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## Open-Source Information and Repression

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# OPEN-SOURCE INFORMATION AND REPRESSION

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January 27, 2024

## Abstract

As an ever increasing share of human activity is “chronicled”, the chance that acts of government incompetence or wrongdoing leave incriminating traces open for public discovery steadily rises. The current paper proposes an applied game-theoretic model to explore how an incumbent government with reelection concerns responds to the rise in open-source information. The analysis shows that an inherent aspect of this rise is a tendency towards heightened repression. In the model, if executive power is not sufficiently checked, the government escalates hidden repression against free speech. Consequently, voters receive less, rather than more, information about the type of their government—and the prospect of electoral defeat due to incompetence diminishes. The model’s predictions align with recent global trends in freedom of expression. The current analysis stresses the increasing importance of fortifying institutions that safeguard free speech and warns that international organizations like the European Union will be subject to growing centrifugal forces.

**JEL classification:** D72, D82, H11

**Keywords:** Open-source information, hidden repression, institutional safeguards, reelection

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# 1 Introduction

With smartphone cameras and microphones present in ever more situations, with an ever larger share of social and economic activities leaving a “digital footprint” (Binswanger and Oechslin 2020), and with the number of (private) satellites orbiting Earth rising fast (Burke et al. 2021), the amount of information available in the public sphere—open-source information—has been surging lately. This has nurtured hopes that it will become easier for voters, opposition parties, or civil society to hold governments to account. Referring to the surge in open-source information, *The Economist* (Aug 7, 2021) wrote that this “is a welcome threat to ... governments with something to hide”. Such hopes are not unfounded. A recent *Amnesty International Publication* (May 1, 2020) revealed a large number of human rights violations that were identified on the basis of open-source information only. Similarly, various international bodies have recently relied on open-source information to monitor whether governments comply with specific international obligations (Bochert 2021).

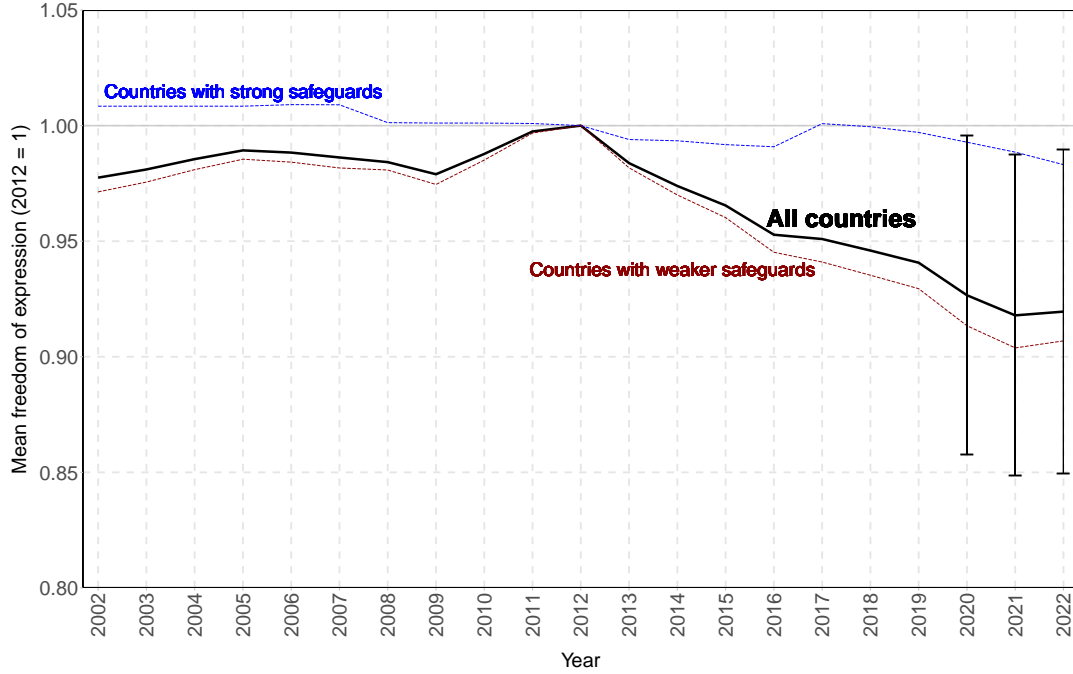
Still, an increase in the chance that acts of government incompetence or wrongdoing leave incriminating traces somewhere in the public sphere does not necessarily mean that unworthy governments now face a higher chance of losing power. Obviously, such governments may have access to a number of countermeasures. In particular, they may try to silence (or co-opt) those actors, like the opposition and their associates, with an incentive to identify such traces in the large sea of unstructured open-source information and compile them into convincing evidence that can be shown to the voters.<sup>1</sup> And indeed, in parallel with the rise of open-source information, freedom of expression has substantially deteriorated over the past ten years (Boese et al. 2022). Figure 1 illustrates this finding with the help of the freedom of expression index provided by Coppedge et al. (2023), a broad measure that also captures the extent to which government respects the freedom to discuss political matters in the public sphere. As the black line in the figure shows, in 2022, global freedom of expression had declined by about 8.1% compared to its all-time high in 2012, an ominous trend that has been referred to as the “dawn of a free-speech recession” (Mchangama 2022).

This paper analyzes the two trends, the rise in open-source information and the decline in free expression, in a single framework. It proposes a game-theoretic model to explore the consequences for voters and governments with (or without) something to hide. The model is of the political agency type (following, e.g., Persson and Tabellini 2000; Maskin and Tirole 2004;

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<sup>1</sup>“Open source” does not mean that there is no need for the information to be processed. Relevant traces must be identified, analyzed, and then synthesized into a coherent, readily accessible picture. Doing such “intelligence work” requires resources such as time, computing power, and analytical skills.

Figure 1: Freedom of expression has been under attack since 2012



*Notes.* Own calculations based on the variable freedom of expression (Coppedge et al. 2023), which is measured on a scale from 0 (min) to 1 (max). The scores are based on information from country experts with [strongly protected](#) identities. Black line: mean value in a sample of 141 countries, with the value for 2012—the all-time high—normalized to 1 (95% confidence intervals shown for the final three years). Blue (red) line: mean value in a subsample of 17 (124) countries with strong (weaker) safeguards against the misuse of executive power, whereby the 2012 value is again normalized to 1. The definition of strong safeguards considers institutional and norms-based checks. See Appendix I for details.

Alesina and Tabellini 2007, 2008; Smart and Sturm 2013; Guriev and Treisman 2020), but incorporates new elements. It features an incumbent politician with reelection concerns who is either competent or not, a quality the electorate cannot directly observe and the economic consequences of which materialize only after an upcoming election. The electorate forms a belief about the incumbent's quality, which then affects the probability with which the incumbent is reelected. This constellation incentivizes the opposition to engage in a (possibly costly) search for early evidence of incompetence. Such evidence, if convincing, would change the electorate's belief against the incumbent, lifting the prospect of an electoral win by the opposition. And here is where open-source information enters the picture. In practice, a key aspect of the rise of open-source information is that actors not belonging to the executive branch become more successful in searching for (scattered) traces that can be compiled into convincing evidence of

facts the executive seeks to hide (Larkin 2016; Ghioni et al. 2023).<sup>2</sup> This is the aspect the model captures: the rise of open-source information takes the form of an increased chance that a search effort by the opposition is successful in the sense that it produces early evidence that enables the electorate, outside the political elite, to verify actual incompetence. That is, the opposition’s search effort becomes more productive. However, the incumbent can repress any such effort, even though this comes at a cost (possibly affected by open-source information). The level of the cost is taken to reflect the strength of the safeguards against the misuse of executive power. While the electorate does not directly observe repression, it does account for the incumbent’s incentives when forming a belief about the quality of the latter.

This setup captures that nowadays most countries, democracies as well as autocracies, hold elections (Little 2017). However, leaders who lean towards autocracy are more inclined to curb electoral competition. Compared to the previous century, the repressive measures used more recently tend to be less blatant, more subtle, and often involve manipulating information to make voters believe that their leaders are competent and benevolent (Guriev and Treisman 2019, 2022). In practice, repression frequently involves largely concealed efforts to silence unwelcome voices. This is achieved by different means, among them the promotion of self-censorship through targeted intimidation (Gehlbach et al. 2022) or online censorship (Roberts 2020; Earl et al. 2022).<sup>3</sup> In the current model, the practice of concealed silencing is reflected in the assumption that the electorate does not directly observe whether the absence of early evidence of incompetence is due to repression. However, when forming beliefs, the model electorate is aware of the possibility of hidden repression, something that appears to hold for real-world citizens, too (Roberts 2020). Finally, at least for some policy areas, it is plausible that any economic damage of government incompetence is not immediate but delayed, for instance due to long policy implementation lags (see Ramey 2011 for the case of fiscal policy).

The analysis of this setup leads to four main insights. *First*, as the likelihood of unwelcome evidence being found rises, the benefit incurred by an incompetent incumbent through repression increases, potentially intensifying its use. *Second*, if repression indeed intensifies, the escalation is so aggressive that the electorate experiences an information loss—which is mirrored in a lower chance that the incumbent is voted out when incompetent. That is, in the “struggle” between a better search productivity and intensified repression, the latter dominates. The information loss is also mirrored in a reduced probability that the incumbent is reelected

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<sup>2</sup>Consider the run-up to the 2003 US invasion of Iraq, where false claims of Iraq holding weapons of mass destruction were pivotal. With today’s access to open-source information, critics outside the Bush administration would have had a much better chance at uncovering this huge intelligence failure.

<sup>3</sup>Online censorship can be pursued by various means, including the flooding of the internet with large amounts of irrelevant information and distracting messages to create information overload.

when competent. The reason is that intensified repression when incompetent makes the signal “absence of evidence” less informative. All this lowers the electorate’s welfare. *Third*, the safeguards against the misuse of executive power (like institutional and norms-based checks) are a key arbiter of the impact of a secular trend towards richer open-source information. With sufficiently strong safeguards, repression remains off the table and the chance that incompetence is punished and competence rewarded steadily improves. With weaker safeguards, by promoting repression, such a trend erodes the chance that competence makes a difference in elections. That is, the consequences of richer open-source information are not orthogonal to the safeguards in place to check executive power. Sufficiently strong safeguards that can withstand the heightened incentives for repression are a precondition for better evidence to be beneficial. Finally, endogenizing the safeguards against the misuse of executive power leads to a *fourth* insight. If the incumbent were to set them before learning her type, she would choose strong safeguards—anticipating that, should she turn out to be competent, the option of repression would be useless but would reduce her reelection chances. Thus, in the longer run, the institutional setting may adapt to the informational advancements.

The current analysis casts a spotlight on a mechanism that, absent sufficiently strong safeguards, inherently leads to an aggressive escalation of repression in response to richer open-source information. A higher chance of unwelcome evidence being found makes refraining from repression more risky with regard to reelection—and thus less attractive. At the same time, using repression becomes more attractive as, indeed, the reelection chance associated with it improves. The reason is that the absence of evidence, which repression flatly ensures, becomes a stronger signal of competence when evidence of incompetence is more likely to be found. These diverging effects result in the incumbent having strong incentives to ratchet up repression. Thus, in the incumbent’s mixed strategy, the probability of using repression experiences a significant rise, causing a loss of information for the electorate.

Shifting the focus from the model to the actual world, we indeed see that the recent decline in mean freedom of expression was mostly driven by countries with weaker safeguards. In Figure 1, the mean in the corresponding country subset (red line) lost 9.3% relative to 2012, whereas the loss in the strong-safeguards subset (blue line) was just 1.7%. In a forward-looking perspective, the present analysis points to the possibility that the secular trend towards richer open-source information will amplify cross-country differences along institutional lines. Countries whose institutions prevent an escalation of repression will see more competent and honest governments, while in the remaining countries those qualities will increasingly come under pressure. This pattern may also amplify disparities in economic performance—which would be

a particular worry for international institutions, such as the European Union, that use transfers to foster convergence but consist of a heterogeneous membership in terms of institutional safeguards. Another conclusion is that institutions will become more important. A priori, one might think that, with incompetence and wrongdoing more likely to leave traces, the importance of formal safeguards that check executive power lessens. The current analysis suggests otherwise: information and institutions are complements, not substitutes.

