi_0^{fss} = \tau k_0^{fss}$, $\pi_2^{fss} = \tau k_2^{fss} + \Delta r k_3^{fss}$, and $\pi_j^{fss} = \bar{r} k_j^{fss}$ for $j = 3, 4$;

(iii) the following required bank’s levels of capital at risk: $\Psi'(k_3^{fss}) = (1 + \lambda) \frac{\bar{r}}{1 - \tau} + \frac{\alpha}{1 - \tau} (1 - \tau) \lambda \frac{\Delta r}{1 - \tau}$, and $\Psi'(k_4^{fss}) = \frac{\alpha}{1 - \alpha} \frac{1 - \varepsilon}{\varepsilon} \tau \lambda \frac{\Delta r}{1 - \tau}$; for $j = 3, 4$;

(iv) off-the-equilibrium path, $w_i^{fss} = \tau \Delta r k_4^{fss}$, $\pi_i^{fss} = \tau k_1^{fss}$, and $k_i^{fss} = k_0^{fss}$.

Again, the FSC can undertake two alternative methods to discourage all the capture opportunities, whose optimality is a function of $\tau$.

When $\tau < \varepsilon$, the FSC prefers to deter capture in state 2 by rewarding the supervisor $w_2^{fss} = \tau \Delta r(k_4^{fss} - k_3^{fss})$, which is paid on-the-equilibrium path. While this increases the payment the supervisor receives in state 1, $w_1^{fss}$ is paid only off the equilibrium path. Being aware that the supervisor would not accept to be captured, the low-risk banker will bypass supervision when the signal is informative. Thanks to Flexible Supervision, the distortion of capital in state 4 is mitigated with respect to Mandatory Supervision.

When $\tau \geq \varepsilon$, the rewards that should be paid to the supervisor on-the-equilibrium path to deter capture would be too high. Therefore the FSC prefers to distort capital in state 4 as much as in state 3, i.e., $k_3^{fss} = k_4^{fss}$.

It is immediate to see that Flexible Supervision entails lower distortions in the levels of capital put at risk than Mandatory Supervision. This is so irrespective of the strength of the institutional setting. Moreover, in Appendix B we show that welfare strictly decreases in the weakness of institutions only under the Mandatory Supervision regime. This is not the case under Flexible Supervision, as for $\tau \geq \varepsilon$, the quality of the institutional setting only affects the payment the supervisor receives off-the-equilibrium path.

Finally, the presence of soft-information bites as it prevents the FSC to achieve the benevolent supervisor’s level of welfare, as highlighted by the following corollary:
Corollary 2. Under soft information, the simultaneous use of Flexible and Mandatory Supervision strictly dominates a supervisory plan in which supervision is always mandatory but does not achieve the second-best outcome, i.e.: $W^{bs} > W^{fss} > W^{mss}$.

4.3 Benevolent and Self-interested Supervisors

We have considered two polar cases in the baseline model. One in which the supervisor is benevolent and another in which the supervisor is self-interested. In the latter case, we have shown how social welfare can be improved by complementing Mandatory Supervision with the Flexible Supervision regime. Arguably, in the real world, both types of supervisor may coexist and, as a result, it is important to determine whether our conclusion on the optimality of introducing Flexible Supervision would persist when we allow for the presence of a fraction of supervisors who are benevolent.

To this end, suppose that the supervisor is benevolent with probability $\beta \in (0, 1)$ and self-interested with probability $(1 - \beta)$. Her true type is her private information while both the banker and the FSC only know the probability distribution of the supervisor’s type. Note first that the FSC is unable to hire only benevolent supervisors and implement the second-best solution under Mandatory Supervision. Self-interested supervisors would pretend to be benevolent as they expect to pocket a side transfer from the banker in state 1.\textsuperscript{27}

If the FSC wants to implement the mandatory supervisory option it has two alternatives. First, it can prevent collusion by setting a reward to a supervisor who reports that the bank has a low-risk.\textsuperscript{28} Alternatively, the FSC can pay the supervisor a flat salary thereby inducing only a benevolent supervisor to report truthfully. A self-interested supervisor would collude with the banker in state 1.\textsuperscript{29} Regardless of the FSC’s favorite solution when supervision is mandatory, Flexible Supervision unambiguously increases welfare as it eliminates any additional distortion engendered by the presence of some self-interested supervisors or by the non perfect detectability of capture like in the baseline model.

4.4 Different Timings of Information

So far we have maintained the assumption that both the financial supervisor and the banker observe the signal $\sigma$ at the beginning of the game. This timing of information is reasonable if the financial supervisor is an expert and the banker is aware of the information technology

\textsuperscript{27}In fact, as argued in a different context by Mishra and Mookherjee (2012), absent wealth-constraints of supervisors, the FSC might benefit from auctioning off the right to supervise banks, in so selecting only self-interested supervisors. Unlike benevolent supervisors, corruptible ones would be willing to pay up to the expected value of the rents they expect to collect to be hired.

\textsuperscript{28}Note that this generates an unnecessary rent to a benevolent supervisor who would have unconditionally reported truthfully the bank’s riskiness.

\textsuperscript{29}Tolerating collusion implies that the low-risk bank achieves $\pi_2 > \pi_1$ also in state 1 with probability $(1 - \beta)$. This increases the downward distortion of capital in state 3. The relative efficiency of tolerating collusion increases in the probability that the supervisor is benevolent and in the strength of the institutional setting, namely in $1 - \tau$. Indeed, in an environment in which banking supervision is mandatory, the absence of rewards contingent on the content of the reports for the supervisors can be explained by the presence of strong institutions and high-moral standards of the civil servants tasked with supervising banking institutions. In a related vein, Giebe and Gurtler (2012) show that the leniency bias often observed in organizations (i.e. the practice of overstating employees’ performance) can be explained by incomplete information about the supervisors’ social preferences.
that is used to inspect the bank’s level of risk. However, this assumption is not critical for our main result concerning the benefits of a regulatory regime wherein both Mandatory and Flexible Supervision coexist. In this subsection, we highlight that its benefits carry through to different timings at which the information flows to the parties. The characteristics of the optimal contracts differ, though, and we give the details of the contracts in Appendix B. Below, we provide some intuition as to how Flexible Supervision should be tailored under alternative sequences of events.

In contrast to the baseline model, suppose that in stage 1 the banker observes the riskiness of his bank but is unaware of the supervisor’s signal. Initially, the banker only knows the distribution of $\sigma$, and will learn its realization just before the side-contracting opportunity arises. This scenario encompasses two alternative timings: one in which the supervisor privately learns $\sigma$ in stage 1 and one in which both the supervisor and the banker observe $\sigma$ after they have decided to participate. In this latter sequence of events, one can think of an inspection of the bank carried out by the supervisor, whose outcome is also observed by the banker. Irrespective of when the supervisor learns $\sigma$, as long as the banker is initially oblivious as to its realization the contractual solutions are affected as follows.

First, note that the optimal contract under Mandatory Supervision is unaltered, namely it is the same as that characterized in Lemma 3. The banker enjoys a rent when his bank is low-risk and it turns out that the supervisor has found out nothing (state 2). This is due to his ability to mimic a high-risk bank in state 3. The value of this rent is $\Delta r k_3$. To induce the informed supervisor to report that the bank is low-risk, the FSC must set a wage $w_1 = \tau \Delta r k_3$.

Second, when we allow for Flexible Supervision, the optimal contract differs from that characterized in Proposition 1, but it shares the same desirable feature of achieving the second-best outcome. In particular, Flexible Supervision always induces the banker to opt for the supervision-free contract when his bank is low-risk by setting this incentive compatibility constraint:

$$\pi_0 - r k_0 \geq \varepsilon (\pi_1 - r k_1) + (1 - \varepsilon) (\pi_2 - r k_2)$$

Conversely, the banker decides to be inspected when the bank’s risk is high thanks to the following incentive compatibility constraint:

$$\varepsilon (\pi_4 - r k_4) + (1 - \varepsilon) (\pi_3 - r k_3) \geq \pi_0 - r k_0$$

Intuitively, when the banker is initially unaware as to the supervisor’s signal, it is optimal for the FSC to offer a contract that induces the bankers to opt to bypass supervision whenever their banks are low-risk. The FSC can persuade the low-risk bankers to do so by offering the expected value of the information rent that they would obtain given that a supervisor would learn their true level of risk with probability $\varepsilon$. This information rent is equal to $(1 - \varepsilon) \Delta r k_3$. In expectation the low-risk bankers are at least as well-off by choosing the supervision-free contract as they would be under supervision. By implementing both Mandatory and Flexible Supervision, the FSC can save the reward it should pay to the supervisor and, as a consequence, the distortion of capital requirements is the same as when the supervisor is benevolent.

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30The same timing of events can be found in the classical model by Laffont and Tirole (1991).
Interestingly, under these different timings of events, low-risk bankers would always choose to bypass supervision whereas only high-risk bankers would always be supervised. Moreover, the low-risk bankers would always derive positive utility in expectation, whereas the participation constraints of the high-risk ones would always bind in expectation. This marks a significant departure from the sorting of high and low-risk banks described in Section 3, and highlights how implementing Flexible Supervision would require a clear understanding of the actual characteristics of how the information flows to the bankers.

