How Modern Dictators Survive: An Informational Theory of the New Authoritarianism*

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Abstract

We develop an informational theory of dictatorship. Dictators survive not because of their use of force or ideology but because they convince the public—rightly or wrongly—that they are competent. Citizens do not observe the dictator's type but infer it from signals inherent in their living standards, state propaganda, and messages sent by an informed elite via independent media. If citizens conclude that the dictator is incompetent, they overthrow him in a revolution. The dictator can invest in making convincing state propaganda, censoring independent media, co-opting the elite, or equipping police to repress attempted uprisings—but he must finance such spending at the expense of the public's living standards. We show that incompetent dictators can survive as long as economic shocks are not too large. Moreover, their reputations for competence may grow over time—even if living standards fall. Due to coordination failure among members of the elite, multiple equilibria emerge. In some equilibria the ruler uses propaganda and co-opts the elite; in others, propaganda is combined with censorship. In the equilibrium with censorship, difficult economic times prompt higher relative spending on censorship and propaganda. The results illuminate tradeoffs faced by various recent dictatorships.

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1 Introduction

How do dictators hold onto power? The simplest answer is by means of violent repression. Many autocrats—from the military dictators Franco and Pinochet to the personalistic tyrants Mobutu and Somoza—have left behind them rivers of blood.[1] Totalitarians such as Stalin, Hitler, Mao, and Pol Pot combined terror with ideology. Besides murdering millions, they indoctrinated citizens into creeds that demanded the sacrifice of individual interests to a higher goal. In a similar way, religious dogmas have prescribed obedience to incumbent rulers in monarchies and theocracies.

However, a less violent and ideological form of authoritarianism has recently come to rival the old-style autocracies. From Alberto Fujimori's Peru to Victor Orban's Hungary, illiberal leaders have managed to consolidate power without isolating their countries from global markets, imposing outlandish social philosophies, or resorting to mass killings. Rather than terrorizing or indoctrinating the population, such leaders survive by manipulating information so that citizens believe—rationally but incorrectly—that the leader is competent and benevolent. Having thus secured popularity, they use formally democratic institutions to ratify their rule, despite having removed any genuine political constraints or accountability.[2]

Compared to most other dictators, the rulers of such informational autocracies use violence sparingly.[3] Rather than jailing thousands of political prisoners, they harass and humiliate opponents, accuse them of fabricated non-political crimes, and encourage them to emigrate. Moreover, unlike old-style autocrats, who sought to publicize their brutality in order to deter others, informational autocrats often conceal their responsibility when killings occur. Their goal is to be popular rather than feared. At the same time, they have to persuade the public that they do not need political violence to stay in power.

The manipulation of information is not new in itself—some totalitarian leaders were great innovators in the use of propaganda.[4] What is different is how the regime employs such tools. Where Hitler and Stalin sought to reshape citizens' goals and values by imposing comprehensive ideologies, informational autocrats are more surgical: they aim only to convince citizens of their competence to govern.

The informational autocracy shares with other authoritarian states the goal of empowering its leader to operate with little or no accountability. But informational autocracies accomplish this in a distinctive way.

[1] More than 30,000 people are believed to have been killed by Pinochet's agents, "most of them taken away to secret detention centers and camps, tortured, tossed still alive from airplanes into the sea or shot and buried in unmarked graves" (Roht-Arriaza 2005, p.viii).

[2] On the use of elections and partially democratic or pseudo-democratic institutions in dictatorships, see Gandhi (2008), Gandhi and Lust-Okar (2009) and Levitsky and Way (2010). For insightful journalistic accounts of how such regimes operate, see Dobson (2012) and Simon (2015). Although our focus is on "autocracies," which we see as synonymous with "authoritarian regimes," and "dictatorships," we consider the dividing line between soft authoritarian regimes and illiberal democracies to be a fuzzy one. Our model also applies to most illiberal democracies. Compared to their counterparts in democracies, leaders in dictatorships are more likely to be replaced as the result of mass protests or coups rather than simply because they lost a fair election. Institutional checks on leaders also tend to be more elaborate and effective in democracies. But, although operating within tighter constraints, democratic leaders also seek to influence and manipulate information flows.

[3] An exception is when fighting civil wars. In such cases, all regimes—from liberal democracies to totalitarian tyrannies—use far more force.

[4] On the use of radio to spread anti-semitic propaganda under Hitler, see Adena et al. (2015).

Besides Fujimori's Peru and Orban's Hungary, other examples include Vladimir Putin's Russia, Mahathir Mohamad's Malaysia, Hugo Chavez's Venezuela, and Recep Tayyip Erdogan's Turkey. The concept is an ideal type, so actual cases may exhibit only some of the characteristics. China's recent party bosses also fit in some respects, but whereas the other leaders inherited flawed democracies and undermined them further, the institutions hollowed out in China were those of totalitarian communism.

The phenomenon is not completely new. One can see Lee Kuan Yew's Singapore as a pioneer of such "soft autocracy." As we show later, Lee perfected the inobtrusive management of private media and instructed his Chinese and Malaysian peers on the need to conceal violence. Alberto Fujimori's unsavory intelligence chief Vladimiro Montesinos was also a key innovator, paying million dollar bribes to television stations to skew their coverage. "We live on information," he told a reporter in one unguarded interview. "The addiction to information is like an addiction to drugs" (McMillan and Zoido 2004, p.74).

Yet, in recent decades the balance has shifted. While some old-style dictatorships remain, more and more have some or all the characteristics of an informational autocracy. There are probably several reasons. In a world of advanced technology and economic interdependence, isolating one's country to preserve ideological purity has become extremely costly. Indeed, the internet makes it almost impossible to keep out foreign information completely and to prevent citizens from communicating autonomously. For this reason, concealing state violence becomes harder. Since the Cold War ended, aid donors and Western-dominated international institutions have pressured poor countries to respect human rights, raising the premium on models of dictatorship that simulate democracy. At the same time, the power of centralized media to set the agenda and distort popular beliefs remains impressive. All this has led autocrats to pursue the same goals by different means—by monitoring and shaping information flows rather than by relying on fear and ideological brainwashing.

Although previous papers have studied certain aspects of authoritarian propaganda and censorship, the informational autocracy has attracted little systematic investigation. We develop a model to capture the logic that governs the survival of such regimes. It includes three types of players—the dictator, who, as in signalling models of democratic politics, may be either competent or incompetent; a small group of players—"the informed"—who observe the dictator's type directly; and a large group of players—"the uninformed"—who do not observe the dictator's type but who update their beliefs about it based on communications from the dictator, communications from the informed, and their own living standards.[5] Their living standards depend, in turn, on the tax rate set by the dictator, on economic performance (itself a function of the leader's competence and a stochastic shock), and on the amount of any public goods the dictator provides. If enough uninformed players infer, based on these signals, that the incumbent is incompetent, they overthrow him. The informed players—if not co-opted—would also prefer to replace an incompetent incumbent, but they,

[5]Competence here refers to the ability to promote—or at least not undermine—economic growth and defend the country against external threats. The contrast between the rapid, sustained growth in the Singapore of Lee Kuan Yew and the consistent economic decline in the Zaire of Mobutu Sese Seko suggests that some dictators may indeed be more competent than others.

being a minority, cannot do so without the uninformed players to back them up.

In the model's most natural application—which we will use as a running example—"the informed" constitute an elite with access to the private media and "the uninformed" represent the mass of the population. Revolutions to overthrow the dictator succeed if they are backed by both the informed elite and the masses. The dictator sends propaganda messages to the uninformed via the state media and can censor messages sent by the elite through its private media. However, one can also use the model to study how the dictator interacts with his armed forces. In this case, "the informed" are the top circle of generals and government ministers, while "the uninformed" are officers and ordinary soldiers. The model then explains how dictators manage communications within the state hierarchy to avoid coups.[6]

The dictator can affect all the channels of information. He can spend on making the propaganda broadcast via state media more convincing. He can bribe the informed elite to prevent the latter from sending critical messages. And he can censor those messages that they do send. The dictator can also spend on hiring and equipping the police with the tools of repression, thus increasing the cost of revolution. However, all these actions must be paid for by the government, either by raising the tax rate (which reduces after-tax income and therefore consumption for citizens) or by reducing government spending on other items, which may include public services that the population values: policemen assigned to intimidate journalists are not solving real crimes. Citizens, observing their lower consumption or the depleted supply of public services, will downgrade their estimates of the incumbent's competence. Hence the tradeoff.

Our model shows how the dictator's strategy and equilibrium survival odds, as well as the path of citizens' beliefs, change with the various exogenous parameters—the magnitude of the economic shocks, the distribution of competence, and the technology of censorship, propaganda, and repression. We identify two equilibria: in one the dictator co-opts the elite, in the other he censors the private media. Multiple equilibria exist because members of the elite must coordinate on a strategy. When both equilibria exist, the one with co-optation always yields the dictator higher survival odds than the one with censorship. We also find that, so long as force is not too cost-effective, it is used against the general public only as a last resort after co-optation, censorship, and propaganda have failed.

The model offers insight into a number of observations and puzzles. First, it shows how modern autocracies can survive while employing little violence against the public. Repression is not necessary if mass beliefs can be manipulated sufficiently by means of propaganda, censorship, and co-optation of the elite. Indeed, since in our model major repression is only used if equilibria based on co-optation and censorship have disappeared, violence signals to the public that the regime is incompetent and therefore vulnerable. This explains why various modern dictators try to conceal their involvement in violence against their opponents—and why the exposure of such violence often catalyzes anti-regime protest.

[6]Leaders of authoritarian states are more often removed by coups than by mass uprisings (Geddes 1999). However, such coups tend to occur when a dictator is unpopular and facing public unrest, so the two applications will often apply to the same cases (Nordlinger 1977, Linz 1978, Finer 1988, Casper and Tyson 2014, p.548).

Second, we shed light on the puzzle of the effectiveness of propaganda in authoritarian regimes. Given that citizens know the dictator has an incentive to lie about his type, why do they ever listen? In our model, propaganda works because whereas competent leaders can costlessly show themselves to be competent, incompetent ones must invest resources to fake the evidence that will make this claim convincing—and sometimes they choose to spend their budget on other actions instead. Thus, observing a dictator claim persuasively to be competent increases the odds that he actually is—especially since if he were not, he could often benefit from shifting resources to consumption and public goods, which are valued—and directly observed—by the public.

Third, the model offers one reason why some clearly incompetent dictators nevertheless manage to retain power for long periods. Rulers whom most or all citizens—if fully informed—would prefer to overthrow can still survive in many circumstances simply by manipulating information. And we focus on a mechanism other than the well-studied one of blocking communication among potential protesters. The dictator's survival depends here not on preventing citizens from expressing their willingness to rebel (in our model, we abstract from the issue of coordination among the protesters), but on manipulating public beliefs about the state of the world and the incumbent's type.

Moreover, we show that over time incompetent leaders, if they survive, may acquire a reputation for competence as a result of rational Bayesian updating by citizens. Such reputations can withstand temporary economic downturns if these are not too large. This is consistent with the empirical finding that dictators that last through their first few years are less likely to be overthrown (Svolik 2009, Bueno de Mesquita and Smith 2010, Treisman 2014). However, the mechanism we propose here—of rational updating of beliefs about the leader's type—differs from those of Svolik (2009), who emphasizes power consolidation by the incumbent, and Treisman (2015), who emphasizes selection effects.

