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Corruption and the case for safe-harbor regulation[☆]

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ABSTRACT

We study whether the joint adoption of ex-ante regulation and ex-post liability leads to a higher level of welfare in a setting in which firms invest resources to develop an innovative product that can have negative social repercussions. We allow for firm-regulator corruption and compare two alternative regulatory regimes: lenient authorization and strict authorization. Corruption favors strict authorization and strengthens the case for making firms immune from ex-post liability so as to encourage ex-ante investment. By contrast, when lenient authorization is adopted, firms should not be insulated from liability. Hence, liability should be more severe when corruption is less common.

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1. Introduction

New products or production techniques that may exhibit negative externalities, like drugs, pesticides, digital assets, or hydraulic fracturing, are often regulated. Although regulation may prevent the sale or use of some harmful activities, accidents inevitably occur. A controversial and unresolved question is whether regulation should provide safe-harbor protection against litigation.[1] Safe-harbor proponents argue that immunity from liability is essential for firms to invest and deliver innovations. In this paper, somewhat surprisingly, we highlight how bureaucratic corruption may make immunity from liability more desirable. Specifically, we show that more pervasive corruption may favor the adoption of a stricter regulatory regime, under which unsafe activities are never authorized. As corrupt bureaucrats extract a part of firms' profits, incentives to invest are reduced. In this scenario, the prospect of facing ex-post litigation would overly depress investment. Hence, the need for a safe-harbor provision. By contrast, in a looser authorization regime firms tend to devote excessive resources to investment. To help discipline firms' investment incentives, in this alternative regime, obtaining authorization should not insulate firms from ex-post liability. Accordingly, liability should be more severe when corruption is less common.

Our work contributes to the heated debate on safe-harbor regulation by approaching the problem from the standpoint of economic efficiency, like (Schwartzstein and Shleifer, 2013) and Henry et al. (2021). Schwartzstein and Shleifer (2013) analyze a setting where firms must be motivated to take costly precautions that decrease the occurrence of accidents, whereas (Henry et al., 2021) compare different regulatory frameworks when information about product safety is obtained through costly experimentation and ex-post learning following product adoption. By contrast, akin to De Chiara and Manna (2022), we study a firm that must devote resources to increase the probability of developing an innovation that may entail negative externalities and we allow for corruption. Our work is also linked to the extensive literature on the interplay between ex-ante regulation and ex-post liability, pioneered by Shavell (1984). Similarly to Hiriart

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[1] In the U.S. the F.D.A.'s marketing approval preempts liability for medical devices (*Riegel v. Medtronic*, 552 U.S. 312, 2008) but not for drugs (*Wyeth v. Levine*, 555 U.S. 555, 2009), unless there is a public health emergency, like the COVID-19 pandemic (see the PREP Act Pub. L. 109-148, 2005, and the notice of declaration of the Secretary of the Health and Human Services Department on 03/17/2020).

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et al. (2010), we focus on the role played by corruption. We study how different forms of corruption affect investment incentives under two alternative regulatory regimes and, in turn, how this impacts on the desirability of safe-harbor provisions.

2. Setup

Players. We consider a profit-maximizing firm (it) that must decide how much to invest to develop a new production technology or a marketable product. The innovation may generate negative externalities and the benevolent regulator (he) decides whether or not to authorize its use. The regulator can employ a public official (she) who collects evidence about the social repercussions of the innovative activity. All players are risk-neutral and both the firm and the public official are protected by limited liability.

