Open-Source Information and Repression

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Open-Source Information and Repression

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Abstract

As the digital space becomes an ever more attentive "chronicler" of human activity, the likelihood that acts of government incompetence or wrongdoing leave incriminating traces steadily increases. The current paper proposes an applied game-theoretic model to explore how an incumbent government with reelection concerns responds to the rise in digital open-source information. 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 present 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, repression, institutional checks, manipulated votes

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PBE Perfect Bayesian Equilibrium

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—digital open-source information—has been surging lately. This has nurtured hopes that it will become easier for voters and civil society to hold governments to account. Referring to the surge in digital open-source information, *The Economist* (Aug 7, 2021) wrote that this "is a welcome threat to ... governments with something to hide".[1] 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 digital open-source information only. Similarly, various international bodies have recently relied on digital open-source information to monitor whether governments comply with specific international obligations (Bochert 2021). Some investigative journalistic outfits (such as Bellingcat) are heavy users of open-source information, too.

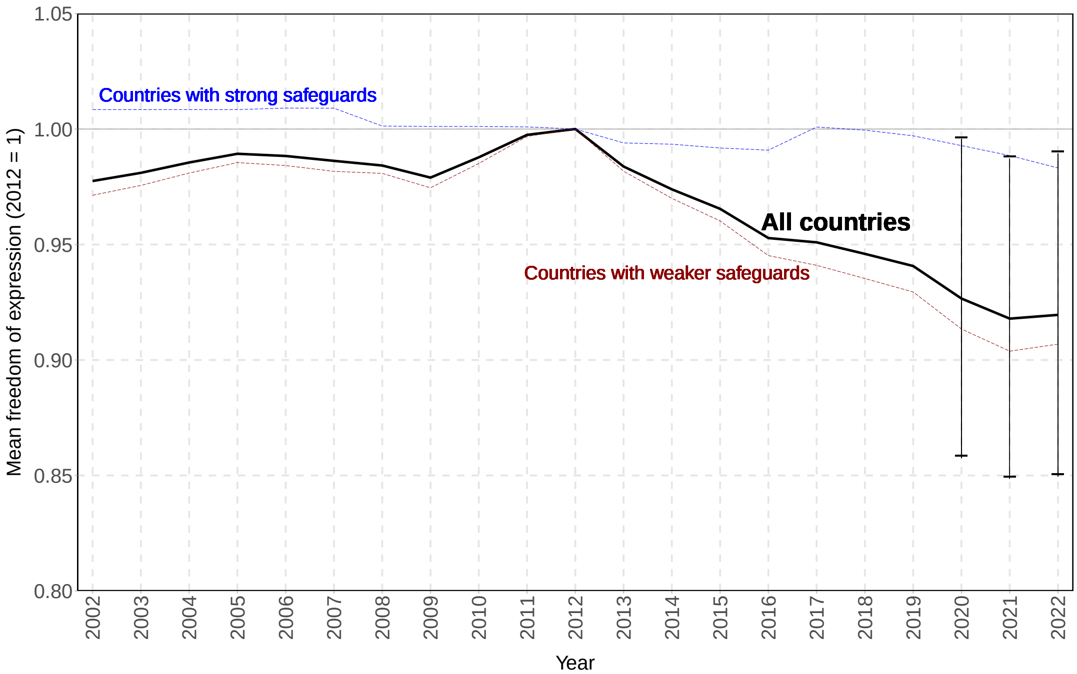
Still, an increase in the chance that acts of government incompetence or wrongdoing leave incriminating evidence somewhere in the public sphere does not necessarily mean that unworthy governments now face a higher chance of losing power. Obviously, such governments may have access to a number of countermeasures. In particular, they may try to prevent incriminating evidence from reaching the general public by silencing (or co-opting) those actors who would filter out such evidence of the large sea of unstructured digital open-source information—opposition groups, journalists, or bloggers.[2] And indeed, in parallel with the rise of digital 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 measure of the extent to which a government respects the freedom of the press and that of ordinary people to discuss political matters in the public sphere. As indicated by the black line in the figure, 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 called 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, within a single framework. It proposes an applied game-theoretic model to explore the consequences for voters and governments with (or without) something to hide.

[1] ChatGPT agrees: open-source intelligence "can serve as a powerful tool for watchdog organizations and civil society groups, who can use it to monitor and hold governments accountable for their actions." (Feb 10, 2023).

[2] Open source does not mean that digital information can be accessed without effort. Gathering and connecting relevant data from the digital space requires resources such as time, data skills, and computing power.