Fourth, the multiple equilibria associated with different leader strategies illuminate why, among dictatorships that seem otherwise quite similar, some focus on censoring independent media while others censor much less but co-opt the elite with patronage. For example, while Iran has the world's strictest limits on internet content, according to Freedom House, Morocco has among the least restrictive internet controls, on a par with those of Japan (Freedom House 2013). The Moroccan royal family has consistently viewed co-optation "as a much more effective tool than confrontation and repression," given the country's traditional system in which "patronage and accommodation were deeply ingrained" (Willis 2014, p.444).

Fifth, the model predicts that as economic conditions worsen a dictatorship may boost relative spending on censorship and propaganda. This is consistent with a noted increase since the global financial crisis in efforts to limit opposition media in a range of countries, from Hungary and Turkey to Russia. For example, as Turkey's growth rate fell from 7.8 percent in 2010 to 0.8 percent in 2012, according to the World Bank, the number of journalists in jail increased from 4 to 49.[7] Between 2008 and 2011, Hungary fell 15 percentage

[7]Data from the Committee to Protect Journalists, https://www.cpj.org/imprisoned/2014.php.

points on Freedom House's press freedom index. Conversely, China, while certainly not eschewing censorship, seemed to place an increasing focus on consumption and provision of public goods during its long period of rapid growth. Starting in the 1980s, Beijing replaced the Mao-era system of comprehensive control with one that relied increasingly on co-optation and commercialized self-censorship; media owners, editors, and journalists were rewarded for loyalty with state advertising contracts and well-paid jobs, thus incentivizing them to censor themselves. "The desire to win performance bonuses tends to result in journalism that steers well clear of dangerous political controversy and meets the party's propaganda requirements," one analyst wrote in 2005 (Esarey 2005, pp.57-9).[8] Censorship of the internet, meanwhile, focused on blocking collective action rather than on suppressing criticism of the government and party (King, Pan, and Roberts 2013). However, after China's growth rate fell in recent years, censorship increased notably (Phillips 2015).

Sixth, the model offers a variety of reasons why—as widely noted—modernization makes dictatorship harder to sustain, at least in the absence of vast resource rents. By increasing the size of the "informed elite," economic development increases the cost for incompetent dictators of either co-opting potential critics or censoring their media messages. Even relatively small economic shocks then become sufficient to threaten the incumbent's rule. If modernization also increases the technological sophistication of opposition media, then censorship may fail for this reason as well.[9]

Still, if modernization makes it harder to sustain an information-based dictatorship, we believe it increases the costs of mass repression even more. The more educated, globally integrated, and professionalized are the dictator's agents, the greater is the chance they will shrink from committing a massacre (Francisco 2005, p.66). At the same time, harsh repression is both more public and more economically harmful in a more developed society. A knowledge economy, dependent on innovation, stands to lose its entrepreneurs to emigration if the dictator uses force. In a world of global media and capital flows, political violence can depress foreign investment, stimulate capital flight, and even puncture confidence in the currency (Blanton and Blanton, 2007, Fielding and Shortland, 2005). All these factors help explain the modern dictator's preference for less overt methods.

The next section reviews related literature. Section 3 presents empirical facts about modern informational autocracies. Section 4 outlines the elements of the model. Section 5 derives the equilibria. Sections 6 and 7 discuss comparative statics and several extensions, including a dynamic version of the game and one with continuous economic shocks. Section 8 concludes.

[8] In fast-growing Singapore as well, indirect methods proved effective (see Section 3.4).

[9] A complementary reason why modernization may encourage transition to democracy is that education increases the taste for political participation (Glaeser, Ponzetto, and Shleifer 2007).

2 Literature

Wintrobe (1990) pioneered the formal analysis of dictatorship, modeling, in a reduced form, decision-theoretic framework, the tradeoff between investing in repression and co-opting citizens with material benefits. He distinguished two types of dictators—"totalitarians," who maximized power, and "tinpot" dictators, who maximized their own consumption subject to a minimum power constraint. Wintrobe (2007) generalized the dictator's objective function to include both power and consumption, allowing the equilibrium levels to be determined by cost parameters.

Subsequent analyses focused on several different—although related—questions. Some considered what economic policies autocrats would choose and compared these to those prevailing under anarchy and democracy. Olson (1993) argued that dictators' incentives to adopt growth-promoting policies depend on their time horizon and how encompassing an interest they have in national output.

A second direction of research examined the role of institutions in authoritarian states, interpreting them as mechanisms by which the ruler solves time inconsistency problems. By creating institutions that constrain him in the short run, a dictator can commit credibly to certain policies—repaying state debts and respecting property rights (North and Weingast 1989, Gehlbach and Keefer 2011), redistributing income to the poor (Boix 2003, Acemoglu and Robinson 2006), or sharing power with members of his ruling group (Myerson 2008, Svolik 2012, Boix and Svolik 2013). Models show how such credible commitments can increase borrowing power and private investment in the first case, prevent revolutions in the second, and avoid coups or elite defection in the third.

A related set of papers consider why autocrats hold elections, with more—or less—genuine competition (Gandhi and Lust-Okar 2009). Such elections might serve to inform the ruler about local attitudes or about the effectiveness of his local agents (Cox 2009, Blaydes 2010), to project strength to his bureaucrats (Simpser 2013, Gehlbach and Simpser 2015), or to convince the opposition of the incumbent's popularity (Rozenas 2015, Egorov and Sonin 2014, Little 2014).

Another literature models the relationship between dictators and their support group when such interactions are not mediated by institutions. These works examine how the dictator chooses the size and characteristics of his inner circle, and how these variables in turn determine the dictator's policy choices and survival odds (Egorov and Sonin 2011, Bueno de Mesquita et al. 2003).

Still other papers consider how the dictator and his agents can prevent the much larger number of ordinary citizens, who would prefer a less predatory government, from coordinating to overthrow them.[10] Coordination among protesters is a key factor of the protests' success (Lohmann 1994). Autocrats may restrict communication among members of the public and criminalize protests (Kricheli et al. 2011). They may censor private messages that encourage anti-regime collective action (King, Pan, and Roberts 2013).

[10] Dagaev et al. (2013) consider how new information technologies may lower the costs of coordination.

They may disrupt coordination by sending misleading propaganda signals about their own repressive capacity (Edmond 2013, Huang 2014). Or they may use both propaganda and censorship to prevent coordinated collective action (Chen and Xu 2015). Yet, there are often tradeoffs. Egorov, Guriev, and Sonin (2009) and Lorentzen (2014) model the choice of a dictator in setting the level of censorship, where a free media, on the one hand, provides the dictator with useful information, but, on the other hand, facilitates the expression and organization of opposition.

All these papers consider ways that the ruling group prevents the much larger opposition from coordinating on rebellion. Such techniques enhance the deterrent capacity of a given level of repressive force. By contrast, in our paper the dictator stays in power not by preventing the discontented masses from rebelling but by taking away their desire to do so. He manipulates information not to disrupt coordination but to increase citizens' support for him. The closest paper to ours is Shadmehr and Bernhardt (2015), which offers a theory of state censorship in which citizens seek to infer whether the absence of "bad news" is due to censorship or to the lack of bad news for journalists to report. Although their model of censorship is similar to ours, Shadmehr and Bernhardt do not consider the interaction of censorship with cooptation, propaganda, and economic shocks, which is central to our analysis.

3 Stylized facts on modern informational autocracies

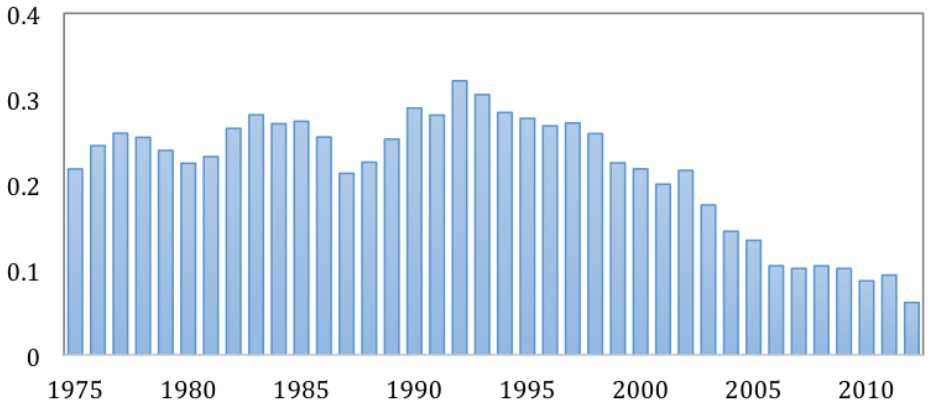
Informational autocracies differ in a number of ways from those based primarily on repression or ideological indoctrination (for convenience, we call the latter "old-style dictatorships," recognizing that this category includes many different types).

3.1 Violent repression

Old-style dictatorships often threaten and employ considerable violence—jailing political prisoners, killing unarmed opposition members, and torturing dissidents. By contrast, informational autocracies—except when fighting civil wars or separatist insurgencies—use violence sparingly. As their number has grown in recent decades, the frequency of authoritarian violence has decreased worldwide. Since the early 1990s, the proportion of non-democracies with ongoing state-sponsored mass killings—defined as "any event in which the actions of state agents result in the intentional death of at least 1,000 noncombatants from a discrete group in a period of sustained violence"—has fallen sharply (Figure 5).[11]

The threshold of 1,000 deaths is a demanding one. Figure 2 plots the number of cases in non-democracies in which the use of a state's armed forces against civilians resulted in at least 25 deaths. We show the data broken down by five-year-period, from 1990 to 2014 (the data only begin in 1989). Again, we see a sharp drop in the number of cases of such violence and an even more dramatic fall in the number of fatalities.

[11] We use the standard cutoff of a score of 6 on the Polity2 scale to distinguish democracies from non-democracies.

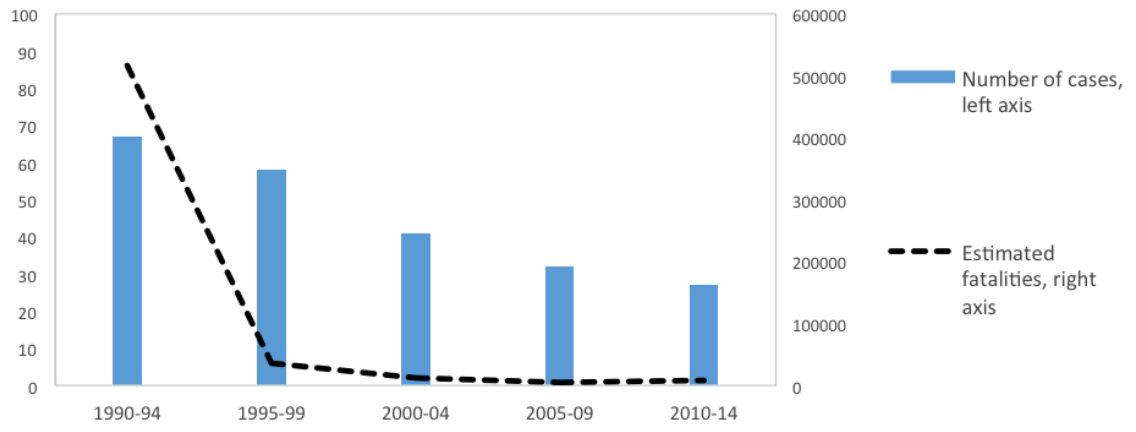


Sources: Polity IV; Mass Killings Database (see Ulfelder and Valentino 2008, and updated data at https://dartthrowingchimp.wordpress.com/2013/07/25/trends-over-time-in-state-sponsored-mass-killing).
Notes: "Non-democracies" are states with Polity2 scores of less than 6. A "mass killing" is "any event in which the actions of state agents result in the intentional death of at least 1,000 noncombatants from a discrete group in a period of sustained violence."