The rest of the paper is organized as follows. The upcoming section turns to the related literature. Section 3 introduces the basic setup. This is followed by a discussion in Section 4. Section 5 characterizes the equilibrium strategies, and Section 6 examines equilibrium turnover in the contested position, with both sections discussing the impact of a trend towards richer open-source information on equilibrium outcomes. Section 7 focuses on the safeguards against the misuse of executive power, while Section 8 considers robustness issues. Section 9 concludes.

## 2 Literature

Like many contributions using a political agency framework, this paper follows, among others, Persson and Tabellini (2000, Chapter 4) and Alesina and Tabellini (2007, 2008) in assuming that an incumbent politician is concerned about the electorate’s perception of her competence in the run-up to an election. We also follow those works in assuming that the incumbent can take a hidden action to influence the electorate’s perception. But our setup differs in that it includes an informational asymmetry between the incumbent (who knows her type) and the electorate (who cannot directly observe it). A second difference is that the incumbent’s hidden action does not pertain to her effort but the information the electorate will receive.

Both deviations are also part of Guriev and Treisman (2020), a paper that presents a theory of informational autocracy. In that paper, a leader chooses among different political regimes (democracy, informational autocracy, dictatorship) and also selects a tool of manipulation or repression, one of which is censorship.<sup>4</sup> The main focus is on how elite size determines the regime type and the choice of the manipulation or repression tool. The current paper, while keeping the regime fixed, zooms in on how a secular trend towards richer open-source information, which steadily improves the productivity of searches for early evidence of incompetence, alters the use of repression by censorship; and it focuses on how the struggle between information and repression affects the importance of competence in elections.

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<sup>4</sup>More recent works that also allow for an entire range of tools of manipulation and/or repression include Gehlbach et al. (2022) and Gitmez and Sonin (2023). However, unlike Guriev and Treisman (2020), these contributions are based on models of Bayesian persuasion rather than on a political agency framework.

In political science, too, there is a large literature on the role of information asymmetries in holding incumbent governments to account via elections (e.g., Canes-Wrone et al. 2001; Ashworth and Mesquita 2014). A long-standing debate centers on the impact of voter competence on democratic performance. In that debate, a crucial aspect of competence is the extent to which voters are informed. For instance, in Ashworth and Mesquita (2014), the focus is on the circumstances under which better access to information for voters actually improves their welfare. While in the present paper voters' access to information takes center stage, too, the issue being explored is a different one. In the model below, better information unambiguously helps voters—the key question is whether richer open-source information necessarily improves voters' access to information. The answer is negative: only when the institutional provisions against the misuse of executive power are sufficiently strong to withstand the stronger incentives for repression, does the rise of open-source information benefit voters.

The present analysis, by eventually moving on to an endogenous determination of the institutional provisions against repression, also connects with a literature on how in presence of informational asymmetries institutional constraints may actually work to the benefit of an incumbent leader—for instance, by spurring investment (e.g., Gehlbach and Keefer 2011) or forestalling intra-elite conflict (e.g., Boix and Svolik 2013).<sup>5</sup> In Shadmehr et al. (2019), the government has an incentive to grant the judiciary (limited) powers to block the repression of reform-minded opposition groups since doing so helps in creating a less negative public perception of state coercion—to the benefit of the government. Here, by contrast, stronger institutions work as a commitment not to take concealed actions to sweep possible evidence of incompetence under the carpet. This commitment, while potentially costly when incompetent, is valuable in the opposite case: it means that the electorate takes absence of evidence as a strong signal of the incumbent's competence—with beneficial electoral consequence.

At a different level, this paper relates to research on how the digital space, and all the innovations that have come with it, affects the balance of power between leaders, authoritarian or not, and actors in the opposition. A key theme is whether, or when, the digital space and its new communication tools strengthen the opposition by facilitating coordination and mobilization—and when it should be expected to have a weakening effect due to the enhanced possibilities for propaganda, surveillance, and repression (e.g., Edmond 2013; Little 2016; Manacorda and Tesei 2020; Dragu and Lupu 2021). Focusing on the economic rather than the political sphere, the enhanced possibilities for surveillance, and the associated potential for misuse, are also a

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<sup>5</sup>Of course, many commitment problems are unrelated to asymmetric information. See Gehlbach et al. (2016) for a review of commitment problems that make autocrats accept some “rules of the game”.



key theme in Oechslin and Steiner (2022). Here, the spotlight is on another, so far neglected, aspect of the digital space: its function as a chronicler that increasingly puts facts on the record that in the past would have gone undocumented. Accounting for a leader’s response to that, this paper asks what the chronicler function means for how well voters are informed eventually.

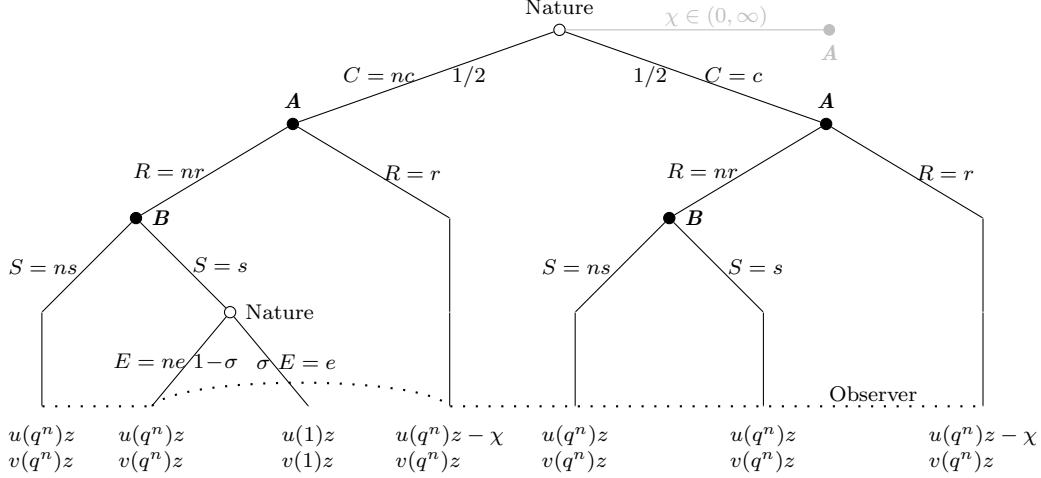
### 3 Setup

**Players and actions.** There are two players,  $A$  and  $B$ , and an observer. While player  $A$  is always asked to act, it depends on player  $A$ ’s decision whether or not player  $B$  is called on to act, too. The observer forms a posterior belief that affects both players’ payoffs, as specified in the next two paragraphs. Nature also has a part to play. First, it determines whether or not player  $A$  is competent:  $C \in \{c, nc\}$ , where  $c$  stands for competent and  $nc$  for not competent. The probability of each option is  $1/2$ . Second, Nature determines whether in case of  $C = nc$  a possible search by player  $B$  for evidence of incompetence is successful or not:  $E \in \{e, ne\}$ , where  $e$  means success and  $ne$  failure. The probability of success is given by  $\sigma > 0$ . In the analysis below, richer open-source information is captured by a larger  $\sigma$ .

Having learned her level of competence,  $C$ , player  $A$  must decide on whether or not to use repression:  $R \in \{r, nr\}$ , where  $r$  means that player  $A$  uses repression and  $nr$  that it desists from repression. If player  $A$  chooses the former option, player  $B$  is barred from searching for evidence of incompetence. Otherwise, player  $B$  has to decide on whether or not to search:  $S \in \{s, ns\}$ , where  $s$  stands for a decision in favor of a search and  $ns$  for a decision against. For player  $B$ , player  $A$ ’s level of competence is observable. But only a successful search for evidence ( $S = s$  and  $E = e$ ) allows the observer, an “outside party”, to verify  $C = nc$ . Figure 2 shows the options available to Nature and the players at any given point.

**Beliefs.** The observer neither directly sees Nature’s decision on competence nor that on evidence (if any). Similarly, the observer neither directly sees player  $A$ ’s repression decision nor player  $B$ ’s search decision (if any). These are hidden actions. But the observer knows the structure of the game and understands the players’ incentives. The observer’s posterior belief about the probability of player  $A$  being incompetent is denoted by  $q$ . Following a successful search for evidence by player  $B$ , the observer verifies  $C = nc$ , which in turn implies  $q = 1$ . If evidence of incompetence is absent, the observer’s posterior is denoted by  $q^n$ . Thus,  $q \in \{q^n, 1\}$ . The possibility of repression invites a signal-jamming effect: if used with a strictly positive probability, repression is an additional reason for why evidence of incompetence may

Figure 2: The game in extensive form



*Notes.* The dashed line indicates that the observer does not know the previous moves in case of absence of evidence. The figure also refers to an extended version of the model, in which player  $A$  chooses the cost of repression,  $\chi$ , prior to Nature's decision on competence.

fail to surface. As a result, the signal “absence of evidence” carries less information and hence will have less of an impact on  $q^n$ , the observer's absent-evidence posterior.

**Payoffs.** Player  $A$  wants to win a fresh term in her current position, while player  $B$  seeks to take over that position from the former. The successful player receives a benefit of size  $z > 0$ , the losing player gets nothing. The outcome of this competition is influenced by two factors, the observer's posterior,  $q$ , and the incumbency advantage enjoyed by player  $A$ ,  $\alpha \in (0, 1)$ , where a larger  $\alpha$  means a stronger advantage. In particular, the chance that player  $A$  wins a fresh term is given by  $u(q) = [1 - (1 - \alpha)q]$ ; player  $B$  takes over with probability  $v(q) = (1 - \alpha)q$ . Thus, given  $\alpha$ , the chance of a win by player  $A$  is a decreasing function of the observer's posterior belief about the probability that player  $A$  is incompetent. On the other hand, given  $q$ , the chance of a win by player  $A$  is an increasing function of that player's incumbency advantage. In short, incompetence hurts, incumbency helps. Appendix II introduces an explicit objective function for the observer and derives  $u$  and  $v$  from optimizing behavior. The modeling involves a trade-off between economic competence and closeness in terms of a value issue.

Repression, while preventing a search for possible evidence of player  $A$ 's incompetence, is costly: if player  $A$  chooses  $R = r$ , her payoff is cut by  $\chi > 0$ . For the most part,  $\chi$  is treated as an exogenous parameter. But in the final part of Section 7,  $\chi$  becomes a choice variable, determined by player  $A$  before Nature chooses competence. We define the two players'

payoffs as the expected benefit (possibly less  $\chi$  in  $A$ 's case) after all decisions have been taken and posterior  $q$  has been formed (but before chance allocates the position). The payoffs are indicated at the bottom of Figure 2. The top (bottom) line refers to player  $A$  ( $B$ ).

**Robustness.** For parsimony, the baseline analysis assumes that searching for evidence is costless and that the cost of repression is independent of  $\sigma$ . But obviously, looking for clues in open-source information and compiling them into convincing evidence may also involve a cost.<sup>6</sup> Moreover, richer open-source information may make concealing repression costlier. Therefore, Section 8 assumes a strictly positive search cost: player  $B$ 's payoff is cut by  $\psi > 0$  if the player chooses  $S = s$ . In a separate step, that section also treats the relative cost of repression,  $\chi/z$ , as a strictly increasing function of  $\sigma$ . The findings of the baseline analysis are shown to be robust if  $\psi$  is less than  $\chi$  and the elasticity of  $\chi/z$  with respect to  $\sigma$  is less than 1.

## 4 Discussion

This setup captures in broad terms a standard situation that arises in many different spheres, such as politics, business, and civil society: the fate of an incumbent depends on the perception of her competence; the latter can be influenced by obscuring facts that cast a negative light on the incumbent's record. Avoiding blame for mistakes (rather than claiming credit for successes) is indeed a time-tested way of holding on to a contested position (Hood 2011).