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 App. I for details.

The model is of the political agency type (following, e.g., Persson and Tabellini 2000, Chapter 4; Maskin and Tirole 2004; Alesina and Tabellini 2007, 2008; Smart and Sturm 2013; Guriev and Treisman 2020) but incorporates novel elements. It features an incumbent politician with reelection concerns who is either competent or not, a quality that 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 influences 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 found, would change the electorate's belief to the disadvantage of the incumbent, lifting the prospect of an electoral win by the opposition. Richer digital open-source information is modeled as an increase in the chance that, should the incumbent be incompetent, the opposition is successful in its search for early evidence. That is, richer open-source information raises the productivity of the opposition's search effort. However, the incumbent can repress any such effort, even though this comes at a cost for the incumbent. The size 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 by the incumbent, it understands the incentives of the latter to use it and accounts for them when forming the belief about the incumbent's quality.

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 online censorship (Roberts 2020; Earl et al. 2022) or the promotion of self-censorship through targeted intimidation (Gehlbach et al. 2022). In the present 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*, the benefit an incompetent incumbent incurs through repression increases as digital open-source information becomes richer, possibly intensifying the use of repression. *Second*, if the use of 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 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 digital 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 digital open-source information are not orthogonal to the safeguards in place to check executive power. Sufficiently strong safeguards that can withstand the stronger 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. Therefore, in the longer run, the institutional environment may adapt to the informational advancements.

Linking the model world to the actual one, 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 digital open-source information will amplify cross-country differences along institutional lines. Countries whose institutions prevent a rise in 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 prior, one might think that, with incompetence and dishonesty more likely to leave traces, the importance of formal safeguards that check executive power lessens. The present analysis suggests otherwise: evidence 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, which is then discussed in Section 4. Section 5 characterizes equilibrium strategies, while Section 6 considers equilibrium turnover in the contested position. Both sections also discuss the consequences of a trend towards richer digital open-source information for equilibrium outcomes. Section 7 focuses on the safeguards against the misuse of executive power. Finally, Section 8 concludes.

2 Literature

Like many contributions using a political agency framework, we follow, 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.[3] The main focus is on how elite size determines the regime type and the choice of the manipulation or repression tool. Here, while keeping the regime fixed, we zoom in on how a secular trend towards richer digital open-source information, which steadily improves the productivity of searches for early evidence of incompetence, alters the use of repression by censorship—and on how the struggle between information and repression affects the significance of (in-)competence in elections.

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 the 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). Here, 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 consequences.[4]

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,

[3]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.

[4]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".

the enhanced possibilities for surveillance, and the associated potential for misuse, are also a key theme in Oechslin and Steiner (2022). The present paper emphasizes 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, we ask what the chronicler function means for how well voters are informed eventually.

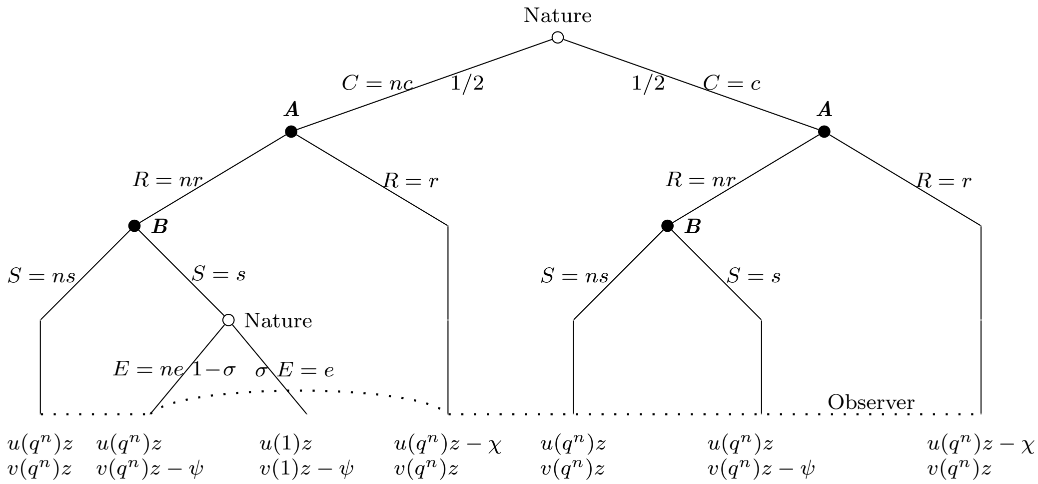
3 Setup

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 digital open-source information is captured by a larger σ.