Figure 1: Proportion of non-democracies with ongoing mass killings.

Informational dictatorships are distinctive not only in the amount of violence but also in the way it is handled. In old-style authoritarian regimes, leaders publicize their brutality in order to deter future opposition or to energize supporters. Many regimes—from European monarchies to the Afghan Taliban—have held show trials and public executions of "traitors" and "heretics." Mussolini "continually insisted upon the Fascists' right to use violence. He openly threatened the opposition in speeches, even within the Parliament, and ordered attacks on his most vocal enemies" (Ebner 2011, p.42). Idi Amin executed a cross-section of the Ugandan elite, from government ministers and judges to diplomats, church leaders, university rectors, and business executives. "Their killings were public affairs carried out in ways that were meant to attract attention, terrorize the living and convey the message that it was Mr. Amin who wanted them killed" (Kaufman 2003). South American military juntas, although denying complicity in mass murders to preserve international respectability, nevertheless "considered it essential that the terror be widely known." When victims "disappeared" in Argentina, "it was not unusual for several vehicles—automobiles, trucks, vans—as well as a helicopter to surround the victim's home" (Fagen 1992, pp. 62-3).

By contrast, in an informational autocracy, violence risks exposing the dictator's true nature and destroying his reputation for competence. Fujimori's intelligence chief Vladimiro Montesinos rebuffed an associate's suggestion that he make death threats against an uncooperative television station owner: "Remember why Pinochet had his problems. We will not be so clumsy" (McMillan and Zoido 2004, p.74). After the Tiananmen Square massacre, Singapore's Lee Kuan Yew set out to educate the Chinese leadership (Elegant and Elliott 2005):



Source: UCDP One-sided Violence Dataset v. 1.4-2015, 1989-2014.
Notes: Use of armed force by the government of a state against civilians which results in at least 25 deaths. Extrajudicial killings in custody are excluded. "Non-democracies" are countries with Polity2 scores of less than 6. Number of fatalities is the "best estimate" according to the UCDP, based on available reports.

Figure 2: State violence against civilians in non-democracies, 1990-2014.

> I said later to [then Premier] Li Peng, "When I had trouble with my sit-in communist students, squatting in school premises and keeping their teachers captive, I cordoned off the whole area around the schools, shut off the water and electricity, and just waited. I told their parents that health conditions were deteriorating, dysentery was going to spread. And they broke it up without any difficulty." I said to Li Peng, you had the world's TV cameras there waiting for the meeting with Gorbachev, and you stage this grand show. His answer was: We are completely inexperienced in these matters.

Lee also criticized the Malaysian leader Mohamad Mahathir for arresting his rival, Anwar Ibrahim, under the Internal Security Act in 1998 rather than for some ordinary criminal offense, which would have masked the political motivation. According to Lee, Mahathir agreed with him that the subsequent beating of the jailed politician, who showed up in court with bruises and a black eye, had been a "disaster" (Pereira 2000).

As Lee understood, in an informational autocracy, when state violence becomes public, it can backfire, provoking further protest. The emergence of a tape that seemed to implicate Ukrainian President Leonid Kuchma in the killing of a journalist set off protests in 2000 that ultimately led to the country's "Orange Revolution" four years later. More generally, among the 46 cases between 1989 and 2011 in which a government responded violently to an unarmed protest, resulting in more than 25 deaths, the crackdown catalyzed domestic mobilization in 30 percent and prompted defections by security force members in 17 percent (Sut-

ton, Butcher, and Svensson 2014). Such repression backfired more frequently in countries with higher income and in those where the opposition had access to its own parallel media. In informational autocracies, those—usually in the security forces—who stand to benefit from a regime based on raw repression sometimes seek to compromise the leader by committing acts of violence for which they know he will be blamed. The true goal in such cases may be to force the dictator to switch from an information-based survival strategy to one based on sheer force. This also suggests why an incompetent security apparatus can be so dangerous for an autocrat. After troops shot the Philippine opposition leader Benigno Aquino on the tarmac of Manila Airport, it was impossible for President Marcos to deny complicity. This murder ignited the "People's Power" movement that eventually split Marcos's military support group and triggered the collapse of his regime.

3.2 Popularity of leaders

Should we expect old-style dictators to be popular with the public? In ideological regimes, the public may, indeed, be brainwashed into worshipping the "great helmsman." But when obedience results from sheer violent repression, citizens, although intimidated into silence, should nevertheless secretly hate the ruler. Moreover, the dictator should realize that his subjects' conformism is based on fear. By contrast, in informational autocracies, the leader needs to be genuinely popular. And his popularity cannot be based on brainwashing citizens into an all-embracing ideology. Such ideologies are hard to maintain in a world of global commerce, internet media, and international travel. Rather, the leader must—using propaganda and censorship where needed—convince the public that he is competent even if he is not.

Assessing public opinion in non-democracies is obviously difficult; survey respondents may fear to give frank answers. Still, objective experts on Russia, Turkey, and Venezuela have argued convincingly that Putin, Erdogan, and Chavez enjoyed authentic popularity that was not based on fear or ideology. To quote one analyst: "Chavez was beloved – genuinely beloved – of millions of poor Venezuelans, and won election after election for a decade and a half ... his power rested not on violence but on genuine popular affection" (Toro 2013). Using list experiments to elicit sincere responses, a team of US political scientists estimated that Putin's approval rating in early 2015 was actually around 80 percent (Frye et al. 2015).

Stalin and Mao, Idi Amin and Bokassa, did not see much need for opinion polls to check whether they were widely loved. However, informational autocrats often rival democratic politicians in their obsession with approval ratings. Some allow autonomous polling organizations to operate freely. Putin's Kremlin, for instance, commissions weekly polls from one company and additional ones from a second. So far, it has permitted the independent Levada Center to continue publishing surveys on a variety of topics, including Putin's own popularity. Although such leaders might seem superficially similar to the stereotypical democratic politician, with his finger to the wind, their goals are different. Unlike in democracies, the polls are not used to identify popular policies that the dictator should support so much as to monitor the success of government propaganda. If the information strategy is working, publishing polls taken by independent

organizations can confirm to the population that the leader is, in fact, broadly popular. According to Aleksei Chesnakov, a former top Kremlin official:

> When the media are under control, polls can only show how effectively that control is working. It is as if you have a sick person and you infect him with new viruses and take his temperature. The thermometer reveals how the viruses are affecting him. Polls don't provide a reason to change policy. They just show how many people received your signal.[12]

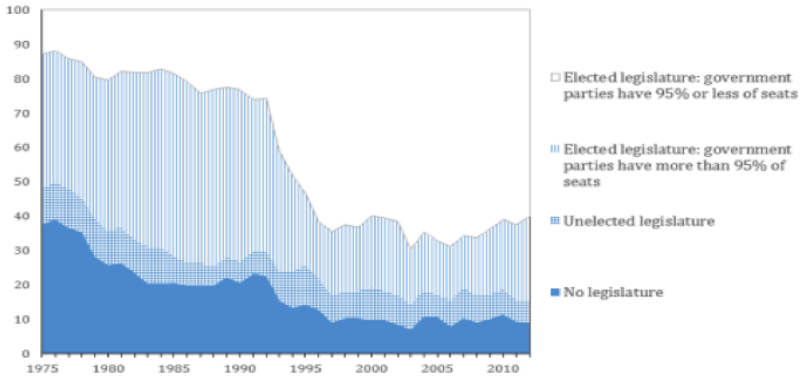
Our model of informational autocracy explains why, when a dictator has survived for some time, his reputation may remain stable even in the face of poor economic performance. Analysis of the Gallup World Poll (GWP) shows that, although, as one would expect, poor economic performance is on average associated with lower government popularity in non-democracies (see Guriev and Treisman 2016), there are nevertheless cases in which the government's rating remains strong despite a sharp economic decline. For instance, in Singapore in 2009, despite two years of negative growth, 98 percent of respondents still said they approved of the performance of the country's leadership. In Russia in 2014, notwithstanding a growth rate just slightly above zero, approval on the GWP was 68 percent. Levada Center polls show that approval remained extremely high in 2015, even as economic output contracted by nearly four percent.

3.3 Formally democratic institutions

Old-style dictatorships should have little use for ostensibly democratic institutions such as legal opposition parties, popularly elected parliaments, and partially free presidential elections. Such institutions complicate decision-making and could help opposition actors to coordinate and overthrow the incumbent. In fact, however, such institutions have multiplied in authoritarian states over the past 30 years. Figure 3 shows the sharp increase in the number of autocracies where an elected parliament existed and was not completely dominated by pro-government parties. While totalitarian states also held ritual elections in which citizens were mobilized to pay homage to the regime, many of the more modern authoritarian elections are at least partially free and officials go to considerable lengths—including sometimes inviting election observers—to render them credible. Where old-style autocracies had laws that criminalized criticism of the ruler, informational ones often have laws or constitutions that guarantee free speech.

Scholars have suggested a number of explanations. Elected parliaments may serve to share information or spoils among members of the elite and to coopt outsiders (Boix and Svolik 2013, Magaloni 2006, Gandhi and Przeworski 2007). Partially free elections may allow the incumbent to identify geographical support bases and opposition strongholds and to evaluate the loyalty and competence of his agents (Gandhi and Lust-Okar 2009). While elected parliaments, opposition parties, and partially free elections may, indeed, perform these functions in autocracies, the puzzle remains why dictators would choose ostensibly democratic institutions,

[12] Interview with Treisman, January 27, 2016.



Sources: Database of Political Institutions 2010 (see Beck et al. 2001); Polity IV database.
Notes: "Non-democracies" are countries with Polity2 scores of less than 6.

Figure 3: Legislatures in non-democracies, 1975-2012

when non-elective ones could perform the same functions with much less risk. Appointed councils could share information or spoils among members of the elite and coopt outsiders; secret polls or bureaucratic performance evaluations could survey local opinion and investigate agents without arousing destabilizing expectations of turnover.

Our model of informational autocracy suggests another role for partially free elections. If the dictator has convinced the public that he is competent, such elections can—with little or no risk—provide both internal and external legitimacy. Large victories will intimidate domestic regime opponents into quiescence, as argued by Magaloni (2006), but not because they result from electoral fraud. Rather, the opposition will understand that these victories represent the actual—albeit manipulated—preferences of the masses. They demonstrate to everyone the incumbent's genuine popularity. Moreover, although those who are censored know that laws protecting free speech are a charade, the masses, who have been maneuvered into sharing the regime's positions, find themselves free to express their opinions. They naturally imagine that at least some freedom of expression exists.[13]

[13] A 2014 cross-country poll by the BBC World Service and Globescan (www.globescan.com/images/images/pressreleases/2014-BBC-Freedom/BBC_GlobeScan_Freedom_Release_Final_March25.pdf) found that respondents in Rusia, China, France, and the US had similar levels of confidence in the freedom of their media. The percentage of respondents that believed their media were free was 24 percent in France, 26 percent in Russia, 42 percent in the US, and 47 percent in China. Only 5 percent of Chinese respondents characterized their media as "not free"; 28 percent of Russians, 28 percent of French respondents, and 40 percent of Americans did.