4.5 No-collusion in the Participation Decisions

In the baseline model, we have assumed that the banker’s and supervisor’s decisions as to whether or not to participate are made non-cooperatively at the beginning of the game. As a consequence, the supervisor and the banker can only collude at stage 3 after they have both accepted the contract offered by the FSC. This assumption is sometimes referred to as no-collusion in participation decisions in the literature on collusion in hierarchies, and it is crucial for the effectiveness of Flexible Supervision. In order to clarify its role, we need to distinguish between two alternative cases. First, if the supervisor has the ability to credibly commit to a side-contract at the beginning of the game, then our mechanism cannot be implemented. The supervisor could promise the banker a positive rent in state 1 and, as a result, the banker would not choose the Flexible Supervision contract. Second, suppose instead that the supervisor lacks such commitment ability. Then, even if she agreed with the banker on reporting \( m_s = \emptyset \) in state 1 in exchange for a side transfer, ex-post she would rather report truthfully \( m_s = r \) so as to collect a salary from the FSC, which is at least as large as the maximum side transfer the banker would be willing to pay. Anticipating that the supervisor’s promise is time-inconsistent and fearing to be held-up, the banker of the low-risk bank would continue to choose a Flexible Supervision contract in state 1.

The implementation of Flexible Supervision crucially depends on the fact that the supervisor and the supervisee must not be able to credible collude ex-ante, namely before the supervisory information is collected. Since the repeated interaction of supervisors with their supervisees might make it more likely ex-ante collusion, then a potential remedy to this problem is to continuously reassign supervisors and retain a record of which supervisor is sent to inspect each bank. This is a standard prescription to make capture more difficult, which would continue to hold also if Flexible Supervision were implemented.

4.6 Monitoring effort of the banker

In the baseline version of the model (Section 2) we have assumed that the riskiness of the bank’s portfolio, \( r \), is exogenously given. In reality, bankers can at least partially control \( r \) by investigating the quality of the borrowers before investing the bank’s money. In this section, we

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31 Where low-risk bankers prefer to be supervised only when they know that the supervisor is not aware of their riskiness.

32 This assumption can also be found in a number of other papers in the literature on collusion in hierarchies (see Faure-Grimaud et al., 2003; Celik, 2009; Motta, 2012, and Burlando and Motta 2015). Some authors, such as Mookherjee and Tsunagari (2004), have departed from this assumption, analyzing a framework wherein the agents communicate before deciding whether or not to participate in the mechanism.

33 See Motta (2012).
enrich our model by assuming that the banker can choose a costly monitoring effort $e \in [0,1]$ to ex-ante check the quality of his bank’s investments. This exercise allows us to show another desirable feature of flexible supervision, namely that it implements the same level of monitoring effort that would be optimal when the supervisor is benevolent. The idea is intuitive: When the mandatory supervisory regime is complemented by Flexible Supervision, the players know that, along the equilibrium path, the payoffs of the continuation game would be as if the supervisor is benevolent.

In what follows we assume that the decision of $e$ is taken at the beginning of the timeline described in Section 2.6. The riskiness of the bank’s portfolio is then equal to $r$ (respectively, $\bar{r}$) with probability $e$ (resp., $1-e$). Exerting a monitoring effort $e$ implies a disutility of $\phi(e)$ to the banker. The function $\phi(\cdot)$ is such that $\phi(0) = 0$, $\phi(1) = \infty$, $\phi'(0) = 0$ and $\phi'(e) > 0$ for all $e \in (0,1]$, $\phi''(e) > 0$.\(^{34}\) The FSC makes a transfer $\pi^e$ to the bank to carry out monitoring. To focus on the beneficial effects of Flexible Supervision, we assume that the monitoring effort $e$ can be contracted upon by the FSC.

The timing of the enriched model is as follows: At time $(0.1)$, the FSC offers a monitoring-effort contract, which is a pair $(\pi^e, e)$. At time $(0.2)$ the banker accepts or rejects the offer. If the banker rejects, the game ends; if the banker accepts, at time $(0.3)$ the banker exerts effort and the game continues following the timeline described in the baseline model (Section 2.6).

Note that both the banker and the FSC take into account how the monitoring-effort choice will impact on the continuation-game payoffs.\(^{35}\) The following observation is shown in Appendix B:

**Observation 1.** The optimal level of monitoring effort required by the FSC when Flexible Supervision complements the Mandatory Supervision regime is the same as when the supervisor is benevolent, i.e., $e^{fs} = e^{bs}$. The optimal level of monitoring required by the FSC when there is only a Mandatory Supervision regime, $e^{ms}$ is such that $e^{ms} \neq e^{bs}$.

When the supervisor is benevolent, players expect the continuation-game payoffs to be as described by Lemma 1. As a result, the banker and the FSC knows that the choice of $e$ will only affect (i) the profit of the banker in state 2 ($r = r, \sigma = \emptyset$) and (ii) the capital put at risk by the risk banker in state 3 ($r = \bar{r}, \sigma = \emptyset$) in the continuation game. The FSC chooses the monitoring effort and the transfer which maximize the expected social welfare function in the continuation game under the ex-ante participation constraint of the banker. Since the banker’s continuation-game payoffs are the same when the supervisor is not benevolent and the FSC sets up a regulatory regime in which both mandatory and flexible supervision are present (see Proposition 1), it follows that the same level of monitoring effort will optimally be implemented.

In contrast, when the supervisor is not benevolent and supervision is mandatory for all banks, players expect the continuation-game payoffs to be as described by Lemma 3. There, the level of monitoring effort $e$ will also affect the continuation-game reward paid to the supervisor along the equilibrium path in state 1 ($r = r, \sigma = r$). This has countering effects on the optimal level of monitoring, $e^{ms}$, required by the FSC. On the one hand, $e$ has bigger returns

\(^{34}\)These assumptions just ensure that the optimal monitoring effort lies in the interval $(0,1)$.

\(^{35}\)Optimal profits, efforts and would be slightly different if the FSC would simultaneously determine $e, k,$ and, $\pi$ in stage $(0.1)$ and then hire the supervisor only at stage 1. However, the main conclusion of the Section, i.e., that Flexible Supervision allows to eliminate additional distortion to $e$, would still hold.
on the social welfare as it increases the probability of $r = z$ in the presence of a less efficient supervision mechanism; on the other hand, a bigger $e$ has an additional negative, indirect effect on the cost of inducing truthful reporting from the supervisor. Therefore, whether the optimal level of monitoring is bigger or lower than in the benevolent supervisor case is a-priori unclear. Regardless, $e^{ms}$ will be distorted away from the effort level set when the supervisor is benevolent. The analysis carried out in this section relies on two simplifying assumptions: First, it is assumed that the monitoring effort of the banker is contractible and second it is assumed that the supervisor is asked neither to monitor the quality of the bank’s investment nor the banker’s behavior.

Relaxing the first assumption would not alter the quality of the analysis presented above: As soon as the banker’s moral hazard is a concern, the FSC should provide the banker with incentives to exert the desired level of effort. This would exacerbate the distortion of the monitoring effort exerted by the banker, but again only by complementing Mandatory with Flexible Supervision the FSC would achieve the same outcome as in the benevolent supervisor case.

Conversely, charging the supervisor with a double supervisory task, i.e., asking her to supervise both the ex-ante banker’s monitoring effort and the ex-post riskiness of the bank’s portfolio would make collusion in the participation decisions easier to sustain, thereby undermining the beneficial effects of Flexible Supervision. Therefore, splitting the supervisory powers among different authorities might be welfare improving in this context, as already highlighted by the literature (see Laffont and Martimort 1999, Boyer and Ponce 2012). Previous contributions also suggested that the monitoring of the risk-taking behaviors of the banker should be de facto delegated to depositors or to external rating-agencies (see contribution cited in Barth et al. 2004), although this supervisory arrangement has shown clear limitations during the recent financial crisis (Eisenbach et al. 2016, Burguet et al. 2016).

5 Concluding Remarks

In this paper we have analyzed the welfare implications of introducing Flexible Supervision in addition to the traditional Mandatory Supervision contract. We have shown that a mechanism which avoids the interaction between bankers and supervisors in those states in which the bankers would be willing to capture the supervisors (i.e., Flexible Supervision) overcomes the threat of capture at no costs. In spite of the lack of interaction between supervisors and supervisees, the FSC is still able to obtain valuable information about the bank’s riskiness. This is so as the decision of bypassing supervision reveals information about the bank’s riskiness. As a result, Flexible Supervision accomplishes the main aim of supervision, namely that of bridging the information gap between the regulator and the bank, and aattains the second-best solution under asymmetric information and the threat of capture.