Timing. In stage 0, the regulator chooses a regulatory policy, which will be detailed below. In stage 1, the firm decides on the innovation intensity $I \in [0, 1]$, which coincides with the probability of a breakthrough, at cost $\frac{cI^2}{2}$ with $c > 0$. If no innovation is discovered, the firm produces a standard good which gives a profit normalized to 0, generates no externalities, and the game ends. If the innovative effort is successful, the firm would be able to produce a new product which would yield a gross profit $\Pi \in (0, c]$. In stage 2, the regulator does not know whether the good is socially harmful or not.[2] It is common knowledge that the good will generate some expected harm. In particular, the state of the world ω can be either safe or unsafe, i.e., $\omega \in \{S, U\}$, and $\beta \in (0, 1)$ is the probability that the state is unsafe. If employed, the public official observes the true state of the world with probability p and does not collect any conclusive evidence with complementary probability $1 - p$. The public official sends a report to the regulator on the collected evidence. In stage 3, a verifiable accident may occur. If the state is safe the probability that an accident occurs is ϵ_S, while if the state is unsafe the probability of an accident is ϵ_U, with $0 < \epsilon_S < \epsilon_U \leq 1$. An accident generates some social harm H. The expected harm caused by the good is h_S (h_U) if the state is safe (unsafe), with $h_S < \Pi < h_U$. Therefore, the innovation is socially harmful, and the good should not be produced, if the state is unsafe. If the state is safe, production of the good would be socially beneficial.

Regulatory policy. At the beginning of the game, the regulator chooses whether to authorize production and can commit to a fine f that the firm must pay if an accident occurs. Authorization of production can be made contingent on the evidence reported by the public official. Following Immordino et al. (2011), we distinguish between two authorization regimes. In a regime of strict authorization, the firm is allowed to produce only if the public official reports conclusive evidence that the state is safe. In a regime of lenient authorization, the firm is allowed to produce unless the public official reports conclusive evidence that the state is unsafe. The difference between the two authorization regimes arises in the absence of conclusive evidence about the expected social harm that the production of the good would bring about.

Corruption. Following Tirole (1986), we assume that the information collected by the public official is hard. Therefore, the public official can conceal, but not fabricate evidence. The probability that the public official is honest is $\upsilon \in [0, 1]$, in which case evidence is always truthfully reported. With complementary probability $1 - \upsilon$ the public official is corrupt. Unlike the public official, we assume that the regulator is incorruptible and maximizes social welfare.

Corruption opportunities differ under the two authorization regimes. If authorization is lenient, the corrupt public official colludes with the firm by concealing evidence that the state is unsafe provided that the firm pays a bribe. If authorization is strict, the corrupt public official blackmails the firm, threatening to conceal evidence that the state is safe, unless the firm pays a bribe. Under both regimes, we assume that the bribe will be paid at the end of stage 3, and can be made contingent on the occurrence of an accident. For simplicity, the public official holds all the bargaining power, e.g., makes a take-it-or-leave-it offer, and can commit to a feasible reporting strategy if the firm refuses to give in to her demand.

2.1. Benchmarks

We consider two benchmarks against which we will compare alternative regulatory regimes.

First-best outcome. We begin by characterizing the *first-best outcome* that would be reached if the regulator chose investment and production decisions directly. Knowing whether the state is safe or not, the regulator would produce only if $\omega = S$. Thus, first-best investment is determined from:

$$I^* := \arg\max_{I \in [0,1]} \quad I[(1-\beta)(\Pi - h_S)] - \frac{cI^2}{2},$$

so that the optimal investment is:

$$I^* = \frac{(1-\beta)(\Pi - h_S)}{c}.$$

First-best investment increases with the probability that the good is safe and the net social benefit of the safe product, $\Pi - h_S$. Expected social welfare in this first-best world is:

$$W^* = I^*[(1-\beta)(\Pi - h_S)] - \frac{cI^{*2}}{2}.$$

Ex-post liability only. The second benchmark we contemplate is a regime of strict liability, namely one wherein firms are free to produce innovative goods, but if an accident occurs they must pay a fine. The firm may not have enough financial resources to cover the entire cost of the accident and in most jurisdictions the firm's resources set a ceiling to the maximum fine that can be imposed on firms. This problem, known as judgment proof, has been extensively studied in the law and economics literature (e.g., see Shavell, 1986). The firm is assumed not to own assets and a natural ceiling to the fine that can be imposed by the court is represented by the profit Π that would otherwise accrue to the firm.[3] The Maximal Punishment Principle (Becker, 1968) applies and the firm will pay Π in the event of an accident. Such a fine is not enough to deter the firm from carrying out production of an unsafe product because $\epsilon_U < 1$. Hence, the firm will only partially take into account the negative social repercussions of production. As a result, there will be over-investment and social welfare will be below first-best. The following remark records the above observations.[4]

Remark 1. In a regime of strict liability, the regulator sets $f^L = \Pi$, production also occurs in the unsafe state, $I^L > I^*$, and $W^L < W^*$.