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 resorts to 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. While player B observes player A's level of competence, only the successful search for evidence ($S = s$ and $E = e$) makes $C = nc$ observable to the observer. Figure 2 shows an overview of the options available to Nature and the two 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 see 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 knows $C = nc$, 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

Figure 2: The game in extensive form



Notes. If $R = r$ (repression), B is barred from searching for evidence of incompetence. If $C = c$ and/or $S = ns$ (A competent and/or no search for evidence), evidence of incompetence cannot surface. The dashed line indicates that the observer does not know the previous moves in case of absence of evidence.

positive probability, repression is an additional reason for why evidence of incompetence may fail to surface. As a result, the signal "absence of evidence" carries less information and hence will have less of an effect 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 α 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 α, 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. App. 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 some "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 $\chi > 0$. Searching for evidence may also involve a cost: player B's payoff is cut by $\psi \geq 0$ if $S = s$.[5] We define the two players' payoffs as the expected benefit (possibly less χ in A's case and possibly less ψ in B's case) after all decisions have been taken and posterior q has been formed (but before chance allocates the position). The payoffs are specified at the bottom of Figure 2. The top (bottom) line refers to player A (B). Regarding ψ, the analysis in the main text assumes $\psi = 0$ for parsimony. But App. III allows for a strictly positive ψ and shows that the key findings are robust as long as $\psi < \chi$. Note that for the most part, χ is treated as an exogenous parameter. But in the final part of Section 7, χ is set by player A before Nature chooses competence.

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 constellation captured by the setup described in Section 3 is quite generic, the concrete modeling of repression is influenced by recent research on the exercise of power in autocracies and weaker democracies. Guriev and Treisman (2019, 2022) argue that, unlike the typical 20th-century autocrat, many modern leaders with a leaning towards autocracy sustain power primarily by manipulating information, by making the broad public "believe—rationally but incorrectly—that they are competent" (Guriev and Treisman 2019, p. 101), in particular when it comes to the stewardship of the economy. In fact, many modern autocrats try to keep a democratic facade by holding elections (Little 2017)—elections that are informationally manipulated. Such manipulation frequently involves the hidden silencing of opposition groups, critical journalists, or bloggers. 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. A frequent non-violent variant 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 hard to discern for the more distant observer). Online censorship through

[5] The existence of a search cost is a possible explanation for why the observer does not search for evidence: if the observer consists of many agents (e.g., voters) and screening digital sources involves a cost that is large for any single agent, only B—who has a chance of replacing A and winning benefit z—may want to incur that cost.

friction or flooding are other widespread forms of hidden, non-violent repression (Roberts 2020; Zhuravskaya et al. 2020; Earl et al. 2022). The former involves the manipulation of internet search results or generally slowing down the net; the latter involves saddling the net with distracting messages, entertainment, or praise for the government. In fact, many modern autocrats "are reverse engineering the technology [the internet] that was supposed to make it impossible for censorship to silence dissent"(Mchangama 2022, p. 121). But even though 21st-century repression is often hidden and hard to observe directly, a substantial body of empirical work (surveyed by Roberts 2020) finds many instances in which citizens were well aware of the possibility of hidden repression when forming their view.

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 App. 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.[6]

Inspired by the above observations regarding repression, the model assumes that any repression by the incumbent is directed at the opposition, serves the purpose of suppressing 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 to private gain. In practice, the safeguards consist of 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 public administration and judiciary.

[6]For instance, continued incompetence in fiscal policy may lead to a proliferation of projects that will eventually prove to be unsustainable "white elephants". The incumbent politician may be concerned about the emergence of evidence that indicates she has overlooked early warning signs about such projects.

How does the use of repression against free speech change when richer open-source information makes the opposition's search for early evidence more productive? What is the net effect on the grip on power by an (in-)competent incumbent? And how do the safeguards against the misuse of executive power moderate how richer open-source information influences repression? These are among the questions to which the analysis now turns.

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 $\sigma(1-\alpha)(1-q^n)z - \psi$. 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 $\sigma > 0$, $\alpha < 1$, and $\psi = 0$, 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 would be in vain with certainty. As a result, the expected payoff difference is $-\psi$. Since $\psi = 0$, 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

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

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

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

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

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

Condition (3) implies that player A, if incompetent, is more inclined to use repression when the incumbency advantage, α, 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, σ, 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 $C = nc$:

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

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,[7]

$$q^n_{nr} = \frac{1-\sigma}{2-\sigma}. \tag{5}$$

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

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

So, for the no-repression equilibrium to exist, σ 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: $q^n_r = 1/2$. Given this, is it indeed optimal for player A to choose repression?