3.4 Censorship

In totalitarian states, censorship was comprehensive and aimed at defending ideological orthodoxy. The ruling party controlled all media and examined their output minutely—both before and after publication—for possible heresy and double-meanings. In Stalin's Soviet Union, when offending material in a newspaper slipped through the cracks, the censors had to trace all copies, down to enumerating the issues that had already served as toilet paper. Many authoritarian states have also sought to dominate the media. Pinochet's military regime placed censors in every newspaper, magazine, radio station, and television channel to check material before publication. A picture of the Interior Minister with one button unfastened was enough to earn one magazine an official reprimand (Spooner 1999, p. 89). After decolonization, many new African autocrats similarly set out to subjugate the press.

> Before long there was not a single independent radio station left in all of black Africa ... President Hastings Banda of Malawi jailed virtually the whole nongovernmental press corps in the mid-seventies. President Kenneth Kaunda appoints and fires newspaper editors in Zambia; in Uganda and Zaire, journalists shuttle in and out of jail so regularly that their wives don't even ask where they have been when they reappear after an absence of several days. Equatorial Guinea's president Macias Nguema Biyogo went one step further: by the time he was overthrown and killed in 1979, all journalists of note had been executed or were in exile (Lamb 1987, pp. 245-6).

Compare this to the modus operandi in the emerging informational autocracy of 1970s Singapore. The public outcry when, in 1971, Prime Minister Lee Kuan Yew detained and expelled a number of media executives and journalists convinced him that such tactics "risked stripping the consensual aspect of [the government's] rule and exposing the raw coercive power underneath" (George, pp.133-5). Instead, he developed a network of loyal shareholders in the key media companies. Subsequently, newspapers' corporate boards—supposedly at arm's length from the government—did the censoring for him. When loyalty failed, he used law suits to punish media offenders and set an example. Singapore's courts often awarded large damages. As one analyst put it: "forsaken profits and stiff legal penalties have been more effective in fostering self-censorship than earlier methods of intimidation" (Rodan 1998, p.69). Defamation suits did the same for spoken opinions.

Similarly, in Russia, Putin "has often relied on surrogates and economic pressure to keep editors and journalists in line" (Gehlbach 2010, p. 78). In Orban's Hungary, critical radio stations are starved of public sector advertising, only to have their broadcast licenses snapped up by friends of the government after their revenue sinks (Howard 2014). In Peru, Fujimori used an elaborate system of bribes to coopt most private media. However, one television station, Frecuencia Latina, continued to investigate the military and the spy chief Montesinos. The government promptly accused the station's main owner, Baruch Ivcher, of having failed to renounce his Israeli citizenship when he became a naturalized Peruvian 13 years earlier. With Ivcher stripped of citizenship, a court awarded his stake in the station to shareholders loyal to Fujimori (Faiola

1999).

In an informational autocracy, the leader seeks to conceal his influence over the media, since if citizens witness censorship they infer that he is hiding his true type.[14] Unlike the Nazis with their book-burnings or African dictators who openly jailed journalists, informational autocrats do best when their censorship is not visible. Recent research shows that when internet users in China become aware of censorship, it induces a more intensive search for information on the censored topic and engenders negative views about the government. By contrast, merely introducing some technical search friction reduces access to the information, with no spur to dissent (Roberts 2014). In Russia, the Kremlin can hire supposedly independent hackers to attack opposition websites and media, and then pretend to have no involvement. When they do admit to censorship, informational autocrats often conceal the true motive, claiming—as Russia's government does—to be protecting citizens from "extremism," "vandalism," child pornography, and other dangers, rather than blocking political criticism (Kramer 2007).

3.5 Propaganda

Old-style autocrats often used propaganda to indoctrinate their subjects into comprehensive ideologies. In totalitarian systems, these ideologies constituted holistic conceptions of man and society that were supposed to supercede the rational pursuit of individual self-interest (Linz 2000, p. 76). They legitimized the rule of the dictator and required his subjects to sacrifice their personal goals to the service of abstract forces—the State, the Race, History. They decisively rejected capitalist democracy.

Even non-totalitarian autocrats often adopted distinctive ideologies as supposed blueprints for their countries' development. Many one-party regimes adapted Marxism-Leninism, often emphasizing anti-colonial themes, to form African and Arab versions of socialism such as Ba'athism and Nasserism. Others served up more exotic ideological blends—for example, the Kemalism of Ataturk and Pancasila of Suharto.

Informational autocrats use propaganda for much more limited purposes. Although often critical of the West, they do not claim to have a superior alternative to democracy, insisting only that it be allowed to evolve gradually within their specific national conditions. Many have no discernible ideology. Those that do—for instance, Hugo Chavez, with his populist "Chavismo"—use this to signal their commitment to helping the masses materially, not to control citizens' thought. Rather than inculcating a comprehensive vision of the world—"engineering human souls," in the words of one Stalin-era writer—informational autocrats use propaganda merely to convince the public that they are doing a good job and that disappointments reflect extraneous obstacles rather than the leader's incompetence.

Given the dictator's incentive to lie, why do citizens ever believe official media? Our model shows how, despite this incentive, state propaganda can be informative. Because competent leaders always demonstrate their competence but incompetent ones must invest resources to fake competence convincingly, the latter

[14] For an analysis of indirect censorship by means of "media capture" in democracies, see Besley and Prat (2006).

may sometimes use the resources for something else.

This helps to explain an apparent paradox. In many informational autocracies, a huge amount of information about the incumbent's incompetence or corruption is available on the internet. Yet the vast majority of the population proves unwilling to spend the time to become informed and continues to rely on state controlled information sources. For instance, although 70 percent of Russians used the internet at least once a month as of October 2015, 69 percent said that they got their news about national events mostly from the state television channels. Only 21 percent thought that television gave "a full and objective picture of events," but another 46 percent nevertheless believed that one could "extract a lot of useful and objective information" from it (Levada Center 2016). As in our model, the fact that the state media sometimes tells the truth enables the dictator to mislead the public, even though the public is aware of such manipulation.

4 Setting

4.1 Players

There is a dictator and a continuum of citizens of unit mass. The dictator receives an exogenous rent each period he remains in power. He maximizes the net present value of expected future rents. In a one-period version of the model, the dictator simply maximizes the probability of staying in power, π. Citizens maximize their current consumption plus the net present value of future consumption.

The citizens are exogenously divided into informed (elite) and uninformed (general public). The mass of informed citizens, I, is small (so the elite cannot overthrow the dictator by itself; the general public can). The informed citizens are organized into a finite number, N, of interest groups, each of mass I/N.[15]

All agents are risk-neutral but have limited liability (i.e. cannot pay large fines).[16]

4.2 The economy

Total output (GDP), Y, may take two values: Y^L and Y^H, where $\Delta Y \equiv Y^H - Y^L > 0$. The probability ξ_θ of the high state, $Y = Y^H$, depends on the quality of the dictator, θ.

For simplicity, we assume that θ can take two values: $\theta = 0$ (the dictator is incompetent) and $\theta = 1$ (the dictator is competent). The dictator is competent with probability $\bar{\theta}$. The parameter $\bar{\theta}$ is therefore also the expected value of θ; indeed, $E\theta = \text{Prob}(\theta = 1) = \bar{\theta}$.

The probability ξ_θ of the high output $Y = Y^H$ is higher if the dictator is competent:

$$\xi_1 > \xi_0.$$

[15] See Guriev and Treisman (2015) for a version of the model with a continuum of infinitesimal elite members.

[16] Dal Bo et al. (2006) consider "plata or plomo" contracts where the regime can offer the elite members not only rewards (*plata*, Spanish for silver) but also punishments (*plomo*, Spanish for lead). In Section 6.4 we also allow for punishments for the elites. In Dal Bo et al.'s model the punishments are costly as they result in lower incentives for high-ability citizens to enter politics. In our case, punishments are costly as they are hard to hide and therefore likely to reveal the ruler's incompetence.

The dictator can use part of GDP for funding propaganda, P, censorship, X, and for rewarding the elites, R. His budget constraint is $Y = C + P + X + R$, where C is consumed by the population (C may include consumption by citizens of both private goods and non-excludable public goods provided by the government). For simplicity, we assume that C is distributed equally among citizens—so C is also per capita consumption, since the number of citizens is normalized to 1—and is observed by all. By contrast, we assume that Y, X, P, and R are not observed by the general public (Y may include both official and unofficial income sources of the regime).

"Propaganda" here should be understood broadly: it refers to any action by the government that makes the message "the leader is competent" more convincing to the public. Thus, it includes traditional instruments such as government advertising, production and broadcast of distorted news shows, pro-regime online media, bribing and planting of stories in the supposedly independent press, and hiring of internet "trolls" to post pro-regime comments. In China, an estimated 20 percent of all internet comments come from members of the "50 cent party," so-called because of the fee each is paid per pro-government post (Simon 2015, p. 99). In addition, reforming school curricula to make them more "patriotic" may fit (Cantoni et al. 2014). But propaganda can also be understood to include actions of the government that render credible the leader's excuses for poor economic performance. These could include manufacturing diplomatic, economic, and even military confrontations with foreign powers so that they can be more convincingly blamed for domestic stagnation. Of course, such actions can be very costly for the country but still rational for the dictator if the propaganda benefit is large.

We model propaganda as follows. By spending P on propaganda, the dictator increases the probability that the propaganda message that the public receives is convincing: $p = 1$. (The content of the message is: "the leader is competent, $\theta = 1$"; the value of p indicates whether it is convincing or not.) We assume that the competent dictator can send the signal $p = 1$ costlessly. If the dictator is incompetent, the probability of the public getting a convincing message, $p = 1$, is

$$\Lambda(P) = \min\left\{\frac{P}{\widehat{P}}, 1\right\}. \tag{1}$$

Here $\widehat{P}$ is a parameter that represents the cost to an incompetent dictator of generating fully convincing propaganda.

Censorship also involves a mix of traditional and non-traditional methods. Besides blocking publication of specific articles or programs, it can include filtering the internet, hiring hackers to attack opposition websites, bribing the owners and journalists in "independent" media to censor themselves, and prosecuting and imprisoning journalists who refuse. It can also involve paying friendly investors to buy out and domesticate critical broadcasters, overtly or through shell companies. Such activities divert resources from productive uses and cut into government spending on welfare-enhancing programs. China reportedly employs two million censors to police the internet (Bennett and Naim 2015). Under Fujimori in Peru, the regime paid more

than $36 million a year to the main television channels to skew their coverage, and reportedly offered one channel a $19 million bribe (McMillan and Zoido 2004, pp.82-5).

In formal terms, by spending X on censorship, the dictator blocks a proportion, x, of the opposition's messages:

$$x = \min\left\{\frac{X/\widehat{X}}{(N-n)/N}, 1\right\}.$$

Here n is the number of the elite groups that support the dictator and $\widehat{X}$ is an exogenous cost parameter that captures how much it costs to block all the messages if all informed citizens join the opposition. In other words, if the dictator wants to block $x \in [0,1]$ per cent of the messages, it has to spend $x\widehat{X}\frac{N-n}{N}$ dollars.

The co-optation of the elites works as follows: the dictator pays r to each member of an elite group if the group does not send negative messages. The total cost of rewarding the elites is $R = rnI/N$; both n and r are endogenously determined in equilibrium.

4.3 Information

There are four types of signals in the model. First, each informed citizen learns the type of the dictator, θ, and GDP, Y, precisely. Second, all citizens observe per capita consumption, C. Third, the dictator disseminates propaganda—which is a public signal, $p = \{0,1\}$, received by every citizen. Given that the competent dictator can send $p = 1$ at no cost, he always does so. Therefore if the public observes $p = 0$, it knows with certainty that the dictator is incompetent.

Finally, the informed citizens can send a signal $z = \{0,1\}$ to the public. We assume that the informed citizens can conceal evidence that the dictator is incompetent—i.e., send a signal $z = 1$ when, in fact, $\theta = 0$—but cannot convincingly claim that a competent leader is incompetent. This allows us to abstract from the possibility that the elite blackmails competent leaders.