While the framework described in Section 3 is broadly applicable, its specific design reflects deeper trends in the information landscape and the exercise of power in weaker democracies and autocracies. Regarding the former, the framework captures that the decentralized nature of open-source information makes it an equalizing force (Larkin 2016). It disproportionately enhances access to intelligence for actors outside the executive—such as the opposition—compared to the executive, which already has established and well-resourced information-gathering facilities. Summarizing the relevant part of the literature, Ghioni et al. (2023, p. 11) note that open-source information “is seen as a critical tool in leveling the playing field”. Regarding the exercise of power, the framework takes up that many modern leaders with a leaning towards autocracy sustain power primarily by manipulating the facts the general public gets to see (Guriev and Treisman 2019, 2022), by making voters “believe—rationally but incorrectly—that they are competent” (Guriev and Treisman 2019, p. 101), in particular when

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<sup>6</sup>The existence of a search cost is a possible explanation for why the observer does not search for evidence: if the observer is composed of many agents (e.g., voters) and screening diverse sources involves a cost that is large for any single agent, only  $B$ —who has a chance of replacing  $A$  and winning  $z$ —may want to incur that cost.

it comes to the stewardship of the economy. In fact, modern autocrats try to keep a democratic facade by holding elections (Little 2017)—elections that are informationally manipulated. Such manipulation often involves the hidden silencing of the opposition. In this regard, Guriev and Treisman (2019, p. 102) observe that, when using violence to silence unwelcome voices, modern autocrats “seek to camouflage the purpose or to conceal the state’s role in violent acts”. But in many cases the hidden repression of unwelcome voices does not even involve violence, making it even harder to observe. A frequent non-violent form is the promotion of self-censorship (Gehlbach et al. 2022) via targeted threats to leverage online defamation laws or tax laws to initiate fabricated court cases (whose merits are difficult to discern for the casual observer). Online censorship is another widespread form of hidden, non-violent repression (Roberts 2020; Zhuravskaya et al. 2020; Earl et al. 2022). Such censorship does not necessarily involve direct blocking of content, but may consist in saddling the net with large amounts of irrelevant information and distracting messages, leading to information overload.

In the present setup, player  $A$  can be viewed as an incumbent politician, the holder of a high executive office, who wants to defend her position in an upcoming election. Player  $B$  takes on the role of the opposition politician, while the observer represents the electorate. As explicitly modeled in Appendix II, one can think that the electorate has an a priori preference for the incumbent politician based on a “value issue”. But the salience of this preference is subject to random factors, hence the election’s stochastic element. At the same time, the electorate holds a dislike for possible future economic losses that would result from continued incompetence—and thus also considers the opposition politician who is known for his aptitude. An example of a policy domain in which current incompetence, if not addressed, tends to have delayed economic consequences is fiscal policy, where long implementation lags (Ramey 2011) and the gradual phasing-in of new programs are not uncommon.<sup>7</sup>

Motivated by the above observations regarding repression, the model assumes that any repression by the incumbent is directed at the opposition, aims to suppress a search for early evidence of incompetence, and is hidden from the electorate. But the incumbent’s power is not unchecked. There is a cost of repression, which reflects the strength of the safeguards against the misuse of executive power. With stronger safeguards, the illegitimate, hidden silencing of unwelcome voices requires more resources in terms of attention, sophistication, and money. Moreover, stronger safeguards may also narrow the scope for deriving private gain from the entrusted powers. So strong safeguards manifest themselves in a large ratio of cost of repression

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<sup>7</sup>For instance, continued incompetence in fiscal policy may lead to a proliferation of projects that prove to be unsustainable “white elephants”. The government may fear the emergence of early evidence that allows voters to verify that it overlooked warning signs or was misled due to its intense contacts with self-interested lobbies.

to private gain. In practice, the safeguards consist in institutional checks like formal provisions that protect judiciary from undue political interference. The formal checks may be complemented by informal ones (Baland et al. 2020), for instance an anticorruption norm that disapproves of corruption in the administration and judiciary.

## 5 Equilibrium Strategies

**Pure strategies.** From Figure 2, it is clear that there are two nodes at which player  $B$  is called on to act. First consider the node following the decisions  $C = nc$  (Nature) and  $R = nr$  (player  $A$ ). At that node, player  $B$  expects the payoff associated with  $S = s$  to exceed the payoff associated with  $S = ns$  by  $\sigma(1-\alpha)(1-q^n)z$ . From the perspective of the observer, there is always a strictly positive probability that the non-publication of evidence of incompetence is due to  $C = c$ . Therefore, in any equilibrium, the observer’s absence-evidence posterior,  $q^n$ , must be strictly less than 1. Given  $\sigma > 0$  and  $\alpha < 1$ , it follows that player  $B$  expects a strictly positive payoff difference and thus decides to search for evidence:  $S = s$ . Now consider the node following the decisions  $C = c$  (Nature) and  $R = nr$  (player  $A$ ). At that node, a search for evidence of incompetence would be in vain with certainty. As a result, the expected payoff difference is 0 and player  $B$  is indifferent between  $S = s$  and  $S = ns$ . In what follows, we assume that in this case the player decides not to search:  $S = ns$ .

With player  $B$ ’s behavior characterized, we now turn to player  $A$ ’s preceding decision on repression. That is, we determine player  $A$ ’s strategy—given the posterior belief formed by the observer in absence of evidence of incompetence. First suppose that player  $A$  is competent ( $C = c$ ). Then, independent of  $q^n$ , repression, while costly, would not serve any purpose. Player  $A$  therefore desists from repression. Now assume that player  $A$  is incompetent ( $C = nc$ ). In that case, repression ( $R = r$ ) gives player  $A$  an expected payoff of

$$EU^A(nc, r \mid q^n) = [1 - (1 - \alpha)q^n]z - \chi, \quad (1)$$

where  $[1 - (1 - \alpha)q^n]$  is used for  $u(q^n)$ . If player  $A$  desists from repression ( $R = nr$ ), we obtain

$$EU^A(nc, nr \mid q^n) = (1 - \sigma)[1 - (1 - \alpha)q^n]z + \sigma[1 - (1 - \alpha)]z, \quad (2)$$

where  $[1 - (1 - \alpha)]$  substitutes for  $u(1)$ . Together, equations (1) and (2) imply that repression

comes with a strictly larger expected payoff if and only if

$$(1 - \alpha)(1 - q^n)\sigma > \chi/z. \quad (3)$$

Condition (3) implies that player  $A$ , if incompetent, is more inclined to use repression when the incumbency advantage,  $\alpha$ , is smaller; when the observer's absent-evidence posterior about the chance of incompetence,  $q^n$ , is smaller; when the success chance of a search for evidence,  $\sigma$ , is larger; and when the cost of using repression relative to the benefit from holding the contested position is smaller. For a given  $q^n$ , condition (3) determines player  $A$ 's strategy in case  $C = nc$ :

$$R^*(nc \mid q^n) = \begin{cases} nr & : (1 - \alpha)(1 - q^n)\sigma \leq \chi/z \\ r & : (1 - \alpha)(1 - q^n)\sigma > \chi/z \end{cases}. \quad (4)$$

Equilibrium requires player  $A$ 's strategy to be consistent with the absent-evidence posterior formed by the observer. First assume  $R^*(nc \mid q^n) = nr$  (no-repression equilibrium). What is the value of the corresponding  $q^n$ ? Absence of evidence of incompetence could mean that, indeed, player  $A$  is competent; or it could mean that  $A$  is incompetent, but player  $B$ 's search effort was unsuccessful. The probability of the former eventuality is  $1/2$ , that of the latter is  $(1/2)(1 - \sigma)$ . As a result, according to Bayes' rule,<sup>8</sup>

$$q_{nr}^n = \frac{1 - \sigma}{2 - \sigma}. \quad (5)$$

It follows from equation (5) that, as  $\sigma$  rises from 0 (search never successful) to 1 (search always successful),  $q_{nr}^n$  monotonically decreases from  $1/2$  to 0. However, given  $q_{nr}^n$ , is it indeed optimal for player  $A$  to choose  $R = nr$ ? Together, equations (4) and (5) imply that it is if and only if

$$\sigma \leq \bar{\sigma}_{nr} \equiv 2 \left( 1 + \frac{1 - \alpha}{\chi/z} \right)^{-1}. \quad (6)$$

So, for the no-repression equilibrium to exist,  $\sigma$  must be sufficiently small.

Now suppose that  $R^*(nc \mid q^n) = r$  (full-repression equilibrium). Then, the absence of evidence of incompetence does not contain any information. Hence, the posterior must be equal to the prior:  $q_r^n = 1/2$ . Given this, is it indeed optimal for player  $A$  to choose repression?

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<sup>8</sup>The rule says that the conditional probability  $q_{nr}^n = \Pr[C = nc \mid \text{no evidence}]_{nr}$  is given by the probability of the second eventuality, divided by the sum of the probabilities of the two eventualities.

It follows from equation (4) that it is if and only if  $\sigma$  is sufficiently large. Specifically:

$$\sigma > \underline{\sigma}_r \equiv 2 \left( \frac{1 - \alpha}{\chi/z} \right)^{-1}. \quad (7)$$

We conclude that, if  $\sigma$  is sufficiently large, the repression equilibrium does exist. Because  $(1 - \alpha)/(\chi/z)$  is strictly positive, it follows from equations (6) and (7) that  $\bar{\sigma}_{nr} < \underline{\sigma}_r$ .

**Mixed strategy if incompetent.** The analysis so far has shown that an incompetent player  $A$  does not follow a pure strategy if  $\bar{\sigma}_{nr} < \sigma \leq \underline{\sigma}_r$ . Instead, she relies on a mixed strategy that uses repression with probability  $m$ . A mixed strategy requires

$$EU^A(nc, r \mid q_m^n) = EU^A(nc, nr \mid q_m^n), \quad (8)$$

where  $q_m^n$  refers to the observer's corresponding posterior. To find the posterior, note that the absence of evidence of incompetence could mean that, indeed, player  $A$  is competent; or it could mean that player  $A$  is incompetent, but relies on repression; or it could mean that the player is incompetent, has desisted from repression, but player  $B$ 's search effort was unsuccessful. The probability of the first eventuality is  $1/2$ , that of the second is  $(1/2)m$ , and that of the third is  $(1/2)(1 - m)(1 - \sigma)$ . As a result, according to Bayes' rule,<sup>9</sup>

$$q_m^n = \frac{1 - \sigma(1 - m)}{2 - \sigma(1 - m)}. \quad (9)$$

Using the explicit expressions for the two expected utilities (equations 1 and 2) and for the posterior (equation 9), equation (8) can be rearranged to obtain an expression for probability  $m$ :

$$m = 1 - \left( \frac{2}{\sigma} - \frac{1 - \alpha}{\chi/z} \right) \quad (10)$$

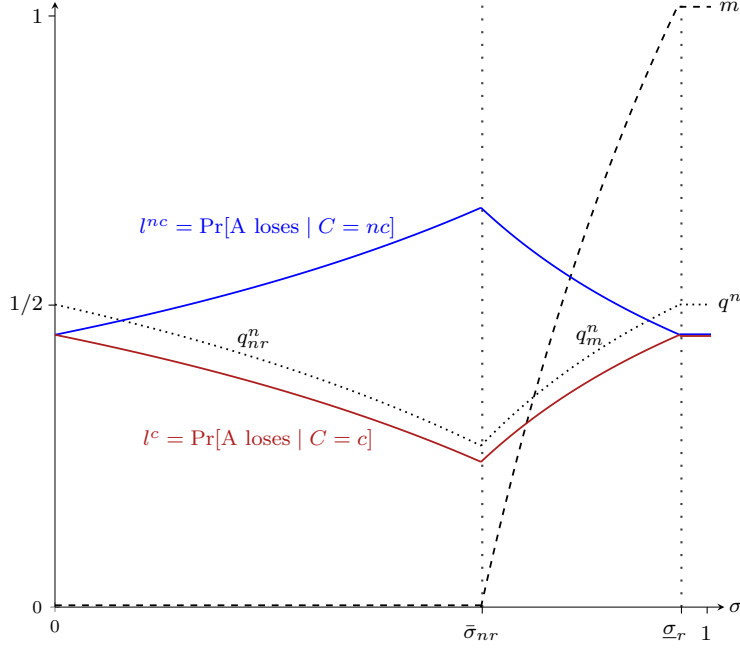
Note that  $m > 0$  is equivalent to  $\sigma > \bar{\sigma}_{nr}$ , while  $m \leq 1$  is equivalent to  $\sigma \leq \underline{\sigma}_r$ . Thus, if  $\sigma$  falls in an intermediate range that neither allows for the no-repression nor the repression equilibrium, there is a partial-repression equilibrium in which player  $A$ , if incompetent, relies on repression with some positive probability. Using equation (10) to substitute for  $m$  in equation (9) yields:

$$q_m^n = 1 - \frac{\chi/z}{1 - \alpha} \frac{1}{\sigma}. \quad (11)$$

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<sup>9</sup>Here the rule says that the conditional probability  $q_m^n = \Pr[C = nc \mid \text{no evidence}]_m$  is the sum of the probabilities of the second and third eventuality, divided by the sum of the probabilities of all three eventualities.