[7] The rule says that the conditional probability $q^n_{nr} = \Pr[C = nc \mid \text{no evidence}]_{nr}$ 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 σ is sufficiently large. Specifically:

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

We conclude that, if σ 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

$$EU^A(nc, r \mid q^n_m) = EU^A(nc, nr \mid q^n_m), \tag{8}$$

where q^n_m 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,[8]

$$q^n_m = \frac{1-\sigma(1-m)}{2-\sigma(1-m)}. \tag{9}$$

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:

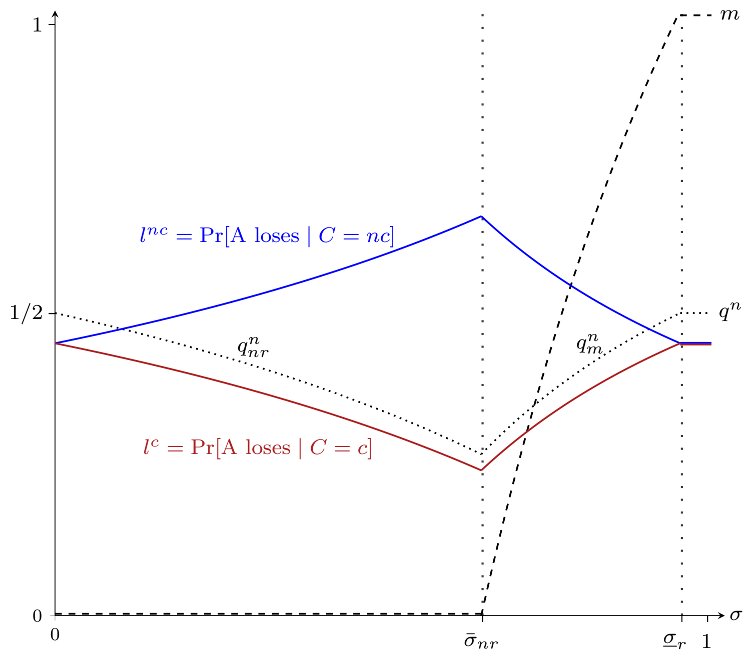
$$m = 1 - \left(\frac{2}{\sigma} - \frac{1-\alpha}{\chi/z} \right) \tag{10}$$

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 σ 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:

$$q^n_m = 1 - \frac{\chi/z}{1-\alpha} \frac{1}{\sigma}. \tag{11}$$

[8] Here the rule says that the conditional probability $q^n_m = \Pr[C = nc \mid \text{no evidence}]_m$ 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 σ



Notes. The parameter constellation is such that all three equilibria emerge as σ rises across its range. It is also assumed that the incumbency advantage, α, is strictly positive.

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

Summary and discussion. The proposition below 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).*

- 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 σ; the observer's absent-evidence posterior, q^n_{nr}, 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 σ; the observer's absent-evidence posterior, q^n_m, 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 former rises monotonically from 0 to 1 as σ crosses the partial-repression range. The latter starts and ends at $1/2$, the value of the prior probability. If $\sigma \to 0$, a search for evidence is never successful; so absence of evidence does not contain any information on player A's competence. At the opposite end, if $\sigma \geq \underline{\sigma}_r$, player B is never allowed to search for evidence—with the result that absence of evidence is again completely uninformative. In between, q^n follows a V-shape profile. As σ rises, q^n first falls: with player B's search efforts more likely to succeed, absence of evidence implies a lower ex post probability that player A is incompetent. Yet, as soon as the threshold to partial repression is crossed, absence of evidence is more and more often due to (hidden) repression. So the signal "absence of evidence" gets increasingly jammed and contains less and less information. That is why q^n eventually returns to $1/2$. 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 increases the observer's absent-evidence posterior belief about the probability of $C = nc$.

6 Equilibrium Turnover

Reelection probabilities. Proposition 1 states a first main result: as digital open-source information becomes richer, player A, if incompetent, increasingly relies on repression. But what is the net effect of repression on player A's chance of reelection? This section shows how σ 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, one can finally determine how richer open-source information affects the observer in terms of welfare (according to the preferences modeled in App. II).

PROPOSITION 2 *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, then converge, and eventually take the same value.*

- 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 App. IV. ■

Figure 3 visualizes l^{nc} and l^c. How is the inverted V-shape of l^{nc} explained? An increase in σ lifts the chance that a search effort by player B makes incompetence, if any, visible 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 σ 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 σ: the marginal effect of an increase in σ 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 σ. 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 σ 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, α.