[2] For the results of the analysis, whether or not the firm is aware of the social harm caused by the good will be irrelevant.

[3] If fines were unbounded, there would be no need for regulation as the fine could optimally be set to induce the firm to make the first-best investment and production decisions. This optimal fine would be $f = H$, and the firm would be made to internalize the social cost caused by the innovative good.

[4] All proofs are in the Appendix.

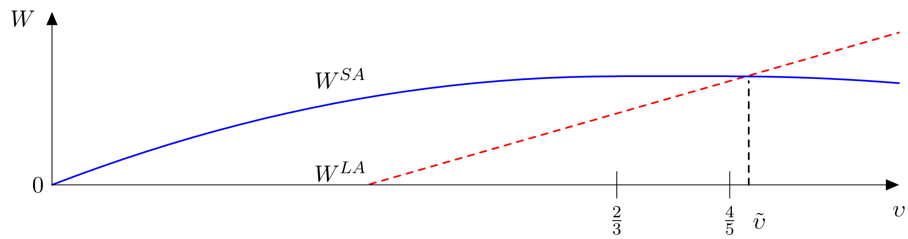

Fig. 1. Welfare under lenient and strict authorization regimes as a function of υ.

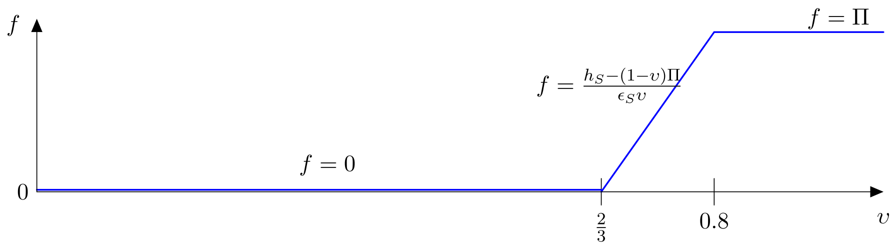

Fig. 2. Equilibrium fine as a function of υ.

2.2. Ex-ante regulation and ex-post liability

Ex-post liability alone does not reach an efficient outcome. Therefore, we now explore the joint use of ex-ante regulation and ex-post liability. We also determine whether receiving authorization to produce ought to give a firm immunity from ex-post liability. We formally define a safe-harbor provision as follows.

Definition. We say that there is a safe-harbor provision when the optimal fine is nil, i.e., $f = 0$.

The following lemma characterizes the optimal fines in the two regimes.[5]

Lemma 1. *In a regime of lenient authorization, the regulator sets* $f^{LA} = \Pi$. *In a regime of strict authorization, the regulator sets the following fine:*

$$f^{SA} = \begin{cases} 0, & \text{if} \quad \upsilon \in \left[0, \frac{\Pi - h_S}{\Pi}\right]; \\ \frac{h_S-(1-\upsilon)\Pi}{\epsilon_S \upsilon}, & \text{if} \quad \upsilon \in \left(\frac{\Pi-h_S}{\Pi}, \frac{\Pi-h_S}{(1-\epsilon_S)\Pi}\right]; \\ \Pi, & \text{if} \quad \upsilon \in \left(\frac{\Pi-h_S}{(1-\epsilon_S)\Pi}, 1\right]. \end{cases} \quad (1)$$

Under strict authorization, there might be under-investment as the firm may not be allowed to produce even when the state is safe. More pervasive corruption, as captured by a lower υ, further discourages investment because the firm anticipates that there is a higher likelihood that any profit will be extracted by the public official. Thus, when the fraction of corrupt public officials is high enough, i.e., $\upsilon \in \left[0, \frac{\Pi-h_S}{\Pi}\right]$, a safe-harbor provision should be used. By contrast, under lenient authorization, the maximum punishment principle applies. In this regime, there is an over-investment problem because the firm produces even when the state is unsafe. Although the firm's investment decision is independent of υ, more pervasive corruption magnifies ex-post inefficiency as it increases the probability that the product will be authorized in the unsafe state. As a result, in order to discourage the firm's investment, the regulator will fully confiscate the firm's profit Π if an accident occurs.