Figure 3: Key equilibrium outcomes as functions of  $\sigma$



*Notes.* The parameter constellation is such that all three equilibria emerge as  $\sigma$  rises across its range. It is also assumed that the incumbency advantage,  $\alpha$ , is strictly positive.

Provided  $\bar{\sigma}_{nr} < 1$ , it follows from equations (5) and (11) that  $q_m^n = q_{nr}^n$  if  $\sigma$  is at the upper end of the no-repression range,  $\bar{\sigma}_{nr}$ . Similarly, provided  $\underline{\sigma}_r < 1$ , we have  $q_m^n = q_r^n = 1/2$  if  $\sigma$  is at the lower end of the repression range,  $\underline{\sigma}_r$ . So, in any case,  $q^n$  is a continuous function of  $\sigma$ .

**Summary and discussion.** The following proposition summarizes the results established so far, assuming that the parameter constellation allows for all three equilibria (proof in the text).

**PROPOSITION 1** *Suppose  $\chi/z < (1 - \alpha)/2$  so that  $\underline{\sigma}_r < 1$ . Then, as  $\sigma \in (0, 1]$  rises across its range, there is a succession of three different types of perfect Bayesian equilibria (PBE) that entails an escalation of repression:*

- No repression: if  $\sigma \leq \bar{\sigma}_{nr} < \underline{\sigma}_r$ , there is a pure-strategy PBE in which: A desists from repression no matter her level of competence; if A is incompetent, B searches for evidence and succeeds with chance  $\sigma$ ; the observer's absent-evidence posterior,  $q_{nr}^n$ , is given by (5).
- Partial repression: if  $\bar{\sigma}_{nr} < \sigma \leq \underline{\sigma}_r$ , there is a PBE in which: A desists from repression if competent and else relies on a mixed strategy that uses repression with chance  $m$ , where  $m$  is given by (10); if A is incompetent and desists from repression, B searches for evidence



and succeeds with chance  $\sigma$ ; the observer's absent-evidence posterior,  $q_m^n$ , is given by (11).

- Full repression: if  $\bar{\sigma}_{nr} < \underline{\sigma}_r < \sigma$ , there is a pure-strategy PBE in which:  $A$  desists from repression if competent and uses repression if incompetent;  $B$  never searches for evidence; the observer's absent-evidence posterior,  $q_r^n$ , is fixed at  $1/2$ .

Figure 3 visualizes  $m$  and  $q^n$ . The use of repression,  $m$ , escalates as  $\sigma$  rises across the partial-repression range, increasing monotonically from 0 to 1. The observer's absent-evidence posterior,  $q^n$ , starts and ends at  $1/2$ , the value of the prior probability. When  $\sigma \rightarrow 0$ , a search for evidence is never successful; so absence of evidence does not contain any information about player  $A$ 's competence. At the opposite end, when  $\sigma \geq \underline{\sigma}_r$ , player  $B$  is never allowed to search for evidence—with the result that absence of evidence is again completely uninformative. To understand the V-shape profile of  $q^n$  in between, it is helpful to consider the informativeness of the signal “absence of evidence” as  $\sigma$  traverses the partial-repression range:

**PROPOSITION 2** *Suppose  $\chi/z < (1 - \alpha)/2$  so that  $\underline{\sigma}_r < 1$ . Then, as  $\sigma$  rises across the partial-repression range, the observer experiences an information loss: for  $\sigma \in (\bar{\sigma}_{nr}, \underline{\sigma}_r]$ , the equilibrium probability of the observer seeing evidence of incompetence conditional on  $C = nc$ ,*

$$\Pr[\text{observer sees evidence} \mid C = nc]_m = 2 - \frac{1 - \alpha}{\chi/z} \sigma, \quad (12)$$

*is a strictly decreasing function of  $\sigma$ .*

**Proof.** See Appendix III. ■

Proposition 2 says that the escalation of repression is sufficiently severe such that it more than offsets the enhanced availability of evidence. Concealed repression is thus increasingly the reason the observer fails to see evidence of incompetence. In other words, as  $\sigma$  traverses the partial-repression range, the signal “absence of evidence” gets more and more jammed and contains less and less information. But why this severe escalation of repression? The reason lies in the different effects on the expected utilities associated with  $R = nr$  and  $R = r$ . Given  $m$ , an increase in  $\sigma$  reduces the expected utility associated with  $R = nr$  because the prime effect is an increase the probability of evidence surfacing. However, the expected utility associated with  $R = r$  rises since the signal “absence of evidence”, which repression ensures, becomes more informative for the observer. So two force— $R = nr$  becoming less attractive and  $R = r$  becoming more attractive—create a strong divergence in expected utility, prompting an aggressive rise in the use of repression. In turn, this response by player  $A$  reduces the information the signal “absence of evidence” contains, closing the gap in expected utility.

The V-shaped profile of the absent-evidence posterior can now be readily understood. As  $\sigma$  rises from 0 through the no-repression range,  $q^n$  must fall: with repression absent and player  $B$ 's search effort more likely to succeed, absence of evidence implies a lower ex post probability that player  $A$  is incompetent. However, once the threshold for partial repression is crossed, absence of evidence becomes an increasingly jammed signal of competence, leading  $q^n$  to eventually return to its prior probability of  $1/2$ . As will become clear below, for player  $A$ , this signal-jamming effect is the downside that comes with the opportunity to use repression. While repression is useful if, in fact, the player is incompetent, the opportunity to use repression lifts the observer's absent-evidence posterior regarding the probability of  $C = nc$ .

## 6 Equilibrium Turnover

**Reelection probabilities.** So far, the analysis has returned two main results: as open-source information gets richer, player  $A$ , if incompetent, increasingly relies on repression (Proposition 1), implying a gradual information loss for the observer (Proposition 2). But what are the implications for player  $A$ 's chance of reelection? This section shows how  $\sigma$  affects the probability of player  $A$  losing when incompetent,  $l^{nc} = \Pr[A \text{ loses} \mid C = nc]$ , and when competent,  $l^c = \Pr[A \text{ loses} \mid C = c]$ . Using these results, the section then shows how open-source information affects the welfare of the observer (according to the preferences modeled in Appendix II).

**PROPOSITION 3** *Suppose  $\chi/z < (1 - \alpha)/2$  so that  $\underline{\sigma}_r < 1$ . Then, as  $\sigma \in (0, 1]$  rises across its range,  $l^{nc}$  and  $l^c$  first diverge and then converge, such that competence first has an increasing and then a decreasing influence on reelection:*

- $l^{nc}$ : the equilibrium probability that an incompetent player  $A$  loses to  $B$  follows a continuous inverted V-shape profile—it first strictly increases (no repression), then strictly decreases (partial repression), and then remains unchanged (full repression).
- $l^c$ : the equilibrium probability that a competent player  $A$  loses to  $B$  follows a continuous V-shape profile—it first strictly decreases (no repression), then strictly increases (partial repression), and then remains unchanged (full repression).

**Proof.** See Appendix III. ■

Figure 3 visualizes  $l^{nc}$  and  $l^c$ . How can the inverted V-shape of  $l^{nc}$  be explained? An increase in  $\sigma$  lifts the chance that a search effort by player  $B$  makes incompetence, if any, verifiable to the observer. As long as an incompetent player  $A$  desists from repression, this

means that incompetence is more likely to be exposed and then “punished”. With  $\sigma$  in the partial-repression range, the chance of a search for evidence being successful continues to grow. However, at the same time, an incompetent player  $A$  is increasingly inclined to prevent a search for evidence. In fact, the use of repression rises steeply in  $\sigma$ : the marginal effect of an increase in  $\sigma$  on the use of repression is  $2/\sigma^2 > 1$  (from equation 10), while the probability of a search being successful rises just 1-for-1 in  $\sigma$ . For the observer, the net effect is an information loss: evidence of incompetence becomes less and less likely to reach the observer—and the chance that incompetence entails the loss of the position recedes again. Eventually, when  $\sigma$  exceeds the full-repression threshold, there is no longer a positive chance that player  $B$  searches for evidence. So  $q^n$  is fixed at  $1/2$  and  $l^{nc}$  is a constant, too. Beyond the full-repression threshold, the gap between  $1/2$  and  $l^{nc}$  (see Figure 3) reflects the incumbency advantage,  $\alpha$ .

When starting from a low level, an increase in  $\sigma$  not only makes the survival of incompetence less likely, it also lifts the chance that a competent incumbent stays on: at first, as shown in Figure 3,  $l^c$  is a decreasing function of  $\sigma$ . But as soon as  $\sigma$  reaches the partial-repression range,  $l^c$  changes direction. The reason is that the signal “absence of evidence” gets increasingly jammed and contains less and less information. As a result, the absent-evidence posterior belief about incompetence re-approaches the less favorable prior of  $1/2$ —and the chance of losing despite being competent grows. Eventually, when  $\sigma$  exceeds the full-repression threshold, absence of evidence no longer offers information on competence. Hence,  $l^{nc} = l^c$ .

The result that for all  $\sigma < \underline{\sigma}_r$  the conditional probabilities  $l^{nc}$  and  $l^c$  move in opposite directions suggests that the unconditional probability of player  $A$  losing,  $l = \Pr[A \text{ loses}]$ , could be rather stable as open-source information becomes richer. This is indeed true:

**PROPOSITION 4** *Suppose  $\chi/z < (1 - \alpha)/2$  so that  $\underline{\sigma}_r < 1$ . Then, as  $\sigma \in (0, 1]$  rises across its range, the unconditional equilibrium probability that player  $A$  loses to  $B$  is a constant:  $l = (1 - \alpha)/2$ .*

**Proof.** See Appendix III. ■

Together, Propositions 3 and 4 imply that richer open-source information leads to “redistribution” between the two different types of player  $A$ . Any gain by the competent type in terms of a lower chance of losing is mirrored in a loss of exactly equal size by the incompetent type in terms of a higher chance of losing (and vice versa). But richer open-source information does not lead to systematic shifts in the a priori success probabilities of players  $A$  and  $B$ . Put differently, the current analysis does not suggest that richer open-source information would accelerate or slow down the turnover in contested positions.

**Impact on observer.** As the formal modeling in Appendix II shows, the functions  $u(q)$  and  $v(q)$ —which specify how the observer’s posterior translates into the probability of a win by, respectively, player  $A$  and player  $B$ —rest on the assumption that the observer faces a trade-off: while the incumbent is closer in terms of a value issue, reelecting an incompetent incumbent comes at an economic cost. According to these preferences, how does a secular trend towards richer open-source information affect the utility expected by the observer at the outset of the game? As Appendix II establishes in formal terms, the paths of  $l^{nc}$  and  $l^c$  are associated first with a rising expected utility (no-repression range) and then with a falling expected utility (partial-repression range). Consider first the no-repression range: with  $\sigma$  rising towards  $\bar{\sigma}_{nr}$ , the probability that voters drop an incompetent incumbent increases ( $l^{nc} \uparrow$ ), while the probability that a competent one has to leave decreases ( $l^{nc} \downarrow$ ). With a higher  $l^{nc}$ , there is a lower probability that the observer makes the mistake of not replacing an incompetent incumbent when doing so would be optimal. With a lower  $l^c$ , there is a lower probability that the observer makes the mistake of replacing a competent incumbent with a player that is less close in terms of the value issue. With those two mistakes becoming less likely, expected utility rises.<sup>10</sup> But as soon as  $\sigma$  crosses into the partial-repression range, the chances of both mistakes reverse course and start to increase—and the welfare gains gradually vanish.

In an empirical paper, Marx et al. (2022) show that electoral turnover improves subsequent economic performance. Is this also what our observer should anticipate? Assuming that the economic cost associated with confirming an incompetent incumbent means sluggish performance, we indeed arrive at an equivalent theoretical conclusion: in equilibrium, expected economic performance following a win by player  $B$  exceeds expected economic performance following a win by player  $A$ . However, as long as the threshold to partial repression is not crossed, a rising  $\sigma$  reduces this difference. The reason is that with a larger  $\sigma$  there is a lower chance that the observer confirms an incumbent who is incompetent (see above). But as soon as  $\sigma$  reaches the partial-repression range, the difference starts to widen again.