When starting from a low level, an increase in σ 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 σ. But as soon as σ 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 σ 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 3 *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 App. IV. ■

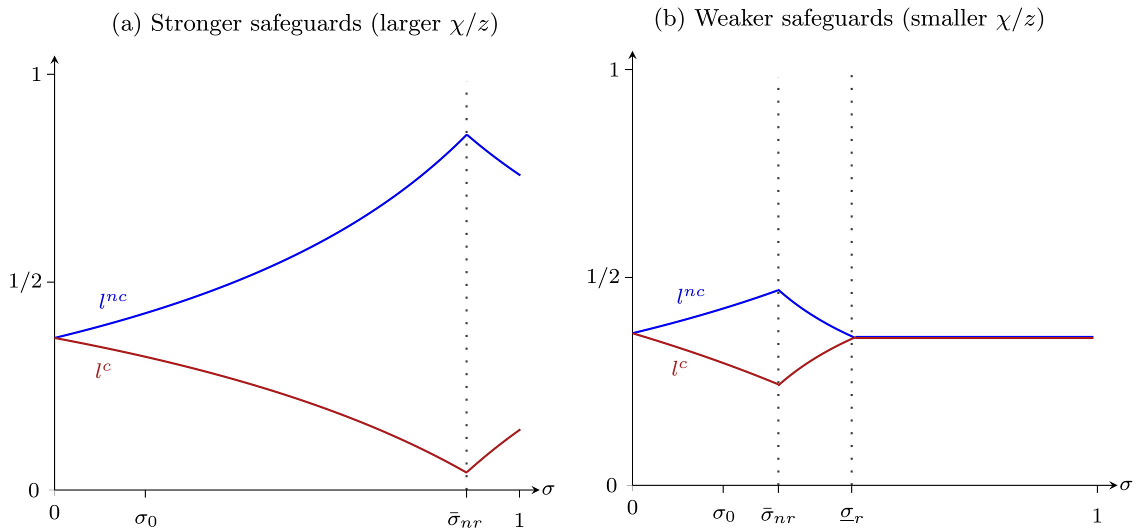
Together, Propositions 2 and 3 imply that richer digital open-source information leads to "redistribution" between the two different types of player A. Any gain by the competent type in terms of a lower chance of losing is mirrored in a loss of exactly equal size by the incompetent type in terms of a higher chance of losing (and vice versa). But richer digital open-source information does not lead to systematic shifts in the a priori success probabilities of players A and B. Put differently, this analysis does not suggest that richer digital open-source information would accelerate or slow down the turnover in contested positions.

Impact on observer. As the formal modeling in App. 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 digital open-source information affect the utility expected by the observer at the outset of the game? As App. 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 σ 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.[9] But as soon as σ 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 σ reduces this difference. The reason is that with a larger σ there is a lower chance that the observer confirms an incumbent who is incompetent (see above). But as soon

[9] 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. σ_0 is an arbitrary start level of σ that gives rise to a no-repression equilibrium in both cases.

as σ reaches the partial-repression range, the difference starts to widen again.

7 Safeguards

Exogenous safeguards. Proposition 2 establishes a second main result: by intensifying repression, richer digital open-source information may lower the chance of a loss when player A is incompetent and may lift 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 also depends on structural parameters. This 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 χ/z, which gives the cost of using repression relative to the benefit from holding the contested position. The larger χ/z, the larger the thresholds that separate the three different equilibria (equations 6 and 7). As discussed in Section 4, χ/z is a mirror of 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 χ/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 γ and ν are considered exogenous parameters.

Figure 4 illustrates l^{nc} and l^{c} with stronger (a) and weaker (b) safeguards. Assuming that the start level of σ, σ_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 4 *Consider an arbitrary start level of $\sigma \in (0,1]$, σ_0, that is strictly less than 1. Suppose σ rises from σ_0 to 1.*

- 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 σ rises.*

- Weak safeguards: *There further 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) σ rises.*

Proof. See App. IV. ■

Proposition 4 establishes a third main result: a secular trend towards richer digital 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 χ/z, the setup also includes the parameter α, which captures the incumbency advantage derived form 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 4 shows that α, too, influences the effect of richer information: the minimum level of safeguards for a globally beneficial effect of σ, $\underline{\chi/z}$, is larger when α 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 σ, $\overline{\chi/z}$, is larger when α 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 γ, the strength of the institutional checks.[10] Arguably, γ 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 γ—and hence χ/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 γ without incurring a cost.