The results have important implications for the design of supervisory arrangements. A close supervision of banking institution is deemed necessary to foster financial stability but the costs

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36 See Marshall and Prescott (2006) for a financial regulation model where there are both adverse-selection and moral-hazard concerns. In their paper, risk depends on bank’s quality and on a screening effort, and neither is observed by the regulator.
it imposes on financial institutions are increasingly criticized. Flexible Supervision would enable
the regulator to obtain the same quality of information about the banks’ risk, while significantly
reducing welfare costs. Under Flexible Supervision, the less risky banks are willing to signal
their type by putting more capital at risk and being more transparent. In exchange, they are
subject to a less stringent intervention by the supervisor which, in turn, reduces the scope for
supervisory capture with welfare improving effects. This Flexible Supervision regime needs to be
complemented with a more stringent, Mandatory Supervision regime applied to the rest of the
banking system. Mandatory and Flexible Supervision may be interpreted as particular strategies
in banking supervision. In practice, bank supervisors generally apply different supervisory
strategies to banks according to their riskiness and other soundness indicators. Hence, the
results in this paper provide a rationale for this kind of supervisory strategies.

The welfare gains stemming from the implementation of Flexible Banking Supervision de-
pend on the strength of the institutions and of the banking lobby. When institutions are weak,
corruption is more pervasive and recent evidence (see Chen et al., 2015) points to a negative
relationship between banks’ stability and perception of corruption in a country, which makes the
benefits of Flexible Supervision all the more substantial.37 Furthermore, even in those countries
in which regulatory capture is a minor concern, Flexible Supervision may streamline regulation
saving on compliance costs, thereby reducing the bureaucratic burden.

The results are robust to a series of extensions to the basic model. A potential caveat to
implement Flexible Supervision is that the banker must not be able to capture the supervisor
ex-ante, namely before the latter collects the supervisory signal. A remedy to this problem
is to continuously reassign supervisors to banks, a standard practice which should continue if
Flexible Supervision were implemented.

37 More specifically, Chen et al. (2015) find that banks engage in more risky activities in those countries in
which the severity of corruption is higher. This finding is robust to different measures of a bank’s risk, which are
standard in the literature, like z-scores and ratio of non-performing loans.
Appendix A

Proof of Lemma 1

In state \( i \in \{1, 4\} \), the FSC maximizes

\[
\max_{k_i, \pi_i} W = (1 - r_i)\Psi(k_i) - \lambda(\pi_i - r_i k_i) - (1 + \lambda) r_i k_i
\]

subject to:

\[
\pi_i - r_i k_i \geq 0 \quad \text{(PCi)}
\]

with \( r_1 = \underline{r} \) and \( r_4 = \bar{r} \).

At the optimum, (BPCi) is binding: Otherwise the FSC would find it profitable to reduce the rent allocated to the bank. Hence, \( \pi_i = r_i k_i \). Replacing (BPCi) into the objective function we obtain a problem in \( k_i \) only:

\[
\max_{k_i} W = (1 - r_i)\Psi(k_i) - (1 + \lambda) r_i k_i.
\]

Taking partial derivative with respect to \( k_i \) and equalizing it to zero leads to:

\[
(1 - r_i)\Psi'(k_i) = (1 + \lambda) r_i
\]

If the signal is uninformative, the FSC does not distinguish between state 2 from state 3 and vice versa. Hence, the FSC imposes the following two incentive compatibility constraints in order to prevent a bank with a given riskiness to choose a contract designed for a bank with a different level of risk:

\[
B_2 = \pi_2 - \bar{r}k_2 \geq \pi_3 - \bar{r}k_3 = B_{23} \quad \text{(IC23)}
\]

\[
B_3 = \pi_3 - \bar{r}k_3 \geq \pi_2 - \bar{r}k_2 = B_{32} \quad \text{(IC32)}
\]

In states \( i \), with \( i \in \{2, 3\} \), the FSC maximizes

\[
\max_{k_2, k_3, \pi_2, \pi_3} W = \alpha[(1 - r)\Psi(k_2) - \lambda[\pi_2 - \bar{r}k_2] - (1 + \lambda)\bar{r}k_2] + (1 - \alpha)[(1 - \bar{r})\Psi(k_3) - \lambda[\pi_3 - \bar{r}k_3] - (1 + \lambda)\bar{r}k_3]
\]

subject to (IC23), (IC32) and

\[
\pi_2 - \bar{r}k_2 \geq 0 \quad \text{(PC2)}
\]

\[
\pi_3 - \bar{r}k_3 \geq 0 \quad \text{(PC3)}
\]

Using standard arguments we know that only (IC23) and (PC3) bind at the optimum. Hence, we can rewrite the objective function of the FSC as follows:

\[
\max_{k_2, k_3} W = \alpha[(1 - r)\Psi(k_2) - \lambda[\Delta r k_2] - (1 + \lambda)\bar{r}k_2] + (1 - \alpha)[(1 - \bar{r})\Psi(k_3) - (1 + \lambda)\bar{r}k_3]
\]

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taking partial derivatives with respect to $k_2$ and $k_3$ and setting them equal to zero we find:

$$(1 - r)\Psi'(k_2) = (1 + \lambda)\bar{r}$$

$$(1 - \bar{r})\Psi'(k_3) = (1 + \lambda)\bar{r} + \frac{\alpha}{1 - \alpha}\lambda\Delta r$$

From (IC23) and (PC3) it is immediate to retrieve the result stated in the text. \hfill \Box

**Proof of Lemma 2**

When the FSC maximizes (2) subject to (\text{PC}) and (\text{IC}), it can set the level of capital and the profit of the bank for all risk announcements.

Note that the optimal profit levels can be obtained from the two constraints which are binding at the optimum. If they were not, the FSC could reduce the profits so as to make the constraints bind. From (\text{PC}):

$$\bar{\pi} = \bar{r}\bar{k}$$

and plugging this value into the (\text{IC}):

$$\pi = rk + \bar{r}\bar{k} - r\bar{k} \frac{\Delta r}{\bar{k}}$$

Then, substituting these two values into (2), the principal’s program becomes:

$$\max_{k, \bar{k}} W = \alpha[(1 - r)\Psi(k) - \lambda\Delta r\bar{k} - (1 + \lambda)rk]$$

$$+ (1 - \alpha)[(1 - \bar{r})\Psi(\bar{k}) - (1 + \lambda)\bar{r}\bar{k}]$$

The first order condition with respect to the level of capital at risk required for the low-risk bank yields:

$$(1 - r)\Psi'(k) = (1 + \lambda)r$$

which is the same level that would have been required in a perfect-information environment, that is, the capital at risk of the low-risk bank is not distorted. In contrast, the first order condition with respect to the level of capital at risk required for the high-risk bank yields:

$$(1 - \alpha)((1 - \bar{r})\Psi'(\bar{k}) - (1 + \lambda)\bar{r}) = \alpha\lambda\Delta r$$

which can be straightforwardly rearranged as shown in the Lemma. Thus, the high-risk bank is required to be smaller than in the first best as $\Psi(\cdot)$ is an increasing and concave function. \hfill \Box

**Proof of Lemma 3**

The proof follows the same reasoning as in Lemma 2. The presence of the additional constraint, (CIC), negatively impacts on social welfare. That constraint binds at the optimum and therefore $w_1 = w_2 + \tau[B_2 - B_1]$. The FSC need not pay the supervisor a rent in states 2, 3, and 4 and the
banker need not receive a positive surplus in state 1. In contrast the banker expects to receive a surplus equal to $\Delta r k_3$ in state 2. Hence, $w_1 = \tau \Delta r k_3$. The FSC’s problem can be written as a function of $k_i$, $i \in \{1, 2, 3, 4\}$ only:

$$\max_{k_i, i \in \{1, 2, 3, 4\}} W = \alpha \varepsilon [(1 - r) \Psi(k_1) - (1 + \lambda)rk_1 - \lambda(\tau \Delta r k_3)] + \alpha(1 - \varepsilon)[(1 - \bar{r}) \Psi(k_2) - \lambda(\Delta r k_3) - (1 + \lambda)\bar{r}k_2]$$

$$+ (1 - \alpha)(1 - \varepsilon)[(1 - \bar{r}) \Psi(k_3) - (1 + \lambda)\bar{r}k_3] + (1 - \alpha)\varepsilon[(1 - \bar{r}) \Psi(k_4) - (1 + \lambda)\bar{r}k_4]$$

from which we can derive the following first-order conditions:

$$\frac{\partial W}{\partial k_1} = 0 \iff (1 - r) \Psi'(k_1^{ms}) = (1 + \lambda)\bar{r}$$

$$\frac{\partial W}{\partial k_2} = 0 \iff (1 - r) \Psi'(k_2^{ms}) = (1 + \lambda)\bar{r}$$

$$\frac{\partial W}{\partial k_3} = 0 \iff (1 - \bar{r}) \Psi'(k_3^{ms}) = (1 + \lambda)\bar{r} + \frac{\alpha(1 - \varepsilon(1 - \tau))\lambda \Delta r}{(1 - \alpha)(1 - \varepsilon)}$$

$$\frac{\partial W}{\partial k_4} = 0 \iff (1 - \bar{r}) \Psi'(k_4^{ms}) = (1 + \lambda)\bar{r}$$

The distortion of the bank’s required level of capital in state 3 reflects the trade-off existing between efficiency and the rent the FSC gives up to the banker in state 2 and to the supervisor in state 1. In contrast, the FSC can impose the first-best level of capital in the other states of the world.