Proposition 1 shows that, when υ is sufficiently low, strict authorization is preferred.

Proposition 1. *There exists* $\tilde{\upsilon} > 0$, *such that for any* $\upsilon \in [0, \tilde{\upsilon}] \subseteq [0, 1]$ $W^{SA} > W^{LA} > W^{L}$.

To understand why, consider that more pervasive corruption magnifies the distortion of the lenient authorization regime with respect to production decisions (i.e., the over-production problem). Conversely, corruption has no effect on production decisions in a strict authorization regime, but it affects investment decisions. Moreover, corruption discourages investment as the firm anticipates that the profit will be extracted by the corrupt public official. Thus, as shown by De Chiara and Manna (2022) in a model without ex-post liability, corruption acts as an indirect tax on an activity that generates negative externalities. Novel is the finding that, when corruption is rife, the adoption of a strict authorization regime should go hand-in-hand with a safe-harbor provision: the benevolent regulator would not want to further depress investment by imposing a fine on the firm if an accident occurs. We highlight this result in the next corollary.

Corollary 1. *For any* $\upsilon \in \left[0, \min\left\{\tilde{\upsilon}, \frac{\Pi-h_S}{\Pi}\right\}\right]$, *the regulator adopts strict authorization with a safe-harbor provision.*

When corruption is less common, the regulator will complement ex-ante regulation with ex-post liability and may lean towards the adoption of lenient authorization. A noteworthy observation ensues: the optimal fine is (weakly) increasing in the fraction of honest public officials.

In Fig. 1, we graphically compare social welfare in the two regimes as a function of υ (the solid blue line is W^{SA}, whereas the dashed red line is W^{LA}), showing that the regime of strict authorization dominates when corruption is pervasive, namely, when υ is sufficiently low. The figure is drawn assuming the following values for the parameters: $h_U = 5$, $\Pi = 3$, $h_S = 1$, $\epsilon_U = \frac{5}{6}$, $\epsilon_S = \frac{1}{6}$, $p = 0.5$, $c = 3$, and $\beta = 0.3$. For these values of the parameters, $\tilde{\upsilon} = 0.82$, $\frac{\Pi-h_S}{\Pi} = \frac{2}{3}$, and $\frac{\Pi-h_S}{(1-\epsilon_S)\Pi} = \frac{4}{5}$. If the likelihood of facing a corrupt public official is sufficiently high, the regulator may prefer banning production to adopting a regime of lenient authorization. Conversely, investment and social welfare are always non-negative in a regime of strict authorization. Using the same values of the parameters as in Fig. 1, we illustrate the weak monotonic relationship existing between the equilibrium fine f and υ in Fig. 2.

[5] As fines do not affect the production decision, there is no loss of generality in restricting attention to just one fine per regime: what matters for investment decisions is the expected fine facing the firm.

3. Conclusions

Our model has shown that a stricter authorization regime is preferred when corruption is more common: ex-ante regulation would avert the production of unsafe goods. It may excessively discourage investment incentives, though, as firms anticipate that they will have to share their profits with corrupt public officials. Therefore, obtaining authorization should provide firms with safe harbor against ex-post liability. As corruption becomes less common, investment is less deterred, and liability may be helpful to discipline firms' investment incentives. When corruption is a limited issue, a looser authorization regime is preferred. This is always complemented by large fines imposed on firms following the occurrence of accidents.