The analysis returns a clear-cut result for the choice of γ 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 γ (so that χ/z has no upper limit); *iii.* the functional form of $s(\gamma,\nu)$ is restricted such that an increase in γ lifts $\chi/z = s(\gamma,\nu)$ via an increase in χ only (i.e., benefit z is unaffected by γ).

PROPOSITION 5 *Suppose player A, the incumbent politician, can introduce any level of institutional checks, γ, without incurring a cost before Nature determines her level of competence.*

[10] 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.

In addition, assume that conditions i. to iii., specified above, hold.

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

Proof. See App. IV. ■

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 5 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 she turn out to be incompetent later on.[11] 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, eschewing the option of repression has no drawback at all.

What could Proposition 5 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 digital 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 5 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 digital open-source information to bring beneficial consequences.

[11] If asked, the opposition would agree with the incumbent. Thus, if the decision on γ required unanimity, the result would still be safeguards that are sufficiently strong to induce the no-repression equilibrium.

8 Conclusion

Edmond (2013, p. 1423) observed that "information optimism has a long and somewhat mixed history". As the digital space becomes an ever more attentive chronicler, there is again optimism that it will become easier to hold governments to account. This paper sets up an applied game-theoretic model to explore whether, or to what extent, the current optimism is warranted. The model highlights the possibility that richer digital 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 mostly be attributed to a set of countries with weaker safeguards.

The present analysis leads to two broad conclusions. The first conclusion is that a secular trend towards richer digital 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 increasingly 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 concern 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 detectable traces that in principle can be shown to voters, such safeguards lose in importance. The results here point to the contrary. 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 the digital space chronicles an ever larger part of what is going on, 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 are characterized by inertia in the short and medium run. But it is not implausible that they get strengthened over a longer time horizon. The present analysis identifies circumstances in which even the political elite may accede to demands for stronger institutional safeguards.

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Open-Source Information and Repression

Appendix

September 26, 2023

App. 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 subsamples according to the strength of the safeguards against such misuse. In practice, safeguards against the misuse of executive power consist in institutional and norms-based checks. Formal provisions that protect the public administration and judiciary from undue political interference are an example of the former, an anticorruption norm that disapproves of corruption in the public administration and judiciary an example of 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).

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. Because until November 2002 parking violations by foreign diplomats were not enforced, Fisman and Miguel (2007) interpret high numbers in the period prior to November 2002 as an indication of a weak anticorruption norm in the corresponding foreign country. The paper provides 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, we consider a country to have strong norms-based checks if it is below the 25th percentile in terms of parking violations; and to have a 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 -0.15, the correlation coefficient 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".

App. 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,

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

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

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

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, α. The expression for $v(q)$, the chance of a win by player B, now follows immediately.

For completeness, we finish by providing the level of utility an observer with the preferences introduced above should expect at the outset of the game:

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

Equation (A3) specifies a continuous function of σ that is strictly increasing in σ 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 $\sigma \to 0$. Expected utility stays at that level for all values of $\sigma > \underline{\sigma}_r$.

App. III Nonzero Search Cost

The analysis in the main text assumes costless search ($\psi = 0$). But provided $\psi < \chi$, Proposition 1 undergoes only a slight modification when we allow for costly search. Suppose that the parameter condition stated in the proposition still holds: $\chi/z < (1 - \alpha)/2$ so that $\underline{\sigma}_r < 1$. To establish how $0 < \psi < \chi$ changes Proposition 1 (and the following ones), we first analyze under which condition a nonzero search cost affects the existence of the equilibria described in the proposition. In particular, we check when 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. The first paragraph of Section 5 establishes that player B expects the payoff associated with $S = s$ to exceed the payoff associated with $S = ns$ by $\sigma(1-\alpha)(1-q^n)z-\psi$. We now characterize how this excess payoff changes as σ rises across its range, assuming that q^n takes the functional forms specified in Proposition 1. Using equations (5), (11), and $q_r^n = 1/2$, one obtains

$$\text{excess payoff} = \begin{cases} (1-\alpha)[\sigma/(2-\sigma)]z - \psi & : \quad \sigma \leq \bar{\sigma}_{nr} < \underline{\sigma}_r \\ \chi - \psi & : \quad \bar{\sigma}_{nr} < \sigma \leq \underline{\sigma}_r \\ (1-\alpha)(\sigma/2)z - \psi & : \quad \bar{\sigma}_{nr} < \underline{\sigma}_r < \sigma \end{cases} . \tag{A4}$$