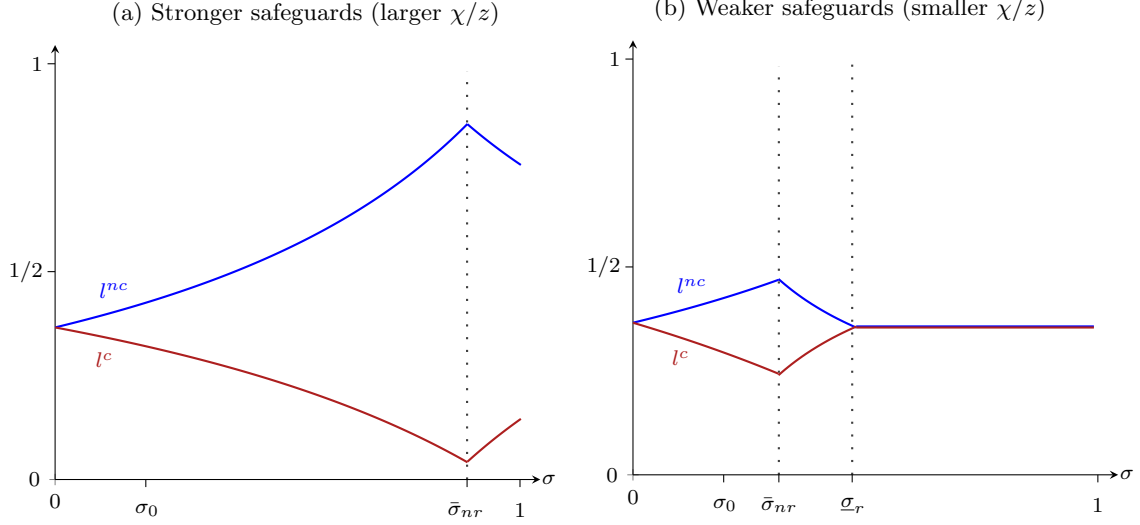
## 7 Safeguards

**Exogenous safeguards.** Proposition 3 establishes that richer open-source information, by intensifying repression, may decrease the chance of a loss when player  $A$  is incompetent and may increase that chance when the player is competent. But the use of repression by an incompetent incumbent is not only influenced by a shifting informational environment. Repression

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<sup>10</sup>One can frame the two mistakes also in the terminology of hypothesis testing. Suppose the observer’s null is that player  $A$  is competent. Then, the first mistake is akin to a type II error, the second one to a type I error.

Figure 4: Departure probabilities with stronger and weaker safeguards



Notes.  $\sigma_0$  is an arbitrary start level of  $\sigma$  that gives rise to a no-repression equilibrium in both cases.

also depends on structural parameters. The current section studies their role, relying on the elections interpretation of the setup. That is, player  $A$  is an incumbent politician, player  $B$  an opposition politician, and the observer represents the electorate.

According to the analysis so far, a key magnitude when it comes to the use of repression is the ratio  $\chi/z$ , which gives the cost of using repression relative to the benefit from holding the contested position. The larger  $\chi/z$ , the larger the thresholds that separate the three different equilibria (equations 6 and 7). As discussed in Section 4,  $\chi/z$  mirrors the strength of the safeguards against the misuse of executive power: all else equal, stronger safeguards increase the level of resources needed for successful repression and may also narrow down the extent to which the entrusted position can be misused for private gain. In practice, safeguards may consist in institutional checks (e.g., formal provisions that protect the public administration and judiciary from undue political interference) as well as norms-based checks (e.g., the general disapproval of corruption on the part of officials in the public administration and judiciary). A formal way to express this is to write  $\chi/z = s(\gamma, \nu)$ , where  $\gamma \geq 0$  and  $\nu \geq 0$  capture the strengths of the institutional and norms-based checks, respectively, and  $s(\gamma, \nu)$  is continuous and strictly increasing in both arguments. In what follows, we understand  $\chi/z$  as an overall indicator of the strength of the safeguards against the misuse of executive power (which in turn are based on institutional and norms-based checks). For the moment, and consistent with the

analysis so far, both  $\gamma$  and  $\nu$  are treated as exogenous parameters.

Figure 4 illustrates  $l^{nc}$  and  $l^c$  with stronger (a) and weaker (b) safeguards. Assuming that the start level of  $\sigma$ ,  $\sigma_0$ , gives rise to a no-repression equilibrium, the figure shows that with stronger safeguards there is a broad range over which the departure probability of an incompetent incumbent rises and that of a competent one falls. But with weaker safeguards,  $l^{nc}$  and  $l^c$  soon change direction. Accordingly, the safeguards against the misuse of executive power moderate the relationship between information and the chance of the incumbent winning:

**PROPOSITION 5** *Consider an arbitrary start level of  $\sigma \in (0, 1]$ ,  $\sigma_0$ , that is strictly less than 1. Suppose  $\sigma$  rises from  $\sigma_0$  to 1. Then:*

- Strong safeguards: *There exists a minimum level of safeguards against the misuse of executive power,  $\underline{\chi/z} = (1 - \alpha)$ , such that for all  $\chi/z = s(\gamma, \nu) \geq \underline{\chi/z}$  the equilibrium probability  $l^{nc}$  ( $l^c$ ) strictly increases (decreases) as  $\sigma$  rises.*
- Weak safeguards: *There exists a maximum level of safeguards against the misuse of executive power,  $\overline{\chi/z} = (1 - \alpha)\sigma_0/(2 - \sigma_0)$ , such that for all  $\chi/z = s(\gamma, \nu) < \overline{\chi/z}$  the equilibrium probability  $l^{nc}$  ( $l^c$ ) decreases (increases) as  $\sigma$  rises.*

**Proof.** See Appendix III. ■

Proposition 5 establishes a third main result: a secular trend towards richer open-source information may have exactly opposite consequences, depending on the (exogenously fixed) safeguards against the misuse of executive power. With sufficiently strong safeguards, such a trend unambiguously raises the chance that incompetence is punished and competence rewarded; with sufficiently weak safeguards, the trend reduces these probabilities. In-between, the effect of the trend is non-monotonic (Figure 4). Viewed from a different angle, the above analysis suggests that the relationship between, on the one hand, institutions and norms and, on the other hand, information is complementary: when it comes to punishing incompetence and rewarding competence, richer information helps if the safeguards against the misuse of executive power are strong; strong safeguards help if the available information is rich. Clearly, the analysis does not support any notion that one could substitute for the other.

In addition to  $\chi/z$ , the setup also includes the parameter  $\alpha$ , which captures the incumbency advantage derived from closeness with the electorate in terms of some value issue. The incumbency advantage is a structural parameter to such a degree as the value issue is a persistent topic. Proposition 5 shows that  $\alpha$ , too, influences the effect of richer information: the minimum level of safeguards for a globally beneficial effect of  $\sigma$ ,  $\underline{\chi/z}$ , is larger when  $\alpha$  is smaller. This

is intuitive: the more precarious the position of the incumbent, the stronger the safeguards needed to deter her from using repression. It is equally intuitive that also the maximum level of safeguards for a globally harmful effect of  $\sigma$ ,  $\overline{\chi/z}$ , is larger when  $\alpha$  is smaller.

**Endogenous safeguards.** In practice, the determinants of the safeguards against the misuse of executive power by the government—institutional and norms-based checks—are deep-rooted and inert factors. They cannot be quickly engineered or adjusted (Acemoglu and Robinson 2020). But it is still legitimate to ask how strong player  $A$ , the incumbent politician, would prefer the safeguards to be if she were given a choice. This section thus turns the strength of the safeguards, in the model captured by the ratio  $\chi/z = s(\gamma, \nu)$ , into a choice variable. It does so by assuming that the incumbent can choose  $\gamma$ , the strength of the institutional checks.<sup>11</sup> Arguably,  $\gamma$  is among the factors that set the stage on which the strategic interaction then unfolds. Its determination is therefore placed at the very beginning, before Nature chooses the incumbent’s level of competence. That is, the incumbent has to make a choice behind the “veil of ignorance”. When choosing  $\gamma$ , and hence  $\chi/z$ , the incumbent aims to maximize the expected payoff, anticipating that the game will continue as specified in Proposition 1. Note that the incumbent can introduce any level of  $\gamma$  without incurring a cost.

The analysis returns a clear-cut result for the choice of  $\gamma$  if, in addition to the no-cost assumption, the following technical conditions are met: *i.* even for  $\gamma = 0$ ,  $\chi/z = s(\gamma, \nu) > 0$  (e.g., due to strictly positive norms-based checks); *ii.*  $s(\gamma, \nu)$  is unbounded in  $\gamma$  (so that  $\chi/z$  has no upper limit); *iii.* the functional form of  $s(\gamma, \nu)$  is restricted such that an increase in  $\gamma$  lifts  $\chi/z = s(\gamma, \nu)$  via an increase in  $\chi$  only (i.e., benefit  $z$  is unaffected by  $\gamma$ ).

**PROPOSITION 6** *Assume that player  $A$ , the incumbent politician, can introduce any level of institutional checks,  $\gamma$ , without incurring a cost before Nature determines her level of competence. Moreover, suppose the technical conditions *i.* to *iii.*, specified above, hold.*

*Then, the incumbent politician chooses  $\gamma$  such that the resulting safeguards against the misuse of executive power,  $\chi/z = s(\gamma, \nu)$ , will give rise to a no-repression equilibrium.*

**Proof.** See Appendix III. ■

In a situation where the incumbent has just learned that her level of competence is low ( $C = nc$ ), she prefers the safeguards against the misuse of executive power to be weak. But Proposition 6 says that at an earlier stage, where the level of competence is not yet chosen, the incumbent prefers the safeguards to be such that they prevent the use of repression should

<sup>11</sup>The alternative assumption, namely that the government has the power to modify norms-based checks, e.g., the extent to which society as a whole disapproves of corruption, would certainly be less plausible.

she turn out to be incompetent later on.<sup>12</sup> What at first sight might look like a contradiction simply reflects that the benefit of strong safeguards in case of  $C = c$  outweighs the benefit of weak safeguards in case of  $C = nc$ . But how would the incumbent, should she turn out to be competent, benefit from strong safeguards? As strong safeguards rule out the use of repression even if  $C = nc$ , the electorate—who neither observes  $C$  nor  $R$ —knows that absence of evidence cannot be due to repression. So the electorate’s absent-evidence posterior about the probability of  $C = nc$ ,  $q^n$ , is lower in the no-repression equilibrium than under partial or full repression. That is, in the no-repression equilibrium, the incumbent does not suffer from the signal-jamming effect that works to her disadvantage. At the same time, when competent, giving up the option of repression has no drawback at all.

What could Proposition 6 mean for the dynamics of the safeguards against the misuse of executive power in places where such safeguards are weak? The proposition establishes a benchmark result that applies behind the veil of ignorance—and if stronger safeguards do not require substantial resources and primarily work through raising the cost of repression. But even if these conditions are met, one should not expect the safeguards to evolve smoothly in lockstep with the trend in open-source information. Real-world institutional checks are not engineered based on an optimization exercise, but are often rooted in specific historical circumstances. As a result, in the short to medium run, the institutional development in places with weak safeguards might not keep up with the trend in information and thus fail to prevent a further rise in repression. What Proposition 6 does suggest, however, is that the political elite itself, in parallel with the electorate, would increasingly benefit from stronger safeguards. In the long run, this might promote institutional reforms that allow the trend towards richer open-source information to bring beneficial consequences.

## 8 Robustness

**Nonzero search cost.** Up to this point, the analysis has assumed that player  $B$ ’s search for evidence of incompetence is costless. In practice, though, the process of finding clues in a vast and unorganized source and then compiling them into convincing evidence requires effort. This subsection assumes that in case of  $S = s$  player  $B$ ’s payoff is cut by  $\psi > 0$ . Relative to the baseline analysis (with an exogenous  $\chi$ ), everything else is kept unchanged. If  $\psi$  is sufficiently small, search costs result in only a minor modification to Proposition 1:

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<sup>12</sup>If asked, the opposition would agree with the incumbent. Thus, if the decision on  $\gamma$  required unanimity, the result would still be safeguards that are sufficiently strong to induce the no-repression equilibrium.