Appendix

Proof of Remark 1

When the fine is bounded the regulator cannot impose a fine which is above Π. The regulator will exactly set the maximum possible fine, i.e. $f^L = \Pi$. Confronted with this fine, the firm will be willing to produce in both states of the world: when the good is unsafe, if the firm decides to go on with production, it will get $\Pi(1-\epsilon_U) > 0$. The investment satisfies:

$$I^L = \frac{[1-(1-\beta)\epsilon_S - \beta\epsilon_U]\Pi}{c}$$

and welfare is:

$$W^L = [1-(1-\beta)\epsilon_S - \beta\epsilon_U]\Pi \times \left[\frac{2(\Pi - h_S(1-\beta) - \beta h_U) - [1-(1-\beta)\epsilon_S - \beta\epsilon_U]\Pi}{2c}\right].$$

As compared with I^* and W^*, there is excessive production and investment. Note that $W^L < 0$ if $\Pi < h_S(1-\beta) + \beta h_U$. □

Proof of Lemma 1

First note that, in each regime, the bribe the corrupt public official will request in stage 2 is contingent on whether the fine is paid and its amount. Specifically, if the fine is not paid (i.e., the accident does not occur), $b^{no} = \Pi$. Instead, if the fine is paid (i.e., the accident occurs), $b^{fine} = \Pi - f$. With this in mind, we now determine the optimal fines in the two regimes.

In a regime of lenient authorization, the firm maximizes:

$$I^{LA} := \arg\max_{I\in[0,1]} I\Big[(1-\beta p)\Pi - f[\beta(1-p)\epsilon_U + (1-\beta)\epsilon_S]\Big] - \frac{c}{2}I^2.$$

Equilibrium investment as a function of f is:

$$I^{LA}(f) = \frac{(1-p\beta)\Pi - f[\beta(1-p)\epsilon_U + (1-\beta)\epsilon_S]}{c}.$$

Welfare is:

$$W^{LA}(f) = I^{LA}(f)w^{LA} - c\frac{(I^{LA}(f))^2}{2},$$

where w^{LA} denotes the ex-post welfare, that is:

$$w^{LA} := (1-\beta)(\Pi - h_S) + \beta(1-p)(\Pi - h_U) + \beta p(1-\upsilon)(\Pi - h_U),$$

because production always takes place, unless there is conclusive evidence that the state is unsafe and the public official is honest.

The regulator chooses $f \in [0, \Pi]$ to maximize $W^{LA}(f)$. In an interior solution, the fine would be derived from the first-order condition:

$$\frac{\partial I^{LA}(f)}{\partial f}[w^{LA} - cI^{LA}(f)] = 0.$$

Since the first term is always negative, the interior solution would be derived from $w^{LA} = cI^{LA}(f)$. However, this equivalence yields:

$$f = \frac{(1-\beta)h_S + \beta(1-p)h_U + \beta p(1-\upsilon)(h_U - \Pi)}{(1-\beta)\epsilon_S + \beta(1-p)\epsilon_U} \geq H,$$

as $h_S = \epsilon_S H$ and $h_U = \epsilon_U H$. Therefore, $f^{LA} = \Pi$.

In a regime of strict authorization, the firm maximizes:

$$I^{SA} := \arg\max_{I\in[0,1]} I\Big[(1-\beta)p\upsilon(\Pi - f)\Big] - \frac{c}{2}I^2.$$

The firm's investment decision as a function of f yields:

$$I^{SA}(f) = \frac{(1-\beta)p\upsilon(\Pi - f)}{c}.$$

Welfare is:

$$W^{SA}(f) = I^{SA}(f)w^{SA} - c\frac{(I^{SA}(f))^2}{2},$$

where w^{SA} denotes the ex-post welfare, that is:

$$w^{SA} := (1-\beta)p(\Pi - h_S).$$

The regulator chooses $f \in [0, \Pi]$ to maximize $W^{SA}(f)$. In an interior solution, the optimal fine is derived from:

$$\frac{\partial I^{SA}(f)}{\partial f}[w^{SA} - cI^{SA}(f)] = 0.$$

Since the first term is always negative, the interior solution is derived from $w^{SA} = cI^{SA}(f)$ finding that:

$$f^{SA} = \frac{h_S - (1-\upsilon)\Pi}{\epsilon_S\upsilon},$$

if $\upsilon > 0$. If $\upsilon = 0$, the firm would not expect to get any net profit, as this would always be expropriated by the corrupt public official. Hence, any $f \geq 0$ would always lead to $W^{SA} = 0$.