Equation (A4) specifies a continuous function of σ that is strictly increasing as long as $\sigma \leq \bar{\sigma}_{nr}$, then constant, and then again strictly increasing in σ as soon as $\underline{\sigma}_r < \sigma$. 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 σ that is strictly less than $\bar{\sigma}_{nr}$. This level is given by

$$\tilde{\sigma} \equiv 2\left(1 + \frac{1-\alpha}{\psi/z}\right)^{-1} < \bar{\sigma}_{nr}. \tag{A5}$$

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 $S = s$. It follows that the partial and full repression equilibria continue to exist as described in Proposition 1. If $\sigma > \tilde{\sigma}$, this also holds for the no-repression equilibrium. But if $\sigma \leq \tilde{\sigma}$, the no-repression equilibrium vanishes: in that case, 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. Put differently, given the strictly positive search cost, the probability of the search succeeding is too small.

While for $\sigma \leq \tilde{\sigma}$ the no-repression equilibrium does not exist, there is an alternative pure-strategy PBE that can be called "no repression, no search": 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. Assuming a nonzero search cost of $\psi < \chi$ thus partitions the range $(0, \bar{\sigma}_{nr}]$ into two subranges, $(0, \tilde{\sigma}]$ and $(\tilde{\sigma}, \bar{\sigma}_{nr}]$. If σ is element of the former, we have only the just-described no-repression, no-search equilibrium. If σ belongs to the latter, the no-repression equilibrium characterized in Proposition 1 continues to exist. In Figure 3, this partitioning means that as long as $\sigma \leq \tilde{\sigma}$ all outcome variables stick to their levels for $\sigma \to 0$. As soon as σ 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 σ grows towards 1). It follows that the substance of Propositions 2 and 4 is preserved, while Proposition 3 is entirely unchanged.

App. IV Proofs

Proposition 2. 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 successfully 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

$$\begin{aligned}\Pr[A \text{ loses} \mid C = nc]_{nr} = (1-\sigma)\Pr[A \text{ loses} \mid C = nc, \text{no evidence}]_{nr} \\ + \sigma \Pr[A \text{ loses} \mid C = nc, \text{evidence}]. \quad \text{(A6)}\end{aligned}$$

Equation (A6) 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 σ. Now consider the two conditional probabilities on the right-hand side of equation (A6). The first one is given by $(1-\alpha)q^n_{nr}$ and the second one by $(1-\alpha)\ 1$. Thus,

$$\Pr[A \text{ loses} \mid C = nc]_{nr} = (1-\alpha)\left[(1-\sigma)q^n_{nr} + \sigma\right]. \quad \text{(A7)}$$

Replacing in equation (A7) q^n_{nr} 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 σ) if player A is incompetent ($C = nc$) and desists from repression ($R = nr$), the law of iterated expectations implies

$$\begin{aligned}\Pr[A \text{ loses} \mid C = nc]_{m} = (1-m)\{(1-\sigma)\Pr[A \text{ loses} \mid C = nc, \text{no evidence}]_{m} \\ + \sigma \Pr[A \text{ loses} \mid C = nc, \text{evidence}]\} + m \Pr[A \text{ loses} \mid C = nc, \text{no evidence}]_{m}. \quad \text{(A8)}\end{aligned}$$

Equation (A8) 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 $(1-\alpha)q^n_m$. As above, the second one is $(1-\alpha)\ 1$. Hence,

$$\Pr[A \text{ loses} \mid C = nc]_m = (1-\alpha)\left\{(1-m)\left[(1-\sigma)q_m^n + \sigma\right] + m q_m^n\right\}. \tag{A9}$$

Explicit expressions for m and q_m^n are given by equations (10) and (11), respectively. Using them in equation (A9), 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 σ-subranges stated in Proposition 1, one gets

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

The inverted V-shape profile mentioned in the proposition arises immediately from equation (A10). 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

$$l^{c} = \Pr[\text{A loses} \mid C = c] = \begin{cases} (1-\alpha)(1-\sigma)/(2-\sigma) & : \ \sigma \le \bar{\sigma}_{nr} < \underline{\sigma}_r \\ (1-\alpha) - \chi/(z\sigma) & : \ \bar{\sigma}_{nr} < \sigma \le \underline{\sigma}_r \\ (1-\alpha)/2 & : \ \bar{\sigma}_{nr} < \underline{\sigma}_r < \sigma \end{cases}. \tag{A11}$$

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 3. The unconditional probability of player A losing to player B can be written as

$$\Pr[A \text{ loses}] = (1/2)\Pr[A \text{ loses} \mid C = nc] + (1/2)\Pr[A \text{ loses} \mid C = c] = (1/2)(l^{nc} + l^c). \tag{A12}$$

Replacing in equation (A12) l^{nc} and l^c with the expressions in equations (A10) and (A11), respectively, immediately leads to $l = \Pr[A \text{ loses}] = (1-\alpha)/2$ for all $\sigma \in (0, 1]$.