As already noted, the signal $z = 0$ gets through censorship with probability $(1-x)$, where x is the level of censorship. If the public observes the signal $z = 0$ from the opposition, it knows for sure that the dictator is incompetent. If, on the other hand, the public observes the absence of a negative signal (we denote this as $z = 1$), it must infer whether this is because the signal was censored (probability x), because the true state is $\theta = 1$, or because nobody has joined the opposition ($n = N$) as all the elite groups have been co-opted. Therefore, if the true state is $\theta = 0$ (dictator is incompetent), then the probability of observing a positive signal $z = 1$ is $1 - (1-x)\frac{N-n}{N}$. Indeed, after each informed group decides whether to send a positive or negative signal, the regime spends $x\widehat{X}\frac{N-n}{N}$ dollars to block each negative signal with probability x. Then the total mass of signals—(i) positive from the co-opted groups (their share is $\frac{n}{N}$), (ii) positive due to censorship $x\frac{N-n}{N}$), and (iii) negative that get through censorship (share $(1-x)\frac{N-n}{N}$)—mixes together; we assume that the public picks one of them randomly.[17]

[17] Alternatively, one could suppose that all uncensored signals mix together first, and then the media pick one of them

4.4 Payoffs

4.4.1 Dictator's payoff

The dictator minimizes the probability of regime change. He does not benefit from higher GDP directly, just through increased resources to buy support and to fund propaganda and censorship.

4.4.2 Citizens' payoff

The public maximizes current consumption plus the net present value of future payoffs.[18] In the interest of generality, we assume that current consumption, C, may include both private goods (bought with citizens' after-tax incomes) and public goods (funded by tax revenues minus spending on propaganda, censorship, and co-optation). Therefore $C = Y - P - R - X$.

The co-opted informed citizens (pro-regime elite) receive additional current consumption of r per capita. Notice that the timing of the game (section 4.5) implies that both informed and uninformed citizens make their decisions after C is set. However, the co-optation payment r proposed by the dictator matters for the informed citizens' decision to join the pro-regime elite or the opposition.

Future payoffs depend on the type of regime in place. We describe the citizens' preference for having a competent (rather than incompetent) dictator in the future by a scalar parameter β. If the current dictator stays, the net present value of the future payoffs is $\beta\theta$.[19]

If the regime is changed, the new dictator is drawn from the same distribution: he is competent with probability $\bar{\theta}$ and incompetent with probability $1-\bar{\theta}$. We assume that the regime change involves a non-trivial additional cost to citizens, K. Hence, expected future payoffs are $\beta\bar{\theta} - K$.

4.5 Timing

1. The dictator and the elite observe the type of the dictator, $\theta \in \{0, 1\}$. The economic shock, Y, is realized ($Y = Y^H$ with probability ξ_θ and $Y = Y^L$ with probability $1 - \xi_\theta$). Both the elite and the dictator observe Y.

2. The dictator chooses the level of censorship, $x \in [0, 1]$. The dictator offers a level of rewards, r dollars per capita, to those elite groups that agree not to send anti-regime messages (limited liability implies $r \geq 0$). The dictator chooses a level of investment in propaganda, P.

randomly, after which the dictator tries to censor if this signal is negative. Since the share of negative signals in the mix is $\frac{N-n}{N}$, the public would get the positive signal with the same probability, $1 - (1 - x)\frac{N-n}{N}$.

[18] It might seem cynical to assume citizens care only about economic performance and not about freedom per se. But in the informational equilibria we study, members of the general public are not aware of their loss of freedom. It is only when informational equilibria do not exist and the dictator is reduced to sheer repression that the public becomes conscious of constraint.

[19] In Section 5.2 below, we discuss the microeconomic foundation for the parameter β.

3. Each elite group decides whether (i) to support the regime and receive the reward r, or (ii) to join the opposition and send a signal to the public informing it that the dictator is incompetent. The number of groups that choose to support the regime is n; the remaining $N - n$ groups join the opposition.

4. Contracts for the elite are implemented. Censorship blocks a proportion x of the independent signals, so the public receives the opposition's signals with probability $(1 - x)\frac{N-n}{N}$.[20] Payoffs are realized.

5. Citizens observe their consumption, C, propaganda signal, $p = \{0, 1\}$, and any independent signals that get through censorship, $z = \{0, 1\}$. The citizens update their beliefs about θ and decide whether to overthrow the dictator.

4.6 Assumptions

We assume that the dictator can commit to the contracts with the elites. In Section 5.3 we discuss why this assumption is reasonable given that the elite members fully observe both the type of the dictator and the economic outcomes.

For simplicity's sake, we also assume that $\widehat{X}$ and $\widehat{P}$ are sufficiently large relative to ΔY that $X/\widehat{X} < 1$ and $P/\widehat{P} < 1$ in equilibrium. In the Proof of Proposition 2 in the Appendix we show that our results are robust to dropping this assumption.

To focus on the more interesting cases, we also assume that $K < \beta\bar{\theta}$, so that if the public knows with certainty that the dictator is incompetent it prefers to replace him.

5 Analysis

Given the parameters $\bar{\theta}$, ξ_1, ξ_0, ΔY, I, N, $\widehat{X}$, $\widehat{P}$, β, and K, we shall find the equilibrium strategies of the dictator (C, x, P, r), of the informed citizens (get co-opted or join the opposition), and of the public (protest or support the regime). All agents are rational and maximize their expected payoffs given the available information. In particular, the informed citizens' choice is contingent on the rewards, r, offered for loyalty.

The general public observes consumption, C, and the signals p and z. If at least one of the latter two signals is low ($p = 0$ or $z = 0$), the public knows with certainty that the dictator is incompetent and protests. If both signals are high ($p = z = 1$), then the decision depends on the consumption level, C: the public protests if consumption is low and supports the regime if consumption is high.

Lemma 1. *The public's strategy is described by a threshold C^* such that the public supports the regime if and only if it observes both $p = z = 1$ and $C \geq C^*$.*

[20] Thus, the probability that the public receives an opposition message is proportional to the number of messages sent that escape censorship; if all elite members send messages ($n = 0$) and there is no censorship ($x = 0$), the messages get through for sure.

We first describe the best response functions of the three players and then solve for equilibria.

5.1 Players' best response strategies

5.1.1 Public's choice

The general public chooses its action—support the regime or protest—so as to maximize the sum of its current per capita consumption and the net present value of expected future payoffs, $C+\max\left\{\beta E(\theta|C,p,z);\beta\bar{\theta}-K\right\}$, given all available information. Current consumption, C, is already set and observed by the public when it chooses its action. Here $E(\theta|C,p,z)$ is the expected value of θ given the public's inference of the equilibrium strategies of other players and the observed values of C,p, and z.

The public's decision is described by a scalar threshold, C^*, that solves the following problem: C^* is the lowest level of consumption that satisfies

$$E(\theta|C^*,p=z=1)\geq\bar{\theta}-K/\beta. \tag{2}$$

The public does not protest if and only if $C\geq C^*$ and $p=z=1$.

5.1.2 Informed citizens' choice

The informed citizens choose whether to join the opposition or to get co-opted. They make decisions given the strategies of the dictator and of the general public. They infer the probability of the regime surviving as a function of the size of the pro-regime elite and of the opposition, $\Pi(n)$. The latter is a monotonically increasing function: the fewer elite groups join the opposition, the less likely the public is to receive their signals, and—for a given realization of Y and the dictator's choice of propaganda, P, censorship, x, and rewards, r—the less likely the public is to overthrow the dictator. The function $\Pi(n)$ is endogenously determined in equilibrium.

If an elite group accepts to be co-opted, each member of the group gets:

$$U^C=C+r+\Pi(m+1)\beta\theta+[1-\Pi(m+1)](\beta\bar{\theta}-K).$$

Here $m\in\{0,...,N-1\}$ is the number of other groups supporting the regime.

If the group decides to joins the opposition, each member gets:

$$U^O=C+\Pi(m)\beta\theta+[1-\Pi(m)](\beta\bar{\theta}-K).$$

The trade-off is straightforward. By joining the opposition, an elite group forgoes the co-optation payment, r but decreases the odds of the incumbent staying in power by $[\Pi(m+1)-\Pi(m)]$. The net per capita

returns to regime change are $(\beta\bar{\theta} - K) - \beta\theta$.

Therefore, an elite group joins the opposition if and only if $r < [\Pi(m+1) - \Pi(m)] \left[(\beta\bar{\theta} - K) - \beta\theta\right]$. It is immediately clear that if the true type is high $\theta = 1$, the right hand side is negative and nobody wants to join the opposition—even if there is no co-optation reward. Hence, a competent dictator does not need to offer any rewards.

If the dictator is incompetent ($\theta = 0$), then each elite group prefers to join the opposition if and only if the co-optation rewards are sufficiently low: $r < r^*$. Here

$$r^* \equiv (\beta\bar{\theta} - K) \left[\Pi(m+1) - \Pi(m)\right]. \tag{3}$$

Therefore, if the dictator is incompetent,

$$n(r) = N\mathbf{1}\{r \geq r^*\}. \tag{4}$$

This follows from the fact that all elite groups are symmetric and face the same choice.

5.1.3 Dictator's choice: censorship, rewards, propaganda

The dictator learns his type, θ, observes Y and chooses the strategies: censorship (x), rewards (r), and propaganda (P), so as to maximize his probability of staying in power, π. Given his choice of r, x, and P, the expected probability of staying in power depends on the dictator's type. We will consider the competent and incompetent dictator separately.

5.1.3.1 The competent dictator's choice

If the dictator is competent, there is no opposition in equilibrium: $n = N$. A competent dictator therefore never uses rewards, censorship, or propaganda: $P = R = X = 0$. For him, the propaganda signal is $p = 1$ with probability 1 and consumption is $C = C_1(Y) \equiv Y$. The probability of staying in power is therefore

$$\pi_1 = \mathbf{1}\{Y \geq C^*\}. \tag{5}$$

5.1.3.2 The incompetent dictator's choice

If the dictator is incompetent, the probability of staying in power is:

$$\pi_0 = \left[1 - (1-x)\frac{N-n}{N}\right] \Lambda(P)\mathbf{1}\{C \geq C^*\} \tag{6}$$

where $n = n(r)$ is a function of r determined by (4). Indeed, the probability of $z = 1$ is $1 - (1 - x)\frac{N-n}{N}$, and the probability of $p = 1$ is $\Lambda(P)$.[21]

Equation (6) implies that returns to censorship increase in propaganda and decrease in rewards. In other words, censorship and co-optation are substitutes, and propaganda is complementary to both. This simply reflects the fact that cooptation and censorship are alternative methods of preventing the elite from informing the public about the dictator's type. Propaganda applies to the other signal — the one sent by the dictator himself.

The incompetent dictator's choice is described by the following

Lemma 2. *Denote $R = R^* \equiv r^* I$. The incompetent dictator chooses the level of consumption $C_0(Y) = C^*$.*

The probability of getting both positive propaganda signal and positive elite signal, $p = z = 1$, is

$$\rho(B) = \max\left\{\frac{B - R^*}{\widehat{P}}; \frac{B^2}{4\widehat{P}\widehat{X}}\right\}. \tag{7}$$

where $B = Y - C^*$ is the total budget spent on propaganda, censorship, and co-optation.