**PROPOSITION 7** *Assume that the cost of searching for evidence of incompetence is strictly positive but strictly less than the cost of repression:  $0 < \psi < \chi$ . Moreover, as in Proposition 1, suppose  $\chi/z < (1 - \alpha)/2$ .*

*Then, there exists a  $\tilde{\sigma} < \bar{\sigma}_{nr}$  such that:*

- *For  $\sigma \leq \tilde{\sigma}$ , the no-repression equilibrium described in Proposition 1 does not exist. Instead, there is a no-repression-no-search pure-strategy PBE: player A desists from repression no matter her level of competence; player B does not search for evidence no matter player A's level of competence; the observer's absent-evidence posterior is  $1/2$ .*
- *For  $\sigma > \tilde{\sigma}$ , Proposition 1 continues to hold: depending on the value of  $\sigma$ , there is either the no-repression, the partial-repression, or the full-repression equilibrium.*

**Proof.** See Appendix III. ■

Assuming a nonzero search cost of  $\psi < \chi$  thus partitions the original no-repression range,  $(0, \bar{\sigma}_{nr}]$  into two subranges,  $(0, \tilde{\sigma}]$  and  $(\tilde{\sigma}, \bar{\sigma}_{nr}]$ . If  $\sigma$  belongs to the former subrange, there is only the no-repression-no-search equilibrium as characterized in Proposition 7. The reason is that with  $\sigma \leq \tilde{\sigma}$  the probability of the search succeeding is too small to justify the strictly positive search cost. However, if  $\sigma$  belongs to the latter subrange, the no-repression equilibrium as characterized in Proposition 1 continues to exist because for player B the expected benefit due to the increase in the chance of being elected exceeds the cost of the search.

In Figure 3, this partitioning means that for  $\sigma \leq \tilde{\sigma}$  all outcome variables stick to their levels for  $\sigma \rightarrow 0$ . But as soon as  $\sigma$  crosses the  $\tilde{\sigma}$ -threshold,  $q^n$ ,  $l^c$ , and  $l^{nc}$  jump to the levels shown in the figure (and then behave as in the figure as  $\sigma$  increases). With Proposition 1 (and Figure 3) only modestly modified, the essence of the subsequent analysis is also preserved.

**Increasing relative cost of repression.** In the baseline analysis, the cost of hidden repression relative to the benefit from holding the contested position depends on the strength of the institutional,  $\gamma$ , and norms-based,  $\nu$ , checks on executive power:  $\chi/z = s(\gamma, \nu)$ . Open-source information, on the other hand, is assumed to leave  $\chi/z$  unaffected. In practice, though, richer open-source information may make it more difficult to conceal repression (and may also narrow the scope for deriving private benefits from the position). This subsection assumes that the relative cost of hidden repression is an increasing function of  $\sigma$ , while both  $\gamma$  and  $\nu$  are treated as exogenous parameters. If the relative cost of hidden repression does not rise too sharply in  $\sigma$ , Proposition 1 is essentially unchanged:

**PROPOSITION 8** *Assume that the relative cost of repression is also a function of  $\sigma$ :  $\chi/z = \bar{s}(\sigma, \gamma, \nu)$ . Further assume that  $\bar{s}(\sigma, \gamma, \nu)$  is strictly increasing and differentiable in  $\sigma$ , with  $\bar{s}(\sigma, \gamma, \nu)$ 's elasticity to  $\sigma$  strictly less than 1 and  $\bar{s}(\sigma, \gamma, \nu)/\sigma$  going to infinity as  $\sigma$  approaches 0. Moreover, similar to Proposition 1, suppose  $\bar{s}(1, \gamma, \nu) < (1 - \alpha)/2$ .*

*Then, the three different types of PBE continue to exist as described in Proposition 1, with the only modification concerning the two thresholds  $\bar{\sigma}_{nr}$  and  $\underline{\sigma}_r$ .*

**Proof.** See Appendix III. ■

Proposition 8 says that a moderately increasing relative repression cost does not affect whether, but only when, player  $A$  switches from no to partial, and then to full repression.<sup>13</sup> The values of the modified thresholds, which in analogy to their baseline counterparts can be denoted by  $\bar{\sigma}_{nr}^{\text{in}}$  and  $\underline{\sigma}_r^{\text{in}}$ , depend on the specific functional form of  $\bar{s}(\sigma, \gamma, \nu)$ . With Proposition 1 largely unchanged, the essence of the subsequent analysis based on an exogenous and constant relative repression cost is also preserved.

## 9 Conclusion

Edmond (2013, p. 1423) observed that “information optimism has a long and somewhat mixed history”. As all our actions become ever more likely to be on the record, there is again optimism—this time that it will become easier to hold governments to account. The current paper sets up a game-theoretic model to explore whether, or to what extent, the present optimism is warranted. The model highlights the possibility that richer open-source information leads to intensified repression against free speech; in turn, more repression means that the electorate experiences an information loss—with the result that incompetent governments have a better, and competent ones a worse, chance of reelection. In the model, such a negative outcome arises when the safeguards against the misuse of executive power are weak such that repression is cheap and public offices lucrative. This prediction is consistent with the empirical observation that the sustained decline in global freedom of expression that started after 2012 can primarily be attributed to countries with weaker safeguards.

The current analysis leads to two broad conclusions. The first conclusion is that a secular trend towards richer open-source information will amplify differences among countries along institutional lines. In places where strong institutional safeguards against the misuse of executive power prevent a slide into repression, “bad”—incompetent or corrupt—governments will in-

<sup>13</sup>A specific functional form that satisfies the requirements of Proposition 8 is  $\bar{s}(\sigma, \gamma, \nu) = s(\gamma, \nu) \cdot \sigma^\eta$ , with  $0 < s(\gamma, \nu) < (1 - \alpha)/2$  and  $0 < \eta < 1$ . The elasticity of  $\bar{s}$  with respect to  $\sigma$  is given by  $\eta < 1$ .

creasingly be exposed as such; to the extent that voters value competence and integrity, this will help the quality of government. But in places where the institutional safeguards are weak, the trend will intensify repression against free speech; as a result, incompetence is less often punished and competence less often rewarded. Over time, the increasing quality gap between places with strong and weak institutional safeguards may amplify cross-country differences in economic performance. This is a particular worry for international bodies like the European Union that aim to reduce economic differences via transfers but count among their members countries with widely differing institutions (Alesina et al. 2017).

A second broad conclusion concerns the importance of institutional safeguards against the misuse of executive power. A priori, it might be tempting to think that, as acts of government incompetence or wrongdoing become more likely to leave traces that can be compiled into convincing evidence for voters, such safeguards lose in importance. The results here point in the opposite direction. The role of institutional checks that prevent the executive from trampling free speech, such as an independent judiciary that stands as a bulwark against fabricated court cases, becomes bigger, not smaller. That is, information and institutions are complements, not substitutes. As an ever growing share of human activity is chronicled, it becomes increasingly important to strengthen the institutional checks in a way that enables them to withstand the heightened incentives for repression. In practice, institutions show inertia in the short to medium term. But it is not implausible that they get strengthened over a longer time horizon. The current analysis characterizes circumstances in which even the political elite accedes to calls for better institutional safeguards.

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# Open-Source Information and Repression

## APPENDIX

January 27, 2024

### I Information about Figure 1

The illegitimate silencing of critical voices by a government is a misuse of executive power. This appendix details how the sample of countries underlying Figure 1 is split into two sub-samples according to the strength of the safeguards against such misuse. In practice, safeguards against the misuse of executive power consist of institutional and norms-based checks. Formal provisions protecting the public administration and judiciary from undue political interference are an example of the former, while norms disapproving of corruption in the administration and judiciary exemplify the latter. An obvious empirical proxy for institutional checks is the “Checks on government” indicator from the World Bank’s [GovData360](#) database. The indicator measures the extent to which the other branches of government (legislature, judiciary) control the executive (rather than the other way round). For the purpose of Figure 1, a country is said to have strong institutional checks if it is above the 75th percentile in that dimension; and to have weaker institutional checks if it is below that percentile. The classification is based on the mean value over the years from 2002 (start of the period shown in Figure 1) to 2019 (most recent observation for this indicator).

An empirical proxy for the strength of the norms-based checks can be found with the help of Fisman and Miguel (2007), a paper that helps gauge the strength of the anticorruption norm using the number of parking violations committed by foreign diplomats positioned in New York City. Until November 2002, parking violations by foreign diplomats were not enforced due to diplomatic immunity. Fisman and Miguel (2007, p. 1021) argue that parking illegally under these conditions aligns well with a standard definition of corruption and that “the comparison of parking violations by diplomats from different societies serves as a plausible measure of the extent of corruption social norms”. In other words: a high number of parking violations prior to November 2002 is an indication of a weak anticorruption norm in a diplomat’s country of origin. Fisman and Miguel (2007) provide country-level data on the number of parking violations

per diplomat and year, averaged over the period from November 1997 to November 2002. Consistent with the definition of strong institutional checks, here a country is considered to have strong norms-based checks if it is below the 25th percentile in terms of parking violations, and to have weaker norms-based checks if it is above that percentile.

The definition of strong safeguards used in Figure 1 considers both the strength of the institutional and norms-based checks. In particular, we say that a country has strong safeguards against the misuse of executive power if and only if it combines strong institutional checks with strong norms-based checks. Accordingly, a country is said to have weaker safeguards if it qualifies as weaker in at least one of the two dimensions. A priori, one might expect that the countries with strong institutional checks are also those whose diplomats commit few parking violations (strong anticorruption norm). But with a correlation coefficient of  $-0.15$ , the relationship is only mildly negative. As a result, even though the top 25% consist of 35 countries in each dimension, the intersecting set counts just 17 observations. Finally, note that the pattern in Figure 1 is robust to applying a somewhat stricter definition (top 20% of countries) or a somewhat looser definition (top 30% of countries) of “strong”.

## II Derivation of $u$ and $v$

The terms for expected utility shown at the bottom of Figure 2 are based on ad-hoc assumptions on how the observer’s posterior,  $q$ , affects the probabilities associated with player  $A$  being reelected,  $u(q)$ , and player  $B$  being elected instead,  $v(q)$ . But  $v$  and  $u$  can be derived from optimizing behavior by the observer. In practice, as discussed in Section 4, the observer could be an electorate that elects a prime minister or a firm owner who appoints a CEO.

Suppose that the observer’s utility is affected by two factors. On the one hand, keeping player  $A$  in her current position generates a benefit. This may reflect that player  $A$  is a better match for the observer in terms of a non-economic—or “value”—issue that is of particular importance to the observer. But the salience of this value issue is subject to chance. For concreteness, denote the size of the benefit (in utility terms) by  $a \geq 0$  and assume that Nature draws  $a$  from a uniform distribution with support  $[0, \omega]$ , where  $\omega > 1$ . On the other hand, there is the possibility of an economic loss whose size (in utility terms) is normalized to 1. This loss materializes if and only if player  $A$  is incompetent and kept in her position. The loss may result from damages that, for instance, an economy (with  $A$  as the incumbent prime minister) or a company (with  $A$  as the incumbent CEO) incurs if the position is in incompetent hands for two consecutive terms. There is no uncertainty, however, when it comes to player  $B$ , who



is a “safe pair of hands”, known for being competent in positions like the contested one. As a result, awarding the position to player  $B$  would definitely avoid any economic loss.

Nature draws  $a$  after the observer, having noticed the surfacing or absence of evidence, has formed  $q$ . Knowing  $a$ , the observer then settles for the player who maximizes expected utility,

$$W(P) = \begin{cases} a - q & : P = A \\ 0 & : P = B \end{cases}, \quad (\text{A1})$$

where  $P = A$  means a decision in favor of the incumbent and  $P = B$  one in favor of player  $B$ . Assuming that in case of equal expected utility the observer prefers the incumbent, it follows from equation (A1) that player  $A$  is reelected if  $a \geq q$  and that player  $B$  is elected otherwise. Thus, at the point where the observer has formed  $q$  but Nature has not yet drawn  $a$  from the uniform distribution, the chance of player  $A$  being reelected is

$$u(q) = \Pr[A \text{ reelected} \mid q] = (1/\omega)(\omega - q). \quad (\text{A2})$$

Using the transformation  $\alpha = 1 - (1/\omega)$  results in  $u(q) = [1 - (1 - \alpha)q]$ . Thus, the more salient the value issue can become, the larger the incumbency advantage,  $\alpha$ . The expression for  $v(q)$ , the chance of a win by player  $B$ , now follows immediately.