Proposition 4. 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 $\lim_{\chi/z \to 0} \bar{\sigma}_{nr}(\chi/z) = 0$ to $\lim_{\chi/z \to \infty} \bar{\sigma}_{nr}(\chi/z) = 2$ 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 (A10) and (A11) 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 σ on $[\sigma_0, 1]$ and equilibrium probability l^c is a strictly decreasing function of σ 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 (A10) and and (A11) 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 σ on $[\sigma_0, 1]$ and equilibrium probability l^c is an increasing function of σ on $[\sigma_0, 1]$. The specific term for $\overline{\chi/z}$, again shown in the proposition, is found by solving $\bar{\sigma}_{nr}(\underline{\chi/z}) = \sigma_0$, where $\bar{\sigma}_{nr}(\chi/z)$ is given by equation (6).

Proposition 5. To set γ—and hence χ/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 observers that the chance of being competent is 1/2. Below, EU_x^A denotes the expected payoff if γ—and hence χ/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

$$EU_{nr}^A \;=\; \frac{1}{2}\left\{(1-\sigma)\left[1-(1-\alpha)q_{nr}^n\right]z + \sigma\left[1-(1-\alpha)\ 1\right]z\right\} + \frac{1}{2}\left[1-(1-\alpha)q_{nr}^n\right]z. \quad \text{(A13)}$$

Replacing in equation (A13) 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 σ, reflecting that, on the one hand, a rise in σ 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 σ 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 (A13) is

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

Equation (A14) uses that under partial repression $(1-\sigma)\left[1-(1-\alpha)q_m^n\right]z+\sigma\left[1-(1-\alpha)\ 1\right]z$ is equal to $\left[1-(1-\alpha)q_m^n\right]z-\chi$. Replacing in equation (A14) 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 γ—and hence χ/z—to initiate full repression, the expected payoff is

$$EU_r^A = \frac{1}{2}\left\{\left[1-(1-\alpha)q_r^n\right]z-\chi\right\}+\frac{1}{2}\left[1-(1-\alpha)q_r^n\right]z. \tag{A15}$$

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 σ. 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 σ-subranges stated in Proposition 1, one gets

$$EU^A = \begin{cases} z(1+\alpha)/2 & : \quad \sigma \leq \bar{\sigma}_{nr}(\chi/z) < \underline{\sigma}_r(\chi/z) \\ z\alpha + \chi/\sigma - \chi/2 & : \quad \bar{\sigma}_{nr}(\chi/z) < \sigma \leq \underline{\sigma}_r(\chi/z) \\ z(1+\alpha)/2 - \chi/2 & : \quad \bar{\sigma}_{nr}(\chi/z) < \underline{\sigma}_r(\chi/z) < \sigma \end{cases}. \tag{A16}$$

To identify the value of γ—and hence of χ/z—that maximizes EU^A, we first compare the expected payoff in an arbitrary full-repression equilibrium (third line of equation A16) to the expected payoff under no repression (first line of equation A16). Taking into account that χ is the only magnitude affected by γ (assumption *iii.*), we obtain that the difference between the first and the second expected payoff is given by $-\chi^r/2$, where χ^r refers to the cost of repression in the arbitrary full-repression equilibrium considered. Since χ 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 A16) to the expected payoff under no repression (first line of equation A16). Again taking into account that χ is the only magnitude affected by γ (assumption *iii.*), we obtain that the difference between the first and the second expected payoff is given by $-(\chi^m/z)\left[1/\bar{\sigma}_{nr}(\chi^m) - 1/\sigma\right]$, where χ^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 γ accordingly? Absence of repression requires $\bar{\sigma}_{nr} \geq \sigma$. Since $\chi/z = s(\gamma, \nu)$ is unbounded in γ (assumption *ii.*) and $\bar{\sigma}_{nr}$ strictly increasing in χ/z with $\lim_{\chi/z \to \infty} \bar{\sigma}_{nr} = 2$ (proof of Proposition 4), it follows that player A can always set a γ that is sufficiently large to satisfy this requirement.

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