It remains to show that, when supervision is mandatory, there is no loss of generality in assuming that (a) the supervisor reports $\sigma$ truthfully; (b) $\pi$, $k$, and $w$ are conditional on $m_b$, $m_s$ only; (c) there is no-side transfer in equilibrium, i.e. $b_i = 0$ for all $i$. Following Laffont and Tirole (1991) we first derive an upper bound to the expected welfare by determining those necessary conditions which must be satisfied by the final allocation in equilibrium. We then show that the solution presented in this Lemma allows to reach such upper bound.

When allowing for side-transfers, the utility functions of the banker and the supervisor can be written as follows:

$$\hat{B}_i = \pi - r_i k_i - b_i$$

$$\hat{S}_i = w_i + \tau b_i$$

Note that for all $i$ it must be that:

$$\hat{B}_i \geq 0 \quad \text{(A1)}$$

$$\hat{S}_i \geq 0 \quad \text{(A2)}$$

If either of these inequalities is violated, one of the parties refuses to participate - recall that
supervision is mandatory. Next consider that

\[ \hat{B}_2 \geq \hat{B}_3 + \Delta r k_3 \]  

(A3)

This is because in state 2 the bank is the only one to know that \( r = \hat{r} \) and it can choose the contract designed for type \( \hat{r} \) in state 3 getting its payoff, \( \hat{B}_3 \) as well as a rent \( \Delta r k_3 \). Finally,

\[ \hat{S}_1 - \hat{S}_2 \geq \tau(\hat{B}_2 - \hat{B}_1) \]  

(A4)

In state 1 the bank and the supervisor can always agree on a side-contract to report that the state is 2. This implies the above condition on the equilibrium allocations.\(^{38}\)

The expected social welfare can be written as:

\[ W = \sum_{i=1}^{4} p_i((1 - r_i)\Psi(k_i) + \hat{B}_i + \hat{S}_i - (1 + \lambda)(w_i + \pi_i)) \]   

(A5)

That is,

\[
W = \sum_{i=1}^{4} p_i((1 - r_i)\Psi(k_i) + (\pi_i - r_i k_i - b_i) + (w_i + \tau b_i) - (1 + \lambda)(w_i + \pi_i))
\]

\[
W = \sum_{i=1}^{4} p_i((1 - r_i)\Psi(k_i) - r_i k_i - (1 - \tau)b_i - \lambda(w_i + \pi_i))
\]

\[
W = \sum_{i=1}^{4} p_i((1 - r_i)\Psi(k_i) - \lambda w_i - \lambda(\pi_i - r_i k_i) - (1 - \tau)b_i - (1 + \lambda)r_i k_i)
\]

\[
W = \sum_{i=1}^{4} p_i((1 - r_i)\Psi(k_i) - \lambda(w_i + \tau b_i) - \lambda(\pi_i - r_i k_i - b_i) - (1 + \lambda)(r_i k_i + (1 - \tau)b_i))
\]

that leads to:

\[ W = \sum_{i=1}^{4} p_i((1 - r_i)\Psi(k_i) - \lambda \hat{S}_i - \lambda \hat{B}_i - (1 + \lambda)(r_i k_i + (1 - \tau)b_i)) \]  

(A6)

To find an upper bound to \( EW \), we only impose constraints (A1)-(A4) while we ignore other potential constraints.

Since it is costly to give up rents to the supervisor and the bank, the upper bound must satisfy \( \hat{S}_i = 0 \) for \( i = 2, 3, 4 \) and \( \hat{B}_3 = \hat{B}_4 = 0 \). Also having side-transfers is costly and as a result \( b_i = 0 \) for all \( i \). From condition (A3), it follows that \( \hat{B}_2 = \Delta r k_3 \) and \( \hat{B}_1 = 0 \) can be obtained from replacing the condition \( \hat{S}_1 = \tau(\hat{B}_2 - \hat{B}_1) \) in the expression of the expected social welfare and maximizing it with respect to \( \hat{B}_1 \) under the constraint \( \hat{B}_1 \geq 0 \). Hence, \( \hat{S}_1 = w_1 = \tau \hat{B}_2 = \tau \Delta r k_3 \).

It is immediate to see that the collusion-proof solution where the contracts are based on \( m_s \) and \( m_b \) only reaches the upper bound of the expected social welfare.
Proof of Proposition 1

We follow the same strategy proof as in the above lemmas. We first determine which constraints
bind at the equilibrium. At the optimum, the banker’s participation constraints in states 1, 3, 4 and when he chooses the supervision-free option 0 must bind. Formally we have

\[ \pi_i = k_i r_i \]

for \( i \in \{0, 1, 3, 4\} \). The profit in state 2 must satisfy (IC23), hence:

\[ \pi_2 = rk_2 + \Delta rk_3 \]

The transfers paid to the supervisor can all be set equal to zero, with the exception of \( w_1 \), which
is paid off the equilibrium and must be equal to the value of the maximum bribe the banker
would be willing to pay in state 1 if he decides to be subjected to supervision, that is:

\[ w_i = 0 \text{ for } i = 2, 3, 4; \quad w_1 = \tau \Delta rk_3 \]

Replacing all these equations in the FSC’s problem (4) leads to:

\[
\max_{k_i, i \in \{0,2,3,4\}} \quad W = \alpha \varepsilon \left[ (1 - \bar{r}) \Psi(k_0) - (1 + \lambda)\bar{r} k_0 \right] + \alpha (1 - \varepsilon) \left[ (1 - \bar{r}) \Psi(k_2) - \lambda (\Delta rk_3) - (1 + \lambda) \bar{r} k_2 \right] \\
+ (1 - \alpha)(1 - \varepsilon) \left[ (1 - \bar{r}) \Psi(k_3) - (1 + \lambda) \bar{r} k_3 \right] + (1 - \alpha) \varepsilon \left[ (1 - \bar{r}) \Psi(k_4) - (1 + \lambda) \bar{r} k_4 \right]
\]

Maximization with respect to \( k_i \), for \( i = 0, 2, 3, 4 \) yields the following first-order conditions:

\[
\frac{\partial W}{\partial k_0} = 0 \iff (1 - \bar{r}) \Psi'(k_{0}^{fs}) = (1 + \lambda) \bar{r} \\
\frac{\partial W}{\partial k_2} = 0 \iff (1 - \bar{r}) \Psi'(k_{2}^{fs}) = (1 + \lambda) \bar{r} \\
\frac{\partial W}{\partial k_3} = 0 \iff (1 - \bar{r}) \Psi'(k_{3}^{fs}) = (1 + \lambda) \bar{r} + \frac{\alpha \lambda \Delta r}{(1 - \alpha)} \\
\frac{\partial W}{\partial k_4} = 0 \iff (1 - \bar{r}) \Psi'(k_{4}^{fs}) = (1 + \lambda) \bar{r}
\]

Without loss of generality we can set \( \pi_1^{fs} = \tau k_1^{fs} \) with \( k_1^{fs} \) satisfying the equation \( (1 - \bar{r}) \Psi'(k_{1}^{fs}) = (1 + \lambda) \bar{r} \).

The banker of a high-risk bank never chooses the non-supervision option whereas the banker of a
low-risk bank prefers to be supervised when he knows that the supervisor collects uninformative
evidence so as to earn a positive rent.

It is straightforward to see that the distortion in the level of capital put at risk by a bank in
state 3 and the rent collected by the bank in state 2 are equivalent to those of second-best as
remarked in Corollary 1. Then, the FSC is able to achieve the same expected welfare as in the
benevolent-supervisor benchmark even when the supervisor is self-interested by adopting this
regulatory arrangement.
Appendix B

Multiple Levels of Bank’s Riskiness

Suppose that there are \( N \) possible levels of risk. A bank’s level of risk is denoted by \( r \in \{r_1, r_2, \ldots, r_N\} \), with \( r_i < r_j \) for any \( i < j \). Denote by \( \alpha_i \) the probability that \( r = r_i \) with \( \alpha_i \in (0, 1) \) for all \( i \) and \( \sum_{i=1}^{N} \alpha_i = 1 \). As before, the supervisor observes a signal correlated with the bank’s true level of risk. The signal \( \sigma \) can be either informative, i.e. \( \sigma = r \) with probability \( \epsilon > 0 \), or uninformative, i.e. \( \sigma = \emptyset \) with probability \( 1 - \epsilon \).

**Benchmarks**

When there is a benevolent supervisor, the regulatory contract also depends on the supervisor’s report and may entail a payment to the supervisor \( w \). Salaries, banks’ profits, and levels of capital put at risk are functions of both the supervisor’s report, \( m_s \), and the banker’s message, \( m_b \). Namely, the regulatory contract is a triple \( \{k_i(m_b, m_s), \pi_i(m_b, m_s), w_i(m_b, m_s)\} \). As in the two level of risk case, when the supervisor is benevolent, the FSC need not pay a positive wage to the supervisor to avoid capture and induce truthful revelation of the signal. Therefore, a banker whose bank’s level of risk is not the highest collects a rent only if \( \sigma = \emptyset \). This allows the FSC to mitigate the distortion of the levels of capital put at risk by the banks. The FSC maximizes Equation (5) subject to \((IC^i_s), (PC^i_s), (PC^\emptyset_s)\) and the supervisor’s participation constraints. The following Lemma characterizes the optimal contract when the supervisor is benevolent.

**Lemma 6.** The optimal contract when the supervisor is benevolent entails the following salaries for the supervisor: \( w_i^0 = w_i = 0 \) for \( i = 1, ..., N \). The banker’s utility is \( B_i^0 = 0 \), for \( i = 1, ..., N \), \( B_j^0 = B_{j+1}^0 + \Delta r_j k_{j+1}^0 \), for \( j = 1, 2, ..., N - 1 \) and \( B_N^0 = 0 \). The bank’s required levels of capital at risk are such that \( \Psi'(k_i^j) = (1 + \lambda) \frac{r_j}{1-r_j} \) for \( i = 1, ..., N \), \( \Psi'(k_i^j) = (1 + \lambda) \frac{r_j}{1-r_j} + \sum_{j=1}^{i-1} \frac{\alpha_i \lambda \Delta r_j}{\alpha_j} \frac{1}{1-r_j} \), for \( j = 2, ..., N \).

**Proof.** As the supervisor is benevolent, she will not receive a rent at the optimum. Hence her participation constraint always binds. The banker’s participation constraint always binds when the signal is informative, i.e. \((PC^i_s)\) bind for all \( i = 1, ..., N \). The banker with the highest level of risk cannot attain any positive rent, even when the signal is not informative, i.e. \((PC^\emptyset_s)\) binds. To minimize the rent given up to the banker in the other states, \((IC^i_s)\) binds at the optimum. The FSC’s maximization problem can then be rewritten as follows:

\[
W = \max_{\{k_i^j, k_i^\emptyset\}} \sum_{i=1}^{N} \alpha_i \left( (1 - r_i) \Psi(k_i^j) - (1 + \lambda)r_i k_i^j \right) + (1 - \varepsilon) \sum_{i=1}^{N} \alpha_i \left( (1 - r_i) \Psi(k_i^\emptyset) - \lambda \left[ \sum_{j=1}^{N} \Delta r_j k_j^\emptyset \right] - (1 + \lambda)r_i k_i^\emptyset \right)
\]

whose first-order conditions yield the values of capital reported in the Lemma.
In the absence of a supervisor, the regulatory contract is \( \{ k_i(m_b), \pi_i(m_b) \} \) where \( m_b \) is the self-reported level of risk of a banker. The financial stability committee must set both participation and incentive compatibility constraints to induce the bankers to accept a regulatory contract and to report truthfully the level of risk of their bank:

\[
B_i = \pi_i - r_i k_i \geq 0 \quad (PC_i)
\]

for all \( i \in \{1, \ldots, N\} \) and

\[
B_i = \pi_i - r_i k_i \geq \pi_j - r_i k_j = B_{ij} \quad (IC_{ij})
\]

for all \( i, j \in \{1, \ldots, N\} \).

Since monotonicity holds, then we can focus on local incentive compatibility contraints only:

\[
B_i = \pi_i - r_i k_i \geq \pi_i + 1 - r_i k_i + 1 = B_{i+1} + (r_{i+1} - r_i) k_{i+1} \quad (IC_i)
\]

The FSC can choose the levels of capital and, indirectly, the bankers’ utility levels to maximize social welfare:

\[
\sum_{i=1}^{N} \alpha_i[(1 - r_i)\Psi(k_i) - \lambda B_i - (1 + \lambda) r_i k_i]
\]

As a result, (i) every banker but the one whose bank has the highest risk obtains a rent in equilibrium; (ii) the level of capital of each bank is distorted away from efficiency, with the exception of the one whose level of risk is the lowest. The distortion of bank \( i \)'s capital depends positively on \( \lambda \), the difference in the risk level with \( i - 1 \), and the cumulative probability that the bank has a lower levels of risk, i.e. \( \sum_{j=1}^{i-1} \alpha_j \alpha_i \lambda \), whereas it depends negatively on \( \alpha_i \).

**Lemma 7.** In the optimal no supervision contract, the banker’s utility is \( B_i = B_{i+1} + \Delta r_{i+1} k_{i+1} \) for \( i = 1, \ldots, N - 1 \) and \( B_N = 0 \). The optimal levels of capital put at risk are:

\[
\Psi'(k_1) = (1 + \lambda) \frac{r_1}{1 - r_1}
\]

and

\[
\Psi'(k_i) = (1 + \lambda) \frac{r_i}{1 - r_i} + \sum_{j=1}^{i-1} \frac{\alpha_j \lambda \Delta r_j}{\alpha_i 1 - r_i} \text{ for } i = 2, \ldots, N.
\]

**Proof.** Since at the optimum \( PC_N \) and \( IC_i \) bind for all \( i = 1, \ldots, N - 1 \), the FSC’s maximization problem becomes:

\[
\max_{k_1, \ldots, k_N} \sum_{i=1}^{N} \alpha_i \left( (1 - r_i)\Psi(k_i) - \lambda \left[ \sum_{j=i+1}^{N} \Delta r_j k_j \right] - (1 + \lambda) r_i k_i \right)
\]

First-order conditions yield the values of capital reported in the Lemma.

**Proof of Lemma 4**

The proof is similar to that of Lemma 3. All the capture incentive compatibility constraints and the incentive compatibility constraints bind at the optimum. Therefore, the FSC need not pay the supervisor a rent when the signal is not informative or when the banker could not earn
anything by capturing the supervisor, namely when the level of risk is the highest. However, the supervisor must receive a rent to reveal information when the signal is informative and the bank’s risk level is not the highest. Along similar lines, the banker need not receive a rent when the signal is informative or when the signal is uninformative but the level of risk is the highest. In contrast, the banker expects to receive some positive surplus when the signal is not informative and the level of risk is not the highest. The FSC’s maximization problem can thus be rewritten as a function of $k_i^0$ and $k_i^1$:

$$W = \max_{\{k_i^0\}, \{k_i^1\}} \varepsilon \sum_{i=1}^{N} \alpha_i \left( (1 - r_i)\Psi(k_i^0) - \lambda \left( \sum_{j=i+1}^{N} \Delta r_j k_j^0 \right) - (1 + \lambda)r_i k_i^0 \right) + (1 - \varepsilon) \sum_{i=1}^{N} \alpha_i \left( (1 - r_i)\Psi(k_i^1) - \lambda \left( \sum_{j=i+1}^{N} \Delta r_j k_j^1 \right) - (1 + \lambda)r_i k_i^1 \right)$$

whose first-order conditions yield the values of capital reported in the Lemma.

**Proof of Proposition 2** The proof is similar to that of Proposition 1. The $(IC_i^0)$ bind at the optimum for all $i = 1, ..., N - 1$, and so do the $(PC_i^j)$ for all $i = 1, ..., N$ and $(PC_N^0)$. As a result, $B_i^0 = B_i^1 = B_N^0 = 0$. The supervisor’s participation constraints also bind and so do all the $(CIC_i)$, which affect the salaries the supervisor receives off-the-equilibrium path. The $(IC_i^0)$ bind at the optimum and imply that $B_i^0 = B_{i+1}^0 + \Delta r_{i+1} k_{i+1}^0$ for $i = 1, ..., N - 1$. As a result, the FSC’s maximization program becomes:

$$W = \varepsilon \sum_{i=1}^{N-1} \alpha_i \left( (1 - r_i)\Psi(k_i^0) - (1 + \lambda)r_i k_i^0 \right) + \varepsilon \alpha_N \left( (1 - r_N)\Psi(k_N^N) - (1 + \lambda)r_N k_N^N \right) + (1 - \varepsilon) \sum_{i=1}^{N} \alpha_i \left( (1 - r_i)\Psi(k_i^0) - \lambda \left( \sum_{j=i+1}^{N} \Delta r_j k_j^0 \right) - (1 + \lambda)r_i k_i^0 \right)$$

whose first-order conditions yield the values of capital reported in the proposition. Off the equilibrium path the FSC can set $(1 - r_i)\Psi'(k_i^0) = (1 + \lambda)r_i$ for $i = 1, ..., N - 1$, without loss of generality. Finally, notice that both $(IC_{0,i}^0)$ and $(IC_{j,i}^0)$ hold. A banker who knows that the signal is informative and whose level of risk is not the highest will choose the supervisor-free option designed for him. In contrast a banker who knows that the signal is not informative will prefer to be subjected to direct supervision.

**Soft Information**

**Proof of Lemma 5.**

First note that $(CIC24)$ and $(CIC)$ imply $(CIC14)$. Intuitively, the coalition has no incentive to forge evidence of high riskiness in state 1 when it is already unprofitable to do so in state 2. The FSC maximizes 3 subject to $(CIC)$, $(IC23)$, $(CIC24)$, $(PC_i)$, $(SPC_i)$ for all $i = 1, 2, 3, 4$. 

38
Note that the FSC can prevent collusion by rewarding the supervisor when she reports \( m_s = \emptyset \) and the banker reports \( m_b = r \). This is achieved by imposing the following capture-incentive compatibility constraint:

\[
w_2 - w_4 \geq \tau[B_4 - B_2 + \Delta r k_4] \tag{CIC24}
\]

As a result, the FSC gives up a rent to the banker only in state 2, i.e. \( B_2^{mass} = \Delta r k_3^{mass} \), whereas \( B_1^{mass} = B_3^{mass} = B_4^{mass} = 0 \) because the participation constraint binds in the other states. The supervisor receives the following salaries:

- \( w_4^{mass} = 0 \) since the supervisor’s participation constraint binds. Note that the supervisor need not receive a positive compensation to report that the bank is high-risk;

- \( w_2^{mass} = \max\{\tau \Delta r (k_4^{mass} - k_3^{mass}), 0\} \). This is obtained from \((CIC_{24})\) once we replace \( B_2^{mass}, B_4^{mass}, w_4^{mass} \) with their optimal values, and from the supervisor’s participation constraint in state 2;

- to satisfy \((CIC)\), the FSC sets

\[
w_1^{mass} = w_2^{mass} + \tau B_2^{mass} = \max\{\tau \Delta r (k_4^{mass} - k_3^{mass}), 0\} + \tau \Delta r k_3^{mass}; \tag{COND}
\]

- finally \( w_3^{mass} = 0 \) whenever \( k_2 > k_4 \). To see why this is the case, consider that it does not create an incentive for the banker-supervisor coalition to collude to report \( m_s = \emptyset \) and \( m_b = r \) in state 3. Note that the supervisor would be willing to pay as much as \( w_2^{mass} \) to persuade the banker to misreport risk. The banker in state 3 would accept the supervisor’s maximum bribe if and only if:

\[
\tau w_2^{mass} + \pi_2^{mass} - \bar{r} k_2^{mass} \geq \pi_3^{mass} - \bar{r} k_3^{mass}
\]

Note that the right-hand side is \( B_3^{mass} = 0 \) and the above can be rewritten as:

\[
\tau^2 \Delta r (k_4^{mass} - k_3^{mass}) + B_2^{mass} - \Delta r k_2^{mass} \geq 0
\]

Since \( B_2^{mass} = \Delta r k_3^{mass} \),

\[
\tau^2 \Delta r (k_4^{mass} - k_3^{mass}) - \Delta r (k_2^{mass} - k_3^{mass}) \geq 0
\]

which is never satisfied since we assume \( k_2 > k_4 \). Below we show that this always holds at the optimum.

The required bank’s levels of capital at risk in the case in which \((COND)\) is satisfied for \( k_4 > k_3 \) are determined after plugging into (3) the salaries and the banker’s utilities:

\[
\max_{k_i, \epsilon \in \{1,2,3,4\}} \ W = \alpha \epsilon \left[ (1-\epsilon) \Psi(k_1) - (1 + \lambda) \bar{r} k_1 - \lambda(\tau \Delta r k_4) \right] + \alpha (1-\epsilon) \left[ (1-\epsilon) \Psi(k_2) - (1 + \lambda) \bar{r} k_2 - \lambda \Delta r k_3 (1 - \tau) - \lambda \tau \Delta r k_4 \right] + (1 - \alpha)(1-\epsilon) \left[ (1-\epsilon) \Psi(k_3) - (1 + \lambda) \bar{r} k_3 + (1 - \alpha) \epsilon \left[ (1 - \bar{r}) \Psi(k_4) - (1 + \lambda) \bar{r} k_4 \right] \right]
\]
from which we can derive the following first-order conditions:

\[
\frac{\partial W}{\partial k_1} = 0 \Leftrightarrow (1 - \bar{r})\Psi'(k_1^{mss}) = (1 + \lambda)\bar{r}
\]

\[
\frac{\partial W}{\partial k_2} = 0 \Leftrightarrow (1 - \bar{r})\Psi'(k_2^{mss}) = (1 + \lambda)\bar{r}
\]

\[
\frac{\partial W}{\partial k_3} = 0 \Leftrightarrow (1 - \bar{r})\Psi'(k_3^{mss}) = (1 + \lambda)\bar{r} + \frac{\alpha}{1 - \alpha} \lambda (1 - \tau) \Delta r
\]

\[
\frac{\partial W}{\partial k_4} = 0 \Leftrightarrow (1 - \bar{r})\Psi'(k_4^{mss}) = (1 + \lambda)\bar{r} + \frac{\alpha}{1 - \alpha} \lambda \tau \Delta r
\]

Note that (i) \( k_2 \) is always greater than \( k_4 \) and (ii) this solution holds only as long as \( k_4 > k_3 \), that is when \( \Psi'(k_3) > \Psi'(k_4) \), which requires:

\[
\frac{\varepsilon}{1 + \varepsilon} > \tau
\]

that is \( \tau \) sufficiently small. When the above inequality is not satisfied, \( w_2^{mss} = 0 \) and \( k_3^{mss} \) should be (weakly) greater than \( k_4^{mss} \).

However, since it is inefficient to distort \( k_4 \) away from efficiency more than \( k_3 \), the best the FSC can do is to set \( k_4 = k_3 = k_j \).

Therefore, \( B_2^{mss} = \Delta r k_j \). The FSC chooses \( k_1^{mss}, k_2^{mss}, k_j^{mss} \) to maximize the following program once the optimal level of the supervisor’s salary and bank’s profits are plugged into (3):

\[
\max_{k_1, i \in \{1, 2, j\}} W = \alpha \varepsilon [(1 - \bar{r})\Psi(k_1) - (1 + \lambda)\bar{r}k_1 - \lambda (\tau \Delta r k_j)]
\]

\[
+ \alpha (1 - \varepsilon) [(1 - \bar{r})\Psi(k_2) - \lambda (\Delta r k_j) - (1 + \lambda)\bar{r}k_2]
\]

\[
+ (1 - \alpha) [(1 - \bar{r})\Psi(k_j) - (1 + \lambda)\bar{r}k_j]
\]

from which we can derive the following first-order conditions:

\[
\frac{\partial W}{\partial k_1} = 0 \Leftrightarrow (1 - \bar{r})\Psi'(k_1^{mss}) = (1 + \lambda)\bar{r}
\]

\[
\frac{\partial W}{\partial k_2} = 0 \Leftrightarrow (1 - \bar{r})\Psi'(k_2^{mss}) = (1 + \lambda)\bar{r}
\]

\[
\frac{\partial W}{\partial k_j} = 0 \Leftrightarrow (1 - \bar{r})\Psi'(k_j^{mss}) = (1 + \lambda)\bar{r} + \frac{\alpha}{1 - \alpha} [1 - (1 - \tau)] \lambda \Delta r
\]

The distortion of the bank’s required level of capital in states 3 and 4 reflects the trade-off existing between efficiency and the rent the FSC gives up to the bank in state 2 and to the supervisor in state 1. In contrast, the FSC can impose the first-best level of capital in the other states of the world.

Intuitively, when information is soft there are two alternative policies the FSC can follow to prevent capture. The first is to destroy the incentives of the banker-supervisor coalition to strike a side agreement by rewarding the supervisor in state 2. This makes it irrational for the
supervisor to manipulate evidence with the cooperation of the banker and report that the state is 4. The second is to destroy the incentives of the banker to capture the supervisor by making the low risk banker in state 2 unwilling to mimic the banker in state 4 even if it were possible without the cooperation of the supervisor, i.e., if the supervisor could be captured at no cost. A simple application of the Envelope Theorem shows that welfare is strictly decreasing in $\tau$.

**Proof of Proposition 3**

We first determine which constraints bind at the equilibrium. At the optimum, the banker’s participation constraints in states $1, 3, 4$ and when he chooses the supervision-free option 0 must bind. Formally we have

$$\pi_{fs}^{i} = k_{fss}^{i} r_{i}$$

for $i \in \{0, 1, 3, 4\}$. The profit in state 2 must satisfy (IC23), hence:

$$\pi_{2}^{fss} = r k_{2}^{fss} + \Delta r k_{3}^{fss}$$

In contrast with Proposition 1, only $w_{3}^{fss}$ and $w_{4}^{fss}$ can always be set equal to zero. Whereas, akin to the mandatory supervisory case, the FSC finds it optimal to discourage the additional capture concerns by setting both $w_{1}^{fss}, w_{2}^{fss} > 0$ only when $\tau$ is small enough.\(^{39}\)

When this is the case, preventing forgery of evidence by rewarding the supervisor in equilibrium is not overly costly and, as a result, the FSC can distort $k_{4}^{fss}$ less than $k_{3}^{fss}$.

To satisfy (CIC24), the FSC sets $w_{2}^{fss} = \tau \Delta r (k_{4}^{fss} - k_{3}^{fss})$ and, to satisfy (CIC), the FSC promises $w_{1}^{fss} = \tau \Delta r k_{4}^{fss}$, which is never paid in equilibrium.

This leads to the following program:

$$\max_{k_{i}, i \in \{0, 2, 3, 4\}} W = \alpha \varepsilon [(1 - r) \Psi(k_{0}) - (1 + \lambda) r k_{0}] + \alpha (1 - \varepsilon) [(1 - r) \Psi(k_{2}) - (1 - \tau) \lambda (\Delta r k_{3}) - \lambda \tau \Delta r k_{4} - (1 + \lambda) r k_{2}] + (1 - \alpha) (1 - \varepsilon) [(1 - r) \Psi(k_{3}) - (1 + \lambda) \bar{r} k_{3}] + (1 - \alpha) \varepsilon [\Psi(k_{4}) - (1 + \lambda) \bar{r} k_{4}]$$

Maximization with respect to $k_{i}$, for $i = 0, 2, 3, 4$ yields the following first-order conditions:

$$\frac{\partial W}{\partial k_{0}} = 0 \iff (1 - r) \Psi'(k_{0}^{fss}) = (1 + \lambda) r$$

$$\frac{\partial W}{\partial k_{2}} = 0 \iff (1 - r) \Psi'(k_{2}^{fss}) = (1 + \lambda) r$$

$$\frac{\partial W}{\partial k_{3}} = 0 \iff (1 - \bar{r}) \Psi'(k_{3}^{fss}) = (1 + \lambda) \bar{r} + \frac{\alpha}{1 - \alpha} (1 - \tau) \lambda \Delta r$$

$$\frac{\partial W}{\partial k_{4}} = 0 \iff (1 - \bar{r}) \Psi'(k_{4}^{fss}) = (1 + \lambda) \bar{r} + \frac{\alpha}{1 - \alpha} \frac{(1 - \varepsilon)}{\varepsilon} \tau \lambda \Delta r$$

\(^{39}\)Recall that the FSC does not want to induce the low-risk banker to opt for Flexible Supervision also when the supervisor’s signal is uninformative. While this would allow the FSC to save $w_{2}^{fss}$ (which then would be paid only off-the-equilibrium path) it would destroy the benefits of screening as the low-risk banker should be allocated the same rent in states 1 and 2 and the no-supervision outcome would be achieved.
Without loss of generality we can set \( \pi^f s_1 = r k_{f s 1} \) with \( k_{f s 1} \) satisfying the equation \((1 - r) \Psi'(k_{f s 1}) = (1 + \lambda) r \).

The banker of a high-risk bank never chooses the non-supervision option whereas the banker of a low-risk bank prefers to be supervised when he knows that the supervisor collects uninformative evidence so as to earn a positive rent.

However, this solution holds only has long as \( k_4 > k_3 \), that is when \( \tau < \varepsilon \).

When this condition is not satisfied, the best the FSC can do is to set \( k_{f s 4} = k_{f s 3} = k_{f s j} \). As a result, there are no reasons to reward the supervisor in state 2.

Therefore, \( B^2_{f s} = \Delta r k_j \). The FSC chooses \( k_{f s 1}, k_{f s 2}, k_{f s j} \) to maximize the following program:

\[
\max_{k_i, i \in \{0, 2, j\}} W = \alpha \varepsilon \left[ \Psi(k_0) - (1 + \lambda) r k_0 \right] + \alpha (1 - \varepsilon) \left[ \Psi(k_2) - \lambda (\Delta r k_j) - (1 + \lambda) r k_2 \right] + (1 - \alpha) \left[ \Psi(k_j) - (1 + \lambda) \bar{r} k_j \right]
\]

from which we can derive the following first-order conditions:

\[
\frac{\partial W}{\partial k_0} = 0 \iff \Psi'(k_{f s 0}) = (1 + \lambda) r
\]
\[
\frac{\partial W}{\partial k_2} = 0 \iff \Psi'(k_{f s 2}) = (1 + \lambda) r
\]
\[
\frac{\partial W}{\partial k_j} = 0 \iff \Psi'(k_{f s j}) = (1 + \lambda) \bar{r} + \frac{\alpha}{1 - \alpha} [1 - \varepsilon] \lambda \Delta r
\]

Again, it is without loss of generality to set \( \pi^f s_1 = r k_{f s 1} \) with \( k_{f s 1} \) satisfying the equation \( \Psi'(k_{f s 1}) = (1 + \lambda) r \).

Akin to the hard information case, implementing Flexible Supervision always improves welfare with respect to Mandatory Supervision. However, in the presence of soft information, the greater set of capture possibilities obliges the FSC to distort \( k_4 \) from its efficient level, in so preventing the achievement of the benevolent-supervisor level of welfare.

A simple application of the Envelope Theorem shows that welfare is strictly decreasing in \( \tau \) if \( \tau < \varepsilon \) and does not change with \( \tau \) when \( \tau \geq \varepsilon \).

**Different timings**

In Section 4.4 we have discussed how the Flexible Supervision contract should be optimally tailored in a scenario in which the banker is initially unaware of the signal observed by the supervisor. This timing accommodates different scenarios. One in which the supervisor privately learns \( \sigma \) in stage 1 (that we call Timing 2), and one in which both the supervisor and the banker learn \( \sigma \) just before the side-contracting opportunity arises (Timing 3).

More specifically, the sequence of events under **Timing 2** is the following:

1. The supervisor observes the signal. The banker learns the bank’s riskiness. The probability distributions are common knowledge.
2. The FSC simultaneously proposes *regulatory-supervisory contracts* to the supervisor and the banker. If the banker self-selects the Flexible Supervision contract, then this contract is implemented. If the banker does not select the Flexible Supervision contract, then Mandatory Supervision continues as follows:

3. The banker learns the signal $\sigma$.

4. The banker and the supervisor can privately sign a side-contract.

5. The banker and the supervisor send their messages to the FSC. The regulatory-supervisory contract is implemented according to their reports.

As shown in the paper, when the Flexible Supervision is implemented, the constraints that must be fulfilled to ensure that there is an optimal separation of banks at stage 2 are that the low-risk bankers opt for the supervision-free contracts:

$$
\pi_0 - r k_0 \geq \varepsilon (\pi_1 - r k_1) + (1 - \varepsilon) (\pi_2 - r k_2)
$$

whilst the high-risk bankers choose to be inspected:

$$
\varepsilon (\pi_4 - \bar{r} k_4) + (1 - \varepsilon) (\pi_3 - \bar{r} k_3) \geq \pi_0 - \bar{r} k_0
$$

The constraints hold in expectation because the banker knows the riskiness of his bank but does not know with certainty which state he is in.

Following the same proof strategy as in the above lemmas and propositions, it is possible to show that the Optimal Flexible Supervision with this alternative timing entails the following profits and capital requirements in equilibrium:

$$
\pi_{lr}^{t_2} = r k_0 + (1 - \varepsilon) \Delta r k_3, \quad \pi_{lr}^{t_2} = \bar{r} k_3
$$

The supervisor is paid $w_{lr}^{t_2} = 0$ for $i \in \{3, 4\}$. Off-the-equilibrium path, $\pi_{lr}^{t_1} = r k_1$, $\pi_{lr}^{t_2} = r k_2 + \Delta r k_3$, $\Psi'(k_{lr}^{t_2}) = \Psi'(k_{lr}^{t_2}) = (1 + \lambda) \frac{r}{1 + \lambda} w_{lr}^{t_2} = \tau \Delta r k_3$, $w_{lr}^{t_2} = 0$.

Note that the same contract and the same conclusion on the benefits of Flexible Supervision would be reached in the following setting in which there are two types of supervisors who differ with respect to their ability to learn the bank’s level of risk. Suppose that there is a highly-skilled supervisor who observes the bank’s riskiness with probability one, and a low-skilled supervisor who never observes the riskiness of the bank. It is common knowledge that there is a proportion $\varepsilon \in (0, 1)$ of high-skilled supervisors. At stage 1 the banker does not know which supervisor will be tasked with collecting information on the bank’s riskiness. The FSC is also unable to distinguish between different supervisors. Then, the FSC would design a regulatory contract which induces the low-risk banks to choose to by-pass supervision, and induces the high-risk banks to choose to be subjected to supervision.

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40 In a related vein, Boot and Thakor (1993) develop a model in which there is uncertainty as to the supervisor’s ability to monitor the bank’s asset choice.
Under **Timing 3**, the sequence of events is as follows:\[^{41}\]

1. The banker learns the bank’s riskiness. The probability distributions are common knowl-

2. The FSC simultaneously proposes *regulatory-supervisory contracts* to the supervisor and
the banker. If the banker self-selects the Flexible Supervision contract, then this contract
is implemented. If the banker does not select the Flexible Supervision contract, then
Mandatory Supervision continues as follows:

3. The supervisor and the banker learn the signal $\sigma$.

4. The banker and the supervisor can privately sign a side-contract.

5. The banker and the supervisor send their messages to the FSC. The regulatory-supervisory
contract is implemented according to their reports.

In addition to the assumptions made in the baseline model, we further impose that the
banker is able to quit the game at any time.\[^{42}\] It is immediate to see that the solution is then
identical to the one laid out for Timing 2.

It is important to stress that with these different timings of information, that is, when the
banker is unaware as to the supervisor’s signal, the timing of negotiations is critical. If the
FSC negotiated first with the banker and then with the supervisor, Flexible Supervision could
not profitably be implemented: for the choice of whether or not to be subjected to supervision
would be type-revealing, the FSC would never benefit from hiring the supervisor. Anticipating
this, the banker would always opt for supervision so as to collect an informational rent in some
states of the world.

**Monitoring effort of the banker**

When the supervisor is benevolent, players expect the continuation-game payoffs to be as de-
scribed by Lemma 1. As a result, the banker and the FSC knows that the choice of $e$ will only
affect (i) the profit of the banker in state 2 ($r = r, \sigma = \emptyset$) and (ii) the capital put at risk by the
risk banker in state 3 ($r = \bar{r}, \sigma = \emptyset$) in the continuation game. The FSC chooses the monitoring
effort and the transfer which maximize the expected social welfare function in the continuation
game under the ex-ante participation constraint of the banker, that is:

$$
\max_{e, \pi} \varepsilon [(1 - e)\Psi(k_{1}^{bs}) - \lambda(\pi_{1}^{bs} - \bar{r}k_{1}^{bs}) - (1 + \lambda)e\bar{r}k_{1}^{bs}]
+ e(1 - \varepsilon)\varepsilon [(1 - e)\Psi(k_{2}^{bs}) - \lambda(\pi_{2}^{bs} - \bar{r}k_{2}^{bs}) - (1 + \lambda)e\bar{r}k_{2}^{bs}]
+ (1 - e)(1 - \varepsilon)\varepsilon [(1 - e)\Psi(k_{3}^{bs}) - \lambda(\pi_{3}^{bs} - \bar{r}k_{3}^{bs}(e)) - (1 + \lambda)e\bar{r}k_{3}^{bs}(e)]
+ (1 - e)\varepsilon [(1 - e)\Psi(k_{4}^{bs}) - \lambda(\pi_{4}^{bs} - \bar{r}k_{4}^{bs}) - (1 + \lambda)e\bar{r}k_{4}^{bs}]
- \lambda \pi^{e} - \phi(e)
$$

\[^{41}\]Burlando and Motta (2015) use this time structure in the context of the optimal organization of a firm in
the presence of corruption concerns.

\[^{42}\]For otherwise, the FSC could extract the supervisor’s expected rent in Stage 2 by setting negative wages
whenever the state of the world is different from state 1.
such that:

$$\pi^e - \phi(e) + e(1 - \varepsilon)\Delta r k_{bs}^3(e) \geq 0$$

Note that with the participation constraint the FSC can fully extract the expected value of the banker’s information rent. Since it is costly for the society to collect the resources to pay for monitoring loans (the factor $\lambda$), the FSC sets the minimum $\pi^e$ which satisfies the participation constraint, namely:

$$\pi^e = \phi(e) - e(1 - \varepsilon)\Delta r k_{bs}^3(e)$$

Replacing this value of $\pi^e$ in the maximization program, along with the values of $\pi_{i}^{bs}$ from Lemma 1, we rewrite:

$$\max_{e} e\left[(1 - \bar{r})\Psi'(k_{bs}^1) - (1 + \lambda)\bar{r} k_{bs}^1\right]$$

$$+ e(1 - \varepsilon)[(1 - \bar{r})\Psi'(k_{bs}^2) - (1 + \lambda)\bar{r} k_{bs}^2]$$

$$+(1 - e)(1 - \varepsilon)[(1 - \bar{r})\Psi'(k_{bs}^3(e)) - (1 + \lambda)\bar{r} k_{bs}^3(e)]$$

$$+(1 - e)\varepsilon[(1 - \bar{r})\Psi'(k_{bs}^4) - (1 + \lambda)\bar{r} k_{bs}^4]$$

$$- \phi(e)(1 + \lambda) + e(1 - \varepsilon)\lambda \Delta r k_{bs}^3(e)$$

The FOC yields:

$$\varepsilon[(1 - \bar{r})\Psi'(k_{bs}^1) - (1 + \lambda)\bar{r} k_{bs}^1]$$

$$+(1 - \varepsilon)[(1 - \bar{r})\Psi'(k_{bs}^2) - (1 + \lambda)\bar{r} k_{bs}^2]$$

$$-(1 - \varepsilon)[(1 - \bar{r})\Psi'(k_{bs}^3(e)) - (1 + \lambda)\bar{r} k_{bs}^3(e)]$$

$$- \varepsilon[(1 - \bar{r})\Psi'(k_{bs}^4) - (1 + \lambda)\bar{r} k_{bs}^4]$$

$$+ \frac{\partial k_{bs}^3}{\partial e}[(1 - \bar{r})\Psi'(k_{bs}^3(e)) - (1 + \lambda)\bar{r}](1 - e)(1 - \varepsilon)$$

$$= \phi'(e)(1 + \lambda)$$

Since $(1 - \bar{r})\Psi'(k_{bs}^3(e)) = (1 + \lambda)\bar{r} + \frac{e}{1 - \varepsilon}\lambda \Delta r$,

$$\varepsilon[(1 - \bar{r})\Psi'(k_{bs}^1) - (1 + \lambda)\bar{r} k_{bs}^1]$$

$$+(1 - \varepsilon)[(1 - \bar{r})\Psi'(k_{bs}^2) - (1 + \lambda)\bar{r} k_{bs}^2]$$

$$-(1 - \varepsilon)[(1 - \bar{r})\Psi'(k_{bs}^3(e)) - (1 + \lambda)\bar{r} k_{bs}^3(e)]$$

$$- \varepsilon[(1 - \bar{r})\Psi'(k_{bs}^4) - (1 + \lambda)\bar{r} k_{bs}^4]$$

$$+ \frac{\partial k_{bs}^3}{\partial e} e(1 - \varepsilon)\lambda \Delta r$$

$$= \phi'(e)(1 + \lambda)$$

Note that the FSC’s maximization problem is the same when the supervisor is not benevolent and there is a double regime where both Mandatory and Flexible supervision coexist. Hence, the optimal levels of monitoring effort will be the same.

Conversely, when the supervisor is not benevolent and supervision is mandatory for all banks, players expect the continuation-game payoffs to be as described by Lemma 3. There,
the level of monitoring effort $e$ will also affect the reward paid to the supervisor along the equilibrium path in state 1 ($r = r, \sigma = \sigma$) in the continuation game. The maximization problem can be restated as follows:

$$\max_{e} e[\psi(k_{1}^{ms}) - \lambda r \Delta r k_{3}^{ms}(e) - (1 + \lambda)\rho k_{1}^{ms}] + e(1 - e)[\psi(k_{2}^{ms}) - (1 + \lambda)\rho k_{2}^{ms}] + (1 - e)(1 - e)[\psi(k_{3}^{ms}(e)) - (1 + \lambda)\hat{r} k_{3}^{ms}(e)] + (1 - e)e[\psi(k_{4}^{ms}) - (1 + \lambda)\hat{r} k_{4}^{ms}] - \phi(e)(1 + \lambda)$$

The FOC yields:

$$e[\psi(k_{1}^{ms}) - \lambda r \Delta r k_{3}^{ms}(e) - (1 + \lambda)\rho k_{1}^{ms}] + (1 - e)[\psi(k_{2}^{ms}) - (1 + \lambda)\rho k_{2}^{ms}] - (1 - e)[\psi(k_{3}^{ms}(e)) - (1 + \lambda)\hat{r} k_{3}^{ms}(e)] - e[e(1 - \tau)\psi(k_{4}^{ms}) - (1 + \lambda)\hat{r} k_{4}^{ms}] + \frac{\partial k_{3}^{ms}}{\partial e} e(1 - e)\lambda \Delta r$$

Since $(1 - \hat{r})\psi(k_{3}^{bs}(e)) = (1 + \hat{r})\hat{r} + \frac{e}{1 - e} \frac{1 - e(1 - \tau)}{1 - e} \lambda \Delta r$,

$$e[\psi(k_{1}^{ms}) - \lambda r \Delta r k_{3}^{ms}(e) - (1 + \lambda)\rho k_{1}^{ms}] + (1 - e)[\psi(k_{2}^{ms}) - (1 + \lambda)\rho k_{2}^{ms}] - (1 - e)[\psi(k_{3}^{ms}(e)) - (1 + \lambda)\hat{r} k_{3}^{ms}(e)] - e[e(1 - \tau)\psi(k_{4}^{ms}) - (1 + \lambda)\hat{r} k_{4}^{ms}] + \frac{\partial k_{3}^{ms}}{\partial e} e(1 - e)\lambda \Delta r$$

$$= \phi'(e)(1 + \lambda)$$

The first order conditions determining the optimal monitoring effort under benevolent supervision and mandatory supervision look similar. However, note that $k_{3}^{ms}(e) \neq k_{3}^{bs}(e)$ and neither are their derivatives with respect to $e$. Thus, we can conclude that $e^{bs} \neq e^{ms}$. 
References