For completeness, the current appendix also provides the level of utility an observer with the above preferences should expect at the start of the game:

$$\text{observer's expected utility at outset} = \begin{cases} \frac{1}{4} \left[ 2 \frac{\alpha}{1-\alpha} + \frac{1-\alpha}{2-\sigma} \right] & : \sigma \leq \bar{\sigma}_{nr} < \underline{\sigma}_r \\ \frac{1}{4} \left[ 2 \frac{\alpha}{1-\alpha} + \frac{\chi/z}{\sigma} \right] & : \bar{\sigma}_{nr} < \sigma \leq \underline{\sigma}_r \\ \frac{1}{4} \left[ 2 \frac{\alpha}{1-\alpha} + \frac{1-\alpha}{2} \right] & : \bar{\sigma}_{nr} < \underline{\sigma}_r < \sigma \end{cases}. \quad (\text{A3})$$

Equation (A3) specifies a continuous function of  $\sigma$  that is strictly increasing in  $\sigma$  as long as  $\sigma \leq \bar{\sigma}_{nr}$ , and then strictly decreasing as long as  $\sigma \leq \underline{\sigma}_r$ , returning to the level for  $\sigma \rightarrow 0$ . Expected utility stays at that level for all values of  $\sigma > \underline{\sigma}_r$ .

### III Proofs

**Proposition 2.** Under partial repression, with an incompetent player  $A$ , player  $B$  searches for evidence whenever the former desists from repression (Proposition 1). Player  $A$  desists from

repression with probability  $(1 - m)$  and any search effort is successful with probability  $\sigma$ . Thus:

$$\Pr[\text{observer sees evidence} \mid C = nc]_m = (1 - m) \sigma. \quad (\text{A4})$$

Replacing in equation (A4) probability  $m$  with the explicit expression provided in equation (10), and then rearranging terms, yields the equation stated in the proposition. Finally, since both  $(1 - \alpha)$  and  $\chi/z$  are strictly positive,  $\Pr[\text{observer sees evidence} \mid C = nc]_m$  is a strictly decreasing function of  $\sigma$  (falling from  $\bar{\sigma}_{nr}$  for  $\sigma \rightarrow \bar{\sigma}_{nr}$  to 0 for  $\sigma \rightarrow \underline{\sigma}_r$ ).

**Proposition 3.** Given  $q$ , the probability of player  $A$  losing to player  $B$  can be written as  $(1 - \alpha)q$ , where  $q = 1$  if there was a successful search for evidence by player  $B$  and  $q = q^n$  otherwise. In turn, the functional form of  $q^n$  depends on the type of equilibrium.

First consider  $\Pr[A \text{ loses} \mid C = nc]$ , the probability of losing when incompetent. In the no-repression equilibrium ( $nr$ ), the law of iterated expectations implies

$$\begin{aligned} \Pr[A \text{ loses} \mid C = nc]_{nr} &= (1 - \sigma) \Pr[A \text{ loses} \mid C = nc, \text{no evidence}]_{nr} \\ &\quad + \sigma \Pr[A \text{ loses} \mid C = nc, \text{evidence}]. \end{aligned} \quad (\text{A5})$$

Equation (A5) uses the result that, whenever player  $A$  is incompetent ( $C = nc$ ) and desists from repression ( $R = nr$ ), player  $B$  searches for evidence and is successful with probability  $\sigma$ . Now consider the two conditional probabilities on the right-hand side of equation (A5). The first one is given by  $(1 - \alpha)q_{nr}^n$  and the second one by  $(1 - \alpha) 1$ . Thus,

$$\Pr[A \text{ loses} \mid C = nc]_{nr} = (1 - \alpha) [(1 - \sigma)q_{nr}^n + \sigma]. \quad (\text{A6})$$

Replacing in equation (A6)  $q_{nr}^n$  with the explicit expression provided in equation (5), and then rearranging terms, results in  $\Pr[A \text{ loses} \mid C = nc]_{nr} = (1 - \alpha)/(2 - \sigma)$ .

Let's now turn to the partial-repression equilibrium ( $m$ ). Accounting for the fact that player  $B$  searches (with success chance  $\sigma$ ) if player  $A$  is incompetent ( $C = nc$ ) and desists from repression ( $R = nr$ ), the law of iterated expectations implies

$$\begin{aligned} \Pr[A \text{ loses} \mid C = nc]_m &= (1 - m) \{ (1 - \sigma) \Pr[A \text{ loses} \mid C = nc, \text{no evidence}]_m \\ &\quad + \sigma \Pr[A \text{ loses} \mid C = nc, \text{evidence}] \} + m \Pr[A \text{ loses} \mid C = nc, \text{no evidence}]_m. \end{aligned} \quad (\text{A7})$$

Equation (A7) reflects that under partial repression player  $A$  uses repression with probability

$m$ . The first (and third) conditional probability on the right-hand side of the equation is given by  $(1 - \alpha)q_m^n$ . As above, the second one is  $(1 - \alpha)$ . Hence,

$$\Pr[A \text{ loses} \mid C = nc]_m = (1 - \alpha) \{ (1 - m) [(1 - \sigma)q_m^n + \sigma] + mq_m^n \}. \quad (\text{A8})$$

Explicit expressions for  $m$  and  $q_m^n$  are given by equations (10) and (11), respectively. Using them in equation (A8), and then rearranging terms, yields  $\Pr[A \text{ loses} \mid C = nc]_m = \chi/(z\sigma)$ .

In the full-repression equilibrium ( $r$ ), the observer never sees evidence of incompetence and the absence-evidence posterior equals  $1/2$ . Therefore,  $\Pr[A \text{ loses} \mid C = nc]_r = (1 - \alpha)(1/2)$ .

Combining the results so far, and observing the  $\sigma$ -subranges stated in Proposition 1, one gets

$$l^{nc} = \Pr[A \text{ loses} \mid C = nc] = \begin{cases} (1 - \alpha)/(2 - \sigma) & : \sigma \leq \bar{\sigma}_{nr} < \underline{\sigma}_r \\ \chi/(z\sigma) & : \bar{\sigma}_{nr} < \sigma \leq \underline{\sigma}_r \\ (1 - \alpha)/2 & : \bar{\sigma}_{nr} < \underline{\sigma}_r < \sigma \end{cases} \quad (\text{A9})$$

The inverted V-shape profile mentioned in the proposition arises immediately from equation (A9). As for continuity, observe that  $(1 - \alpha)/(2 - \sigma)$  equals  $\chi/(z\sigma)$  at the threshold separating the no-repression and the partial-repression equilibrium and that  $\chi/(z\sigma)$  equals  $(1 - \alpha)/2$  at the threshold separating the partial-repression and the full-repression equilibrium.

Now consider  $\Pr[A \text{ loses} \mid C = c]$ . If  $C = c$ , evidence of incompetence does not exist (and is also never searched for). So  $\Pr[A \text{ loses} \mid C = c] = (1 - \alpha)q^n$ . Given this, Proposition 1 implies

$$l^c = \Pr[A \text{ loses} \mid C = c] = \begin{cases} (1 - \alpha)(1 - \sigma)/(2 - \sigma) & : \sigma \leq \bar{\sigma}_{nr} < \underline{\sigma}_r \\ (1 - \alpha) - \chi/(z\sigma) & : \bar{\sigma}_{nr} < \sigma \leq \underline{\sigma}_r \\ (1 - \alpha)/2 & : \bar{\sigma}_{nr} < \underline{\sigma}_r < \sigma \end{cases} \quad (\text{A10})$$

The V-shape profile mentioned in the proposition is that of  $q^n$ , scaled by the factor  $(1 - \alpha)$ , and continuity follows from the continuity of  $q^n$ .

**Proposition 4.** The unconditional probability of player  $A$  losing to player  $B$  can be written as

$$\Pr[A \text{ loses}] = (1/2) \Pr[A \text{ loses} \mid C = nc] + (1/2) \Pr[A \text{ loses} \mid C = c] = (1/2)(l^{nc} + l^c). \quad (\text{A11})$$

Replacing in equation (A11)  $l^{nc}$  and  $l^c$  with the expressions in equations (A9) and (A10), respectively, immediately leads to  $l = \Pr[A \text{ loses}] = (1 - \alpha)/2$  for all  $\sigma \in (0, 1]$ .

**Proposition 5.** Regarding the first claim of the proposition, note that  $\bar{\sigma}_{nr}$  is a function of  $\chi/z \in (0, \infty)$  that under any parameter constellation increases from  $\lim_{\chi/z \rightarrow 0} \bar{\sigma}_{nr}(\chi/z) = 0$  to  $\lim_{\chi/z \rightarrow \infty} \bar{\sigma}_{nr}(\chi/z) = 2$  in a strictly monotonic fashion. So there always exists a  $\underline{\chi/z} < \infty$  such that  $\bar{\sigma}_{nr}(\underline{\chi/z}) = 1$  and  $\bar{\sigma}_{nr}(\chi/z) > 1$  for all  $\chi/z > \underline{\chi/z}$ . It follows from  $\sigma \leq 1$  and equations (A9) and (A10) that with  $\chi/z \geq \underline{\chi/z}$  only the strictly increasing arm of  $l^{nc}$  is relevant and only the strictly decreasing arm of  $l^c$  is relevant. As a result, for any  $\chi/z \geq \underline{\chi/z}$ , equilibrium probability  $l^{nc}$  is a strictly increasing function of  $\sigma$  on  $[\sigma_0, 1]$  and equilibrium probability  $l^c$  is a strictly decreasing function of  $\sigma$  on  $[\sigma_0, 1]$ . The specific term for  $\underline{\chi/z}$ , shown in the proposition, is found by solving  $\bar{\sigma}_{nr}(\underline{\chi/z}) = 1$ , where  $\bar{\sigma}_{nr}(\chi/z)$  is given by equation (6).

Regarding the second claim, note that the above exposition immediately implies that under any parameter constellation and for any  $\sigma_0 > 0$  there must exist a  $\overline{\chi/z} > 0$  such that  $\bar{\sigma}_{nr}(\overline{\chi/z}) = \sigma_0$  and  $\bar{\sigma}_{nr}(\chi/z) < \sigma_0$  for all  $\chi/z < \overline{\chi/z}$ . It follows from equations (A9) and (A10) that with  $\chi/z < \overline{\chi/z}$  the strictly increasing arm of  $l^{nc}$  is irrelevant and the strictly decreasing arm of  $l^c$  is irrelevant. As a result, for any  $\chi/z < \overline{\chi/z}$ , equilibrium probability  $l^{nc}$  is a decreasing function of  $\sigma$  on  $[\sigma_0, 1]$  and equilibrium probability  $l^c$  is an increasing function of  $\sigma$  on  $[\sigma_0, 1]$ . The specific term for  $\overline{\chi/z}$ , again shown in the proposition, is found by solving  $\bar{\sigma}_{nr}(\overline{\chi/z}) = \sigma_0$ , where  $\bar{\sigma}_{nr}(\chi/z)$  is given by equation (6).

**Proposition 6.** To set  $\gamma$ —and hence  $\chi/z$ —prior to the start of the game shown in Figure 2, player  $A$  computes the expected payoff under each of the three equilibria characterized in Proposition 1. In doing so, player  $A$  observes that the chance of being competent is  $1/2$ . Below,  $EU_x^A$  denotes the expected payoff if  $\gamma$ —and hence  $\chi/z$ —is chosen so as to induce equilibrium  $x \in \{nr, m, r\}$ . For the no-repression equilibrium, the law of iterated expectations gives rise to

$$EU_{nr}^A = \frac{1}{2} \{ (1 - \sigma) [1 - (1 - \alpha) q_{nr}^n] z + \sigma [1 - (1 - \alpha) 1] z \} + \frac{1}{2} [1 - (1 - \alpha) q_{nr}^n] z. \quad (\text{A12})$$

Replacing in equation (A12)  $q_{nr}^n$  with the explicit expression in equation (5), and then rearranging terms, results in  $EU_{nr}^A = z(1 + \alpha)/2$ . This expression is independent of  $\sigma$ , reflecting that, on the one hand, a rise in  $\sigma$  is beneficial to a competent player  $A$  as it makes absence of evidence a stronger signal of competence. On the other hand, if incompetent, a rise in  $\sigma$  harms  $A$  as a search for evidence becomes more likely successful. The net effect is zero.