If the following condition holds,

$$R^* < B\left(1 - \frac{B}{4\widehat{X}}\right), \tag{8}$$

the dictator chooses $r = r^*$, $x = 0$, $P = B - R^*$. If the condition (8) does not hold, then the dictator chooses $r = 0$, $x = B/(2\widehat{X})$, $P = B/2$.

That is, the dictator uses all the budget on propaganda plus either rewards to the elite for remaining silent or censorship of their messages.

5.2 Equilibria

As the competent dictator always sets $C = Y$, it is easy to show that there can be two kinds of equilibria.

First, $C^* = Y^L$, and the competent dictator always stays in power. The incompetent dictator is overthrown if $Y = Y^L$. However, if $Y = Y^H$ he stays in power and spends $B = Y^H - Y^L = \Delta Y$ on rewards, censorship and propaganda and therefore assures $p = z = 1$ with a non-trivial probability $\rho(\Delta Y)$.

Second, $C^* = Y^H$, and the competent dictator only stays in power if $Y = Y^H$; the incompetent dictator is overthrown with probability 1.

Can there be equilibria with $C^* < Y^L$? This is impossible as the public knows that if it observes $C < Y^L$, the dictator must be incompetent. So it makes sense to replace this dictator with probability 1.

Similarly, there cannot be equilibria with $C^* \in (Y^L, Y^H)$. In this case, if the public observes such a C^* and $p = z = 1$, it knows with certainty that the dictator is incompetent (and lucky).

[21] Notice that equation (6) immediately implies that $\Pi(n+1) - \Pi(n) = (1 - x)\Lambda(P)/N$ in equilibrium.

5.2.1 Equilibrium with $C^* = Y^H$

The equilibrium with $C^* = Y^H$ exists whenever the inferred quality of a dictator with $C = Y^L$ is below the potential alternative $\bar{\theta} - K/\beta$.

Proposition 1. *The equilibrium with $C^* = Y^H$ exists if and only if*

$$\Delta Y \geq \widehat{P}\left(\frac{1}{\bar{\theta} - K/\beta} - 1\right)\frac{\bar{\theta}}{1-\bar{\theta}}\frac{1-\xi_1}{\xi_0}. \tag{9}$$

In equilibrium, none of the informed citizens joins the opposition, the co-optation rewards are infinitesimal, there is no censorship, and the incompetent dictator with $Y = Y^H$ spends ΔY on propaganda.

In this equilibrium, the incompetent dictator survives with probability 0 while the competent dictator survives with probability ξ_1. The intuition is as follows: when the public observes $p = z = 1$ and $C = Y^L$, it understands that it is very likely that the dictator is incompetent. Notice that there is no opposition: the informed citizens, understanding that the dictator will be overthrown anyway, accept to be co-opted even if the rewards are close to zero. Given that there is full co-optation, the dictator spends nothing on censorship. Finally, as the total co-optation rewards are trivial, the dictator spends all of ΔY on propaganda.[22]

5.2.2 Equilibrium with $C^* = Y^L$

In this equilibrium, the competent dictator always survives, while the incompetent dictator only survives if $Y = Y^H$. In the latter case, he spends ΔY on propaganda, censorship and co-optation.

The properties of this equilibrium depend critically on the relative costs of co-optation and propaganda, which is captured by the following parameter:

$$\alpha \equiv \frac{(\beta\bar{\theta} - K)I}{\widehat{P}N}. \tag{10}$$

The co-optation rewards are endogenous in equilibrium; one of their key determinants is the informed citizens' long-term cost of not revealing the dictator's incompetence. There are N groups of informed citizens (size I/N each); they know that replacing an incompetent dictator would improve their own welfare by $(\beta\bar{\theta} - K)$ per capita. Therefore, $(\beta\bar{\theta} - K)I/N$ is the opportunity cost for an elite group (of size I/N) of remaining silent—which will be the minimum reward it will require for co-optation. On the other hand, $\widehat{P}$, is how much it costs the incompetent dictator to generate a positive propaganda signal with probability 1; in other words, raising the probability of $p = 1$ by 1 percentage point costs the dictator $0.01\widehat{P}$.

[22] As the incompetent dictator is overthrown anyway, he is indifferent between various strategies. Among these strategies, spending ΔY on propaganda maximizes the probability of $p = z = 1$. Therefore, it makes this equilibrium likelier to exist. Indeed, the higher the incompetent dictator's odds of delivering a positive message, $p = z = 1$, the stronger the public's incentives to overthrow a ruler with $C = Y^L$.

In this equilibrium, the general public should believe that the average type of the dictator with $C = C^* = Y^L$ and $p = z = 1$ is weakly better than regime change:

$$E(\theta|C = Y^L, p = z = 1) = \frac{\bar{\theta}(1-\xi_1)}{\bar{\theta}(1-\xi_1) + (1-\bar{\theta})\xi_0\rho(\Delta Y)} \geq \bar{\theta} - K/\beta. \tag{11}$$

Proposition 2. *The equilibrium with $C^* = Y^L$ exists only if ΔY is sufficiently small*

$$\Delta Y \leq 4\widehat{X} \max\left\{\frac{1}{\alpha+1}, \frac{\frac{\alpha}{2}-1}{\alpha-1}\right\} \tag{12}$$

There can be two kinds of equilibria in pure strategies:

If $\Delta Y < 4\widehat{X}\frac{1}{1+\alpha}$ and

$$\Delta Y \leq (1+\alpha)\widehat{P}\left(\frac{1}{\bar{\theta} - K/\beta} - 1\right)\frac{\bar{\theta}}{1-\bar{\theta}}\frac{1-\xi_1}{\xi_0}. \tag{13}$$

then there is an equilibrium with co-opted elites: $n = N$. In this equilibrium, the dictator uses co-optation and propaganda, but not censorship. The probability of survival is:

$$\rho(\Delta Y) = \rho^{co}(\Delta Y) \equiv \frac{\Delta Y}{\widehat{P}(1+\alpha)} \tag{14}$$

If $\alpha > 2$ and $\Delta Y < 4\widehat{X}\frac{\frac{\alpha}{2}-1}{\alpha-1}$ and

$$\Delta Y \leq \sqrt{4\widehat{P}\widehat{X}\left(\frac{1}{\bar{\theta} - K/\beta} - 1\right)\frac{\bar{\theta}}{1-\bar{\theta}}\frac{1-\xi_1}{\xi_0}}, \tag{15}$$

there is an equilibrium with censorship in which all informed citizens join the opposition: $n = 0$. In this equilibrium, the dictator uses censorship and propaganda, but not co-optation. The probability of survival is:

$$\rho(\Delta Y) = \rho^{ce}(\Delta Y) \equiv \frac{(\Delta Y)^2}{4\widehat{P}\widehat{X}} \tag{16}$$

Equilibria with $C^* = Y^L$ only exist if ΔY is sufficiently small. Indeed, if ΔY is large, the public knows that the incompetent dictator—if lucky—can spend substantial resources to ensure that $p = z = 1$. Hence citizens understand that signals $p = z = 1$ are not very informative; even observing $p = z = 1$ and $C = C^*$, they still decide to protest.

Multiple equilibria. If $\alpha > 2$ and if ΔY is sufficiently small (satisfying both (12), (13) and (15)), then there are two equilibria—one with propaganda and co-optation ($n = N$) and one with propaganda and censorship ($n = 0$). Comparing (14) and (16) we find that whenever both equilibria exist, the probability of survival is higher in the equilibrium with co-optation. We discuss the intuition behind this result in the section 5.3.

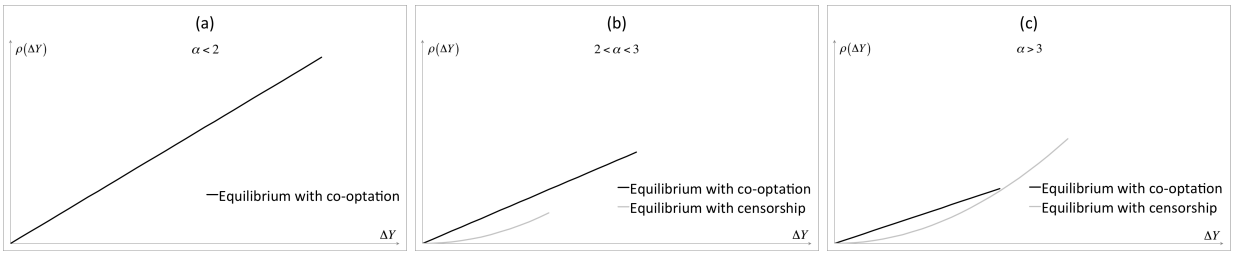


Figure 4: Structure of equilibria for different values of parameters. The graphs represent the probabilities of survival $\rho(\Delta Y)$ for the following parameter values: (a) $\alpha = 1.5$, (b) $\alpha = 2.5$, (c) $\alpha = 3.5$; in all three cases $\widehat{X} = \widehat{P} = 1$. The graph (a) represents the situation where the cost of co-optation is low ($\alpha < 2$) hence no censorship equilibrium exists; the equilibrium with co-optation exists as long as economic volatility ΔY is not too high. The graph (b) represents the situation where the cost of co-optation is relatively high ($\alpha \in (2, 3)$); both equilibria may exist if ΔY is sufficiently low. If ΔY is higher but not too high, only the equilibrium with co-optation exists. The graph (c) represents the situation where the cost of co-optation is very high ($\alpha > 3$); both equilibria exist if ΔY is sufficiently low. If ΔY is higher but not too high, only the equilibrium with censorship exists. In all three cases (a), (b), (c), the survival odds increase with ΔY (as long as it is not too high so that equilibria cease to exist). Whenever both equilibria exist, the survival probability is higher in the equilibrium with co-optation: $\rho^{co}(\Delta Y) \geq \rho^{ce}(\Delta Y)$.

Figure 4 presents the structure of equilibria under different values of parameters (we assume that $(1 - \xi_1)/\xi_0$ is sufficiently high so that both conditions (13) and (15) hold). These equilibria (where $C^* = Y^L$) can also co-exist with the equilibrium with $C^* = Y^H$ (indeed, for some parameter values both conditions (9) and (13) are satisfied). In the latter equilibria, the public, observing a positive signal $p = z = 1$ and low consumption, infers that the expected quality of the dictator is too low and protests. As the informed citizens understand that the dictator will be removed anyway, they know that their information will have no impact and are therefore happy to be co-opted even if rewards are low. Thus, achieving the outcome with $p = z = 1$ and $C^* = Y^L$ is relatively cheap for the dictator. So the public's inference is justified. For the same parameter values, there may exist an equilibrium with $C^* = Y^L$ in which informed citizens do have an impact on the dictator's survival probability; in this case, co-opting them is costly. Hence, observing the outcome $p = z = 1$ and $C^* = Y^L$, the public infers that the expected type of the dictator is relatively high.

Social returns to competence. So far, we have simply assumed that the public prefers to have a competent—rather than an incompetent—dictator. One can now see why this would always be the case. First, the competent dictator provides higher expected per-period consumption. Expected output, $EY = Y^L + \xi_\theta \Delta Y$, is higher under the competent dictator since $\xi_1 > \xi_0$. In addition, the competent dictator never spends anything on propaganda, censorship, and co-optation, while the incompetent one does so at least in some equilibria. The second reason why the public prefers a competent leader is that the incompetent dictator has a non-trivial probability of being overthrown — which reduces the public's payoff by the cost of regime turnover, K.

This allows us to provide micro-foundations for the parameter β. Consider an infinitely repeated version of the game and suppose that the discount rate is δ. Let us focus on the equilibrium with $C^* = Y^L$.

In this equilibrium, the net present value of having a competent leader is $V^H = \frac{Y^L + \xi_1 \Delta Y}{1-\delta}$. What is the net present value of having an incompetent leader? That depends on how long the leader remains in power, which depends, in turn, on how the public updates its beliefs over time. For simplicity's sake let us consider two extreme cases. First, suppose that the information about the regime's type gets revealed next period.[23] In this case the public does not need to update its beliefs as it has perfect information after the end of the period. If the incompetent dictator realizes that his type is known, he understands he will be overthrown anyway and so does not need to spend anything on propaganda, censorship, and co-optation, so that $V^L = Y^L + \xi_0 \Delta Y + \delta \left[\bar{\theta} V^H + \left(1 - \bar{\theta}\right) V^L - K\right]$. Therefore $V^H - V^L = \frac{(\xi_1 - \xi_0)\Delta Y + \delta K}{1 - \delta\left(1-\bar{\theta}\right)} > 0$. As discussed above, the returns to having a competent dictator consist of two terms: having a higher expected per-period payoff (proportional to $(\xi_1 - \xi_0)\Delta Y$) and saving on the cost of turnover (proportional to K).

The opposite extreme case is that the public never learns. Suppose that the public has amnesia and instantly forgets any information acquired in previous rounds.[24] Its prior belief at the start of each round is that the incumbent's expected type is $\bar{\theta}$. In this case, the net present value of having an incompetent leader is $V^L = Y^L + \delta \left\{\xi_0 \rho(\Delta Y) V^L + (1 - \xi_0 \rho(\Delta Y)) \left[\bar{\theta} V^H + (1 - \bar{\theta}) V^L - K\right]\right\}$. Solving for V^L we obtain the net present value of having a competent rather than an incompetent leader: $V^H - V^L = \frac{\xi_1 \Delta Y + \delta[1 - \xi_0 \rho(\Delta Y)]K}{1 - \delta\left\{1 - \bar{\theta}[1 - \xi_0 \rho(\Delta Y)]\right\}} > 0$. Once again, the first term in the numerator is the difference in per-period consumption under competent and incompetent leaders, $\left[Y^L + \xi_1 \Delta Y\right] - Y^L = \xi_1 \Delta Y$. The second term is the per-period equivalent of the future cost of leadership turnover under the incompetent leader.

5.3 Discussion of the results

The previous analysis yields four main results.

First, if economic volatility (the difference between good and bad economic states, ΔY) is not very high (condition (12) holds), the incompetent dictator can survive in equilibrium. The logic is as follows. If ΔY is low, that means that an incompetent dictator who is lucky enough to experience a good economic outcome ($Y = Y^H$) will have only a small amount of extra resources, ΔY, to spend on propaganda, censorship, and co-optation. As a result, the messages received by the public should be relatively accurate. Thus, if the public does receive the positive signals $p = z = 1$, it will tend to believe them and think the incumbent is competent, even if consumption is low $C = Y^L$.

However, if volatility ΔY is high, then no equilibrium with $C = Y^L$ exists and the incompetent dictator is overthrown. The impact of economic volatility is especially important in the dynamic setting (see section 6.2). We show there that when volatility is low, the dictator is less likely to survive the initial period; but, if he does, he is then more likely to remain in power for a long time.

[23] This is tantamount to assuming that the length of the period is the time it takes for information about the regime's type to get revealed to the public.

[24] In Section 6.2, we examine a dynamic version of the game where the public has perfect memory and updates its beliefs using the information on survival of the incumbent in the previous periods.

This result may also be interpreted in a cross-sectional sense. If the public notices that other comparable countries are doing much better (ΔY is high), it infers that its dictator may well have diverted a lot of resources (ΔY) into propaganda, censorship, and co-optation. As a result, it stops believing the positive signals, concludes that the dictator is probably bad, and takes to the streets to protest.

The second result is the multiplicity of equilibria. For some parameter values, two equilibria exist: (i) an equilibrium with co-optation, in which the elite agrees to stay silent in return for rewards, and (ii) an equilibrium with censorship, in which all informed citizens join the opposition but the dictator attempts to block their media communications.

The multiplicity of equilibria is driven by the "fiscal externality" imposed by the elite members on each other. Consider the equilibrium with co-optation, $n = N$. Every elite group is happy to stay in the pro-regime camp, receiving r^* for not joining the opposition. But now imagine that $k > 0$ groups join the opposition. In this case, the dictator spends r^*kI/N less on rewards and reallocates the money to propaganda and censorship, increasing x and P. How does this change affect the returns to joining the opposition for the remaining $N-k$ elite groups? These returns are related to $\Pi(m+1)-\Pi(m)$, which in turn is proportional to $(1-x)P$ (the payoff to joining the opposition decreases in censorship and increases in propaganda). Thus, the defection of some elite groups has two opposite effects. On the one hand, the increase in censorship reduces the odds that an anti-regime message will get through. This *lowers* the payoff to joining the opposition. On the other hand, the increase in propaganda makes it less likely the general public will learn of the dictator's incompetence—and thus makes it all the more important for informed citizens to try to communicate it. This *raises* the payoff to joining the opposition. Which effect dominates will depend on the parameters. If the former effect is stronger, no additional members of the elite defect, and the co-optation equilibrium holds. But if the latter effect dominates, then the initial departures set off a spiral of defections, ending in the equilibrium with censorship and no co-optation. Therefore, for some parameter values, only one equilibrium exists, and for other parameter values, two equilibria exist (see Figure 4).

The third result concerns how the dictator's various instruments interact. As seen in (6), censorship and co-optation of the elite are substitutes, while propaganda is complementary to both of them. Returns to censorship and co-optation increase with propaganda. But higher spending on censorship decreases incentives for co-optation.

These interactions are specific to the baseline setting, in which elites are homogeneous and no signal distortion occurs in communication. As we discuss in Section 6.5, if members of the elite are heterogeneous—for instance, some bear a higher "moral cost" if they are co-opted—it may be cost-effective to co-opt some and censor others. In this case, co-optation and censorship can become complements. We also show that if signals are transmitted with some noise, this can also generate equilibria in which propaganda and censorship are substitutes.

Finally, we see that whenever both the equilibrium with co-optation and that with censorship exist, the

dictator's survival probability is always higher in the former. This follows from the fundamental asymmetry between these two equilibria. In the equilibrium with co-optation, the dictator can always deviate to the equilibrium with censorship by offering zero rewards: $r = 0$. Whatever the elite's original beliefs, if the dictator offers $r = 0 < r^*$, the elite members reject the reward offered and join the opposition. This is why the equilibrium with co-optation can only exist if it delivers a higher probability of survival than the equilibrium with censorship. On the other hand, in the equilibrium with censorship the elites can only be co-opted if r^* is sufficiently high (greater than the right-hand side in (8)). The dictator cannot unilaterally deviate from censorship to co-optation by offering a lower reward: the elites would not agree to be co–opted. This result implies that a dictator can get stuck in an inferior equilibrium, relying on a relatively ineffective instrument (censorship rather than co-optation) to stay in power.

In the analysis above, we have assumed that the dictator can commit to the co-optation contracts with the elite members. If he promises at time 2 to pay r in return for loyalty, and the elite members send the signal $z = 1$ at time 3, he does pay at time 4. This assumption does not matter for the equilibrium with censorship (as $r = 0$ anyway). However, it is crucial for the equilibrium with co-optation. If this assumption does not hold, a promise of any positive $r > 0$ is not credible. One way to justify this assumption is to consider a repeated version of the game. Although we do not model this explicitly, the co-optation contracts can be sustained by grim trigger strategies. The elite members observe the type of the ruler and the economic outcomes, so they fully understand whether the dictator sticks to the co-optation contracts or reneges. If he reneges once, they switch to the censorship equilibrium and the dictator cannot return to the co-optation equilibrium (which delivers a higher probability of survival).

We have not analyzed the efficiency of the equilibria. In the current setting, a welfare analysis would require introducing a social welfare function that would include the payoffs of both citizens and dictators. As the dictator's payoff is non-monetary, there is no natural choice of such a welfare function. However, if we assume that the dictator's "office rents" are small compared to national income, Y, then the first best is straightforward. A competent dictator should always stay in office. If the dictator is incompetent, replacing him is always optimal (given our natural assumption that costs of leadership turnover are not too high $\beta\bar{\theta} - K > 0$).

6 Comparative statics and extensions

6.1 Comparative statics

How do the exogenous parameters affect the dictator's survival probability? While the model has ten parameters (ΔY, $\bar{\theta}$, K, I, N, β, $\widehat{P}$, $\widehat{X}$, ξ_0 and ξ_1), the structure of equilibria with $C^* = Y^L$ depends on just two combinations of them: $\alpha = \frac{(\beta\bar{\theta}-K)I}{\widehat{P}N}$ and $\frac{\Delta Y}{4\widehat{X}}$.

The parameter ΔY is the ex ante economic volatility. From (16) and (18), we see that the dictator's

survival probability in both the possible equilibria, $\rho(\Delta Y)$, increases in ΔY. The reason is simple: the higher is ΔY, the more resources an incompetent dictator can spend on censorship, co-optation and propaganda in a given period when $Y = Y^H$. Not surprisingly, this translates into a higher probability of survival. However, if volatility, ΔY, is too high (condition (12) is violated), then the equilibrium ceases to exist: observing $C = Y^L$, the public understands that it is very likely that there is a lucky incompetent dictator ($\theta = 0$, $Y = Y^H$) who has spent a large amount of resources on information and co-optation.

Parameter α captures the cost of co-optation relative to the cost of propaganda. If α increases then the equilibrium with censorship is more likely to exist, while the equilibrium with co-optation is less likely to exist. (This can be seen as we shift the curves in Figure 4 in response to change in α; indeed $\frac{1}{1+\alpha}$ decreases in α and $\frac{\frac{\alpha}{2}-1}{\alpha-1}$ increases in α). This result also makes it possible to compare large and small countries. In general, the per capita cost of cooptation will be constant, but that of propaganda will fall because of economies of scale: the same broadcasts or arguments can be used to convince multiple citizens. As the population increases, the effectiveness of propaganda per capita grows; so $\widehat{P}$ falls and α increases. This makes the equilibrium with co-optation deliver lower survival probability (relative to the equilibrium with censorship) and less likely to exist.

The comparative statics with regard to α show how the degree of organization within the elite affects outcomes. If the elite is consolidated (N is small), then α is large, the cost of co-optation is high, and the equilibrium attained is more likely to be that with censorship. By contrast, if the elite is divided into many groups (N is large) then these groups are cheaper to co-opt one by one. The probability of any given group being pivotal falls as the number of groups increases, so they become less reluctant to be co-opted. Indeed, in this equilibrium, a single group's incentive to deviate is proportional to its impact on the probability of replacing an incompetent dictator $\Pi(N) - \Pi(N-1)$ which in turn is proportional to $1/N$. As a result, the equilibrium with co-optation is more likely to obtain.

If $\widehat{X}$ increases then both equilibria are more likely to exist—the public understands that censorship is not cost-effective so a good signal, if received, is more likely to be true. If the censorship equilibrium exists, a higher $\widehat{X}$ reduces the dictator's survival odds: his censorship becomes less effective.

If the dictator's expected replacement is relatively competent and revolution is not too costly (high $(\bar{\theta} - K)$), then the equilibrium with censorship is more likely and the one with co-optation is less likely. The intuition is straightforward: for members of the elite, the returns to removing the incompetent dictator are high, and so silencing them with rewards is expensive. As a result, the dictator prefers to use censorship. By the same logic, if the elite cares more about the future (higher β), bribing it to accept an incompetent incumbent costs more, so censorship is favored.

What happens if the cost of propaganda, $\widehat{P}$, falls? Interestingly, α goes up and the equilibrium with co-optation becomes less likely (while the equilibrium with censorship becomes more likely). The lower the cost of propaganda, the more likely the public will get a convincing propaganda signal. This makes the signals

of the opposition more important, and renders the informed elite harder to co-opt, increasing the odds the dictator will use censorship instead. For example, if an external enemy threatens the state's security, this may help the incumbent to dodge blame for poor economic performance, rendering his propaganda claims more believable. If so, the equilibrium with co-optation could disappear, leaving only that with censorship.

The model also implies that modernization is likely to result in the removal of incompetent rulers. Indeed, one consequence of economic modernization is to broaden the informed elite, increasing I. In the current setting, this makes co-opting the elite more expensive, and thus favors the equilibrium with censorship. However, it may be more intuitive to suppose that the cost of censorship, $\widehat{X}$, rather than remaining fixed, also increases with I. If, for instance, $\widehat{X}$ is proportional to I, it is easy to check that an increase in I makes *both* equilibria less likely to exist. Indeed, higher I raises the costs of both co-opting and censoring. Since propaganda cannot substitute for censorship and rewards (propaganda is a *complement* rather than a substitute for both), incompetent dictators face more problems whatever they do. As suggested by "modernization theory," broader access to information (or education) renders dictatorships less likely to survive.

6.2 Dynamics

We consider here a multi-period version of the model. We assume that the economic and informational environment does not change over time (in particular, we do not allow either the dictator or the citizens to save or borrow). The only state variable that does evolve over time is the public's beliefs, $\widetilde{\theta}_t$, about the type of the dictator at time t. Initially, the beliefs are the same as in the one-period model above $\widetilde{\theta}_0 = \bar{\theta}$. After each period, if the dictator survives, the public rationally updates its beliefs about him. We will assume that the alternative regime's quality, $\bar{\theta}$, is constant over time. The informed citizens do not update their views as they learn the dictator's type precisely in the initial period.

We first consider the dynamics of equilibrium with $C^* = Y^H$. Suppose this equilibrium exists and is unique. In this equilibrium, if the dictator survives after the first period, the public knows with certainty that the dictator is competent. Therefore in all future periods $\widetilde{\theta}_t = 1 > \bar{\theta} - K/\beta$, so there are no protests.

The dynamics of the equilibrium with $C^* = Y^L$ are more complicated. In this equilibrium, the competent dictator always survives, while the incompetent dictator survives with probability $\xi_0\rho(\Delta Y)$ where $\rho(\Delta Y)$ is either $\rho^{co}(\Delta Y)$ (if this is the equilibrium with co-optation; see equation (14)) or $\rho^{ce}(\Delta Y)$ (if this is the equilibrium with censorship; see equation (16)). Therefore, the expectation $\widetilde{\theta}_t$ evolves over time according to the following Bayesian updating formula:

$$\widetilde{\theta}_{t+1} = \frac{\widetilde{\theta}_t(1-\xi_1)}{\widetilde{\theta}_t(1-\xi_1) + (1-\widetilde{\theta}_t)\xi_0\rho(\Delta Y)} = \widetilde{\theta}_t + \frac{\widetilde{\theta}_t(1-\widetilde{\theta}_t)\left(1-\xi_1-\xi_0\rho(\Delta Y)\right)}{\widetilde{\theta}_t(1-\xi_1) + (1-\widetilde{\theta}_t)\xi_0\rho(\Delta Y)} \tag{17}$$

This implies that $\widetilde{\theta}_t$ increases over time if and only if

$$\xi_0 \rho(\Delta Y) \leq 1 - \xi_1 \tag{18}$$

If condition (18) holds and if the dictator survives, the next period the public raise its expectation regarding the type of the dictator.

Conversely, if $\xi_0 \rho(\Delta Y) > 1 - \xi_1$, the public downgrades its beliefs every period according to (17). Eventually, at a certain (finite) time $t = t^*$ the belief $\widetilde{\theta}_t$ falls below $\bar{\theta} - K/\beta$, and the incompetent dictator is removed with probability 1.

Proposition 3. *Suppose that at time $t = 0$ the economy is in an equilibrium with $C^* = Y^L$ and $\rho(\Delta Y)$.*

If condition (18) holds, the incompetent dictator survives each period with probability $\xi_0 \rho(\Delta Y)$. His expected lifetime in office is therefore $\frac{\xi_0 \rho(\Delta Y)}{1 - \xi_0 \rho(\Delta Y)}$.

If condition (18) does not hold, then there exists some finite time $t^* > 1$ such that $\widetilde{\theta}_{t^*} < \bar{\theta} - K/\beta \leq \widetilde{\theta}_{t^*-1}$. In the periods $t < t^*$, the incompetent dictator survives each period with probability $\rho(\Delta Y)$, and at the period $t = t^*$ he is removed with probability 1. His expected lifetime is $\frac{\xi_0 \rho(\Delta Y)}{1 - \xi_0 \rho(\Delta Y)} \left(1 - [\xi_0 \rho(\Delta Y)]^{t^*}\right)$.

The distinction between these two cases is especially interesting given that $\rho(\Delta Y)$ is different in the equilibria with co-optation and censorship. For the same values of parameters, there may co-exist two equilibria: an equilibrium with co-optation (with high probability of survival $\rho^{co}(\Delta Y)$) and an equilibrium with censorship (with a lower probability of survival $\rho^{ce}(\Delta Y) < \rho^{co}(\Delta Y)$). It may be the case that in the censorship equilibrium condition (18) holds while in the co-optation equilibrium it does not. In this case, the dynamics will be as follows: in the co-optation equilibrium, the probability of surviving in each given period is higher (conditional on a particular belief) but the beliefs are lowered each period and eventually the dictator is overthrown with certainty. In the censorship equilibrium, per-period survival is less likely, but beliefs are always adjusted upwards, so the regime may continue indefinitely.

The ex ante economic volatility, ΔY, is also important. If ΔY is low, the public knows that condition (18) holds, and a positive public signal, $p = z = 1$, implies that the probability of the dictator being competent is high. So if he survives for another period, his reputation improves and he is even likelier to last for yet another period. Conversely, if ΔY is higher (but still below the threshold that assures the existence of the equilibrium), the public knows that an incompetent dictator could be spending a lot on propaganda and censorship. Hence, each period, the public downgrades the reputation of the surviving incumbent. Eventually, his reputation sinks so low that the public protests against the dictator even if it observes a positive signal, $p = z = 1$.

The binary nature of the shocks renders the dynamics simple to analyze but it also rules out any dynamic effect of change in beliefs on the choice of consumption. In this model, consumption is always equal to either

Y^H (if the dictator is competent and lucky) or Y^L. In section 7, we consider a model with continuous economic shocks. There, an increase in $\bar{\theta}$ results in lower consumption in equilibrium. If the expected type of the dictator is high, the incompetent dictator can get away with lower C. In such a setting, increases in $\widetilde{\theta}_t$—i.e. a trend towards greater perceived competence—are accompanied by falling consumption.

We note one caveat related to the multiplicity of equilibria. In a multi-period model, we have to make assumptions about players' beliefs regarding which equilibrium prevails in the future. In the analysis presented, we presumed that the players remain in the same equilibrium as time evolves. While natural and realistic, this assumption is as arbitrary as any other. In principle, one could also have switching between different types of equilibria over time.

For simplicity's sake, we have assumed away savings and investment. If the public were able to save, the divergence result above would be reinforced. Indeed, if the public believes that the dictator is more likely to be competent, the returns to investment increase, and the public invests more today, thus increasing the probability of higher realization of GDP tomorrow. This helps the incompetent dictator tomorrow to reallocate more resources towards co-optation, censorship, and propaganda, thus further improving his reputation. Conversely, if the dictator's reputation is low, the public invests less, GDP is not likely to be high, and the dictator will have less resources to spend on co-optation, censorship, and propaganda. His reputation will be downgraded even faster and he is likely to be removed from office sooner.

What would happen if the dictator were able to save? If his savings were observable, the dictator would use them as a credible signal of his competence. Indeed, a more competent dictator has a longer expected time in office and therefore a stronger incentive to save for the future relative to the incompetent dictator. However, in equilibrium, a (lucky) incompetent dictator would pool with the competent dictator and also save. This would decrease his budget for co-optation, censorship, and propaganda in the current period and therefore reduce his chance to hold on to power.

If the dictator's savings were not observed, this effect would weaken but would still exist. Suppose the dictator has access to frictionless financial markets and the public has a consumption-smoothing motive. A competent dictator would always choose $C = \bar{Y}_1 \equiv (1-\xi_1)Y^L + \xi_1 Y^H$. Therefore the incompetent dictator would also have to deliver $C = \bar{Y}_1$. However, as his expected income is only $\bar{Y}_0 \equiv (1-\xi_0)Y^L + \xi_0 Y^H$, each period his debt would increase—in expected terms—by $\bar{Y}_1 - \bar{Y}_0 = (\xi_1 - \xi_0)\Delta Y$. Eventually, this debt would be impossible to hide (or the creditors would stop lending to the dictator).

6.3 Why so little violence against the public?

What if the dictator can also invest in repressive capacity to deter potential protesters? By allocating certain resources to the riot police and military, the dictator can increase the cost of regime change, K. The public does not observe such investment but can infer the dictator's optimal choice.

Will the dictator use this fourth instrument? Now he can choose to reduce spending on censorship,

rewards and propaganda, $B = X + R + P$, and use the savings, $\Delta Y - B$, to increase K. The latter matters as it directly affects the parameter α, which, in turn, determines the cost of rewards and therefore the structure of equilibria (see Figure 4).

Suppose that the dictator spends G on repressive capacity. He sets the level at the same time that he allocates the budgets for censorship, X, rewards, R, and propaganda, P. We will assume that the repression technology is linear, $K = G/\widehat{G}$, and that $\widehat{G} > \Delta Y/(\beta\bar{\theta})$, which implies that the dictator cannot achieve $K = \beta\bar{\theta}$. This assumption is reasonable—indeed, if the dictator could achieve $\beta\bar{\theta} - K = 0$, he would always do so and would never use other instruments as the public would never have an incentive to replace him. The modern kind of informational autocracy only becomes optimal when the costs of using brute force are driven up by changes in the global economy, media, and social forces.

In the Appendix, we reproduce our analysis of equilibria in the setting with repression, replacing $B = \Delta Y$ with $B = \Delta Y - G$ and α with $\alpha(G) \equiv \frac{I(\beta\bar{\theta} - G/\widehat{G})}{\widehat{P}N}$. We show there that in equilibrium the dictator uses either no repression or a limited amount of repression. In some cases, he needs to raise the cost of revolution a little in order to make the elite amenable to co-optation or to render censorship effective; if there is no equilibrium in the baseline model, a certain amount of repressive capacity helps make sure that the equilibrium exists. However, within either the co-optation or the censorship equilibrium, the other, non-violent instruments are always more cost-effective. As long as the equilibrium without repression exists, the dictator strictly prefers co-optation, censorship and propaganda.

6.4 Repressing the elites

Would an incompetent dictator ever choose to repress members of the elite? So far, we have assumed $r \geq 0$; the dictator can only reward loyal members of the elite but cannot punish disloyal ones. In this section, we allow for both positive and negative incentives. Suppose that at time 2 the dictator makes an offer to each member of the elite: if the elite member agrees to be co-opted, he receives a reward $r > 0$; otherwise he is repressed and therefore suffers a loss of $q \geq 0$.

In order to be credible, the