Note that the regulator sets $f^{SA} = 0$ when $\upsilon \leq \frac{\Pi - h_S}{\Pi} \in (0,1)$, whereas the regulator sets $f^{SA} = \Pi$, when $\upsilon > \frac{\Pi - h_S}{(1-\epsilon_S)\Pi}$. Note that the right-hand side is lower than 1 if $\epsilon_S < \frac{h_S}{\Pi}$, and this is always the case as $\epsilon_S = \frac{h_S}{H}$. □

Proof of Proposition 1

Consider investment and welfare under lenient authorization. By substituting the fine into the equilibrium investment and welfare, we get:

$$I^{LA} = \frac{[1-(1-\beta)\epsilon_S - \beta\epsilon_U - \beta(1-p)\epsilon_U]\Pi}{c};$$

$$W^{LA} = I^{LA}\left[w^{LA} - \frac{c}{2}I^{LA}\right].$$

It is immediate to show that $W^{LA} > W^L$. This is because the over-investment problem is reduced as $I^{LA} = I^L - \frac{\beta p(1-\epsilon_U)\Pi}{c} < I^L$ and ex-post welfare is higher if υ is positive, i.e., $w^{LA} = w^L + \beta p\upsilon(h_U - \Pi)$. It also follows that W^{LA} is increasing in υ.

Therefore, we compare social welfare in lenient and strict authorization. Under the latter, the firm's investment is:

$$I^{SA} = \begin{cases} \frac{(1-\beta)p\upsilon\Pi}{c}, & \text{if } f^{SA} = 0; \\ \frac{(1-\beta)p(\Pi - h_S)}{c}, & \text{if } f^{SA} = \frac{h_S - (1-\upsilon)\Pi}{\epsilon_S\upsilon}; \\ \frac{(1-\beta)p\upsilon\Pi(1-\epsilon_S)}{c}, & \text{if } f^{SA} = \Pi. \end{cases} \quad (A.1)$$

and welfare is:

$$W^{SA} = \begin{cases} \frac{(1-\beta)^2p^2\upsilon\Pi[2(\Pi - h_S) - \upsilon\Pi]}{2c}, & \text{if } f^{SA} = 0; \\ \frac{(1-\beta)^2p^2(\Pi - h_S)^2}{2c}, & \text{if } f^{SA} = \frac{h_S - (1-\upsilon)\Pi}{\epsilon_S\upsilon}; \\ \frac{(1-\beta)^2p^2\upsilon\Pi(1-\epsilon_S)[2(\Pi - h_S) - \upsilon\Pi(1-\epsilon_S)]}{2c}, & \text{if } f^{SA} = \Pi. \end{cases} \quad (A.2)$$

Welfare is increasing in υ when $f^{SA} = 0$, it does not depend on υ when $f^{SA} = \frac{h_S-(1-\upsilon)\Pi}{\epsilon_S \upsilon}$, and it is decreasing in υ when $f^{SA} = \Pi$.

If $\upsilon = 0$, $W^{SA} = 0 > W^{LA}$. As both welfare functions are continuous in υ, there always exists a subset $[0, \tilde{\upsilon}]$ of $[0, 1]$, where $\tilde{\upsilon} > 0$, in which $W^{SA} > W^{LA}$. If $\tilde{\upsilon} < 1$, then, for any $\upsilon \in (\tilde{\upsilon}, 1]$, $W^{LA} \geq W^{SA}$. This is because W^{LA} is strictly increasing in υ, whereas W^{SA} is first increasing, then constant, and finally decreasing in υ. Last note that if the probability that the state is unsafe β is large enough, the regulator never adopts a lenient authorization regime. □

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