Moving to the partial-repression equilibrium, one finds that the analogue to equation (A12) is

$$EU_m^A = \frac{1}{2} \{ [1 - (1 - \alpha) q_m^n] z - \chi \} + \frac{1}{2} [1 - (1 - \alpha) q_m^n] z. \quad (\text{A13})$$

Equation (A13) uses that under partial repression  $(1 - \sigma) [1 - (1 - \alpha)q_m^n] z + \sigma [1 - (1 - \alpha) 1] z$  is equal to  $[1 - (1 - \alpha)q_m^n] z - \chi$ . Replacing in equation (A13)  $q_m^n$  with the explicit expression in equation (9), and then rearranging terms, results in  $EU_m^A = z\alpha + \chi/\sigma - \chi/2$ .

Finally, if player  $A$  sets  $\gamma$ —and hence  $\chi/z$ —to initiate full repression, the expected payoff is

$$EU_r^A = \frac{1}{2} \{ [1 - (1 - \alpha)q_r^n] z - \chi \} + \frac{1}{2} [1 - (1 - \alpha)q_r^n] z. \quad (\text{A14})$$

Taking into account that  $q_r^n = 1/2$ , and then rearranging terms, yields  $EU_r^A = z(1 + \alpha)/2 - \chi/2$ . As under no repression, the expected payoff is independent of  $\sigma$ . This time the reason is that player  $B$  is never in a position to search for evidence of incompetence.

Combining the results so far, and observing the  $\sigma$ -subranges stated in Proposition 1, one gets

$$EU^A = \begin{cases} z(1 + \alpha)/2 & : \sigma \leq \bar{\sigma}_{nr}(\chi/z) < \underline{\sigma}_r(\chi/z) \\ z\alpha + \chi/\sigma - \chi/2 & : \bar{\sigma}_{nr}(\chi/z) < \sigma \leq \underline{\sigma}_r(\chi/z) \\ z(1 + \alpha)/2 - \chi/2 & : \bar{\sigma}_{nr}(\chi/z) < \underline{\sigma}_r(\chi/z) < \sigma \end{cases} \quad (\text{A15})$$

To identify the value of  $\gamma$ —and hence of  $\chi/z$ —that maximizes  $EU^A$ , we first compare the expected payoff in an arbitrary full-repression equilibrium (third line of equation A15) to the expected payoff under no repression (first line of equation A15). Taking into account that  $\chi$  is the only magnitude affected by  $\gamma$  (assumption *iii.*), we obtain that the difference between the first and the second expected payoff is given by  $-\chi^r/2$ , where  $\chi^r$  refers to the cost of repression in the arbitrary full-repression equilibrium considered. Since  $\chi$  must be strictly larger than 0 in any equilibrium (assumption *i.*), it follows that the expected payoff under no repression is strictly larger than the expected payoff in any full-repression equilibrium.

We now compare the expected payoff in an arbitrary partial-repression equilibrium (second line of equation A15) to the expected payoff under no repression (first line of equation A15). Again taking into account that  $\chi$  is the only magnitude affected by  $\gamma$  (assumption *iii.*), we obtain that the difference between the first and the second expected payoff is given by  $-(\chi^m/z) [1/\bar{\sigma}_{nr}(\chi^m) - 1/\sigma]$ , where  $\chi^m$  refers to the cost of repression in the arbitrary partial-repression equilibrium considered. Since in any partial-repression equilibrium  $\bar{\sigma}_{nr} < \sigma$ , and because  $\chi > 0$  in any equilibrium (assumption *i.*), it follows that the expected payoff under no repression is strictly larger than the expected payoff in any partial-repression equilibrium. Thus, to summarize, the expected payoff under no repression is strictly larger than the expected payoff in any equilibrium involving either partial or full repression.

The conclusion so far is that player  $A$  has a strict preference for the no-repression equilibrium. But is she also in a position to induce one by choosing  $\gamma$  accordingly? Absence of repression requires  $\bar{\sigma}_{nr} \geq \sigma$ . Since  $\chi/z = s(\gamma, \nu)$  is unbounded in  $\gamma$  (assumption *ii.*) and  $\bar{\sigma}_{nr}$  strictly increasing in  $\chi/z$  with  $\lim_{\chi/z \rightarrow \infty} \bar{\sigma}_{nr} = 2$  (proof of Proposition 5), it follows that player  $A$  can always set a  $\gamma$  that is sufficiently large to satisfy this requirement.

**Proposition 7.** The proof first focuses on when a nonzero search cost of  $0 < \psi < \chi$  affects the existence of the equilibria described in Proposition 1. That is, the analysis initially establishes the conditions under which in case of  $C = nc$  searching for evidence ( $S = s$ ) would no longer be optimal for player  $B$ , given the observer's equilibrium-specific posterior,  $q^n$ . From the first paragraph of Section 5 one can conclude that with a search cost of  $\psi$  player  $B$  expects the payoff associated with  $S = s$  to exceed the payoff associated with  $S = ns$  by  $\sigma(1 - \alpha)(1 - q^n)z - \psi$ . Assuming that  $q^n$  takes the functional forms specified in Proposition 1, how does this excess payoff changes as  $\sigma$  rises across its range? Using equations (5), (11), and  $q_r^n = 1/2$ , one obtains

$$\text{excess payoff} = \begin{cases} (1 - \alpha)[\sigma/(2 - \sigma)]z - \psi & : \sigma \leq \bar{\sigma}_{nr} < \underline{\sigma}_r \\ \chi - \psi & : \bar{\sigma}_{nr} < \sigma \leq \underline{\sigma}_r \\ (1 - \alpha)(\sigma/2)z - \psi & : \bar{\sigma}_{nr} < \underline{\sigma}_r < \sigma \end{cases} \quad (\text{A16})$$

Equation (A16) specifies a continuous function of  $\sigma$  that is strictly increasing as long as  $\sigma \leq \bar{\sigma}_{nr}$ , then constant, and then again strictly increasing for  $\underline{\sigma}_r < \sigma$ . Together with  $\chi - \psi > 0$ , the function's properties imply that the excess payoff crosses the threshold of zero exactly once, from below, and at a level of  $\sigma$ ,  $\tilde{\sigma}$ , that is strictly less than  $\bar{\sigma}_{nr}$ :

$$\tilde{\sigma} \equiv 2 \left( 1 + \frac{1 - \alpha}{\psi/z} \right)^{-1} < \bar{\sigma}_{nr}. \quad (\text{A17})$$

The results so far imply that in the partial and full repression equilibria player  $B$ 's incentives with respect to the search decision are unchanged in comparison with the benchmark of costless search: if  $C = nc$  and  $R = nr$ , player  $B$  chooses  $S = s$ . The partial and full repression equilibria thus continue to exist as described in Proposition 1. For  $\sigma > \tilde{\sigma}$ , this also holds for the no-repression equilibrium. However, for  $\sigma \leq \tilde{\sigma}$ , the no-repression equilibrium ceases to exist: since the excess payoff associated with  $S = s$  in case of  $C = nc$  and  $R = nr$  (and with  $q^n$  given by equation 5) is non-positive, deviating to  $S = ns$  becomes optimal.

Now consider the no-repression-no-search pure-strategy PBE characterized in the proposition. To establish this equilibrium for  $\sigma \leq \tilde{\sigma}$ , first consider possible incentives for player  $A$

to deviate to  $R = r$ . Clearly, given that the equilibrium entails that player  $B$  will not search for evidence even if  $C = nc$ , a deviation incentive does not exist irrespective of  $C$ . But how about possible incentives for player  $B$  to deviate to  $S = s$ ? The absence of such an incentive is obvious if  $C = c$ . To see the lack of a deviation incentive if  $C = nc$ , note that with  $q^n = 1/2$  the excess payoff associated with  $S = s$  is  $(1 - \alpha)[\sigma/2]z - \psi$ . Because the first part of the proof established that for  $\sigma \leq \tilde{\sigma}$  the top row on the right-hand side of equation (A16) is negative, it follows that  $(1 - \alpha)[\sigma/2]z - \psi$  must be negative, too. Therefore, player  $B$  does not deviate to  $S = s$  even if  $C = nc$ . In sum, this means that player  $B$  chooses  $S = ns$  irrespective of  $C$ . Given this, the observer's absent-evidence posterior must be  $1/2$ .

**Proposition 8.** With  $\chi/z$  being a function of  $\sigma$ , it is helpful to rewrite equation (4) as

$$R^*(nc \mid q^n) = \begin{cases} nr & : (1 - \alpha)(1 - q^n) \leq \bar{s}(\sigma, \gamma, \nu)/\sigma \\ r & : (1 - \alpha)(1 - q^n) > \bar{s}(\sigma, \gamma, \nu)/\sigma \end{cases}. \quad (\text{A18})$$

Due to  $(\partial \bar{s}/\bar{s})/(\partial \sigma/\sigma) < 1$ , the ratio  $\bar{s}(\sigma, \gamma, \nu)/\sigma$  is a strictly decreasing function of  $\sigma$ . Moreover, the proposition's other assumptions ensure that the value of that function falls from  $\lim_{\sigma \rightarrow 0} \bar{s}(\sigma, \gamma, \nu)/\sigma \rightarrow \infty$  to  $\bar{s}(1, \gamma, \nu) < (1 - \alpha)/2$  as  $\sigma \in (0, 1]$  rises across its range.

Given this, the range of  $\sigma$ ,  $(0, 1]$ , can be divided into three subranges in a way similar to Proposition 1. Consider first the upper row of equation (A18). The posterior belief consistent with  $R^* = nr$  is still given by  $q_{nr}^n = (1 - \sigma)/(2 - \sigma)$ . Using this, the condition in the upper row becomes  $(1 - \alpha)/(2 - \sigma) \leq \bar{s}(\sigma, \gamma, \nu)/\sigma$ . Taking into account the properties of  $\bar{s}(\sigma, \gamma, \nu)/\sigma$ , it follows that there exists a  $\bar{\sigma}_{nr}^{\text{in}} < 1$ , where superscript “in” stands for “increasing cost”, such that the condition is satisfied for all  $\sigma \leq \bar{\sigma}_{nr}^{\text{in}}$  and violated for all  $\sigma > \bar{\sigma}_{nr}^{\text{in}}$ . The threshold  $\bar{\sigma}_{nr}^{\text{in}}$  is thus the equivalent of  $\bar{\sigma}_{nr}$  in the baseline analysis, representing the maximum value of  $\sigma$  for the no-repression equilibrium (as described in Proposition 1) to exist.

Consider now the lower row of equation (A18). The posterior belief consistent with  $R^* = n$  is also unchanged relative to the baseline analysis and thus still given by  $q_r^n = 1/2$ . Using this, the condition in the lower row becomes  $(1 - \alpha)/2 > \bar{s}(\sigma, \gamma, \nu)/\sigma$ . Taking into account the properties of  $\bar{s}(\sigma, \gamma, \nu)/\sigma$ , it follows that there exists a  $\underline{\sigma}_r^{\text{in}} < 1$  such that the condition is violated for all  $\sigma \leq \underline{\sigma}_r^{\text{in}}$  and satisfied for all  $\sigma > \underline{\sigma}_r^{\text{in}}$ . The threshold  $\underline{\sigma}_r^{\text{in}}$  is thus the equivalent of  $\underline{\sigma}_r$  in the baseline analysis, representing the minimum value of  $\sigma$  for the full-repression equilibrium (as described in Proposition 1) to exist. Also note that the left-hand side of the upper-row condition,  $(1 - \alpha)/(2 - \sigma)$ , is strictly larger than that of the lower-row condition,

$(1 - \alpha)/2$ , for all  $\sigma \in (0, 1]$ . Therefore, as in the baseline analysis,  $\bar{\sigma}_{nr}^{\text{in}} < \underline{\sigma}_r^{\text{in}}$ .

Finally, note that for  $\sigma \in (\bar{\sigma}_{nr}^{\text{in}}, \underline{\sigma}_r^{\text{in}}]$  the analysis of the use of a mixed strategy when incompetent is unaffected by assuming that  $\chi/z$  is a function of  $\sigma$ . The description of the partial-repression equilibrium in Proposition 1 remains valid. The only difference is that in equations (10) and (11), which determine  $m$  and  $q_m^n$ , respectively,  $\chi/z$  is a function of  $\sigma$ . To conclude, the only modification to Proposition 1 is that  $\bar{\sigma}_{nr}$  and  $\underline{\sigma}_r$  are replaced by  $\bar{\sigma}_{nr}^{\text{in}}$  and  $\underline{\sigma}_r^{\text{in}}$ , respectively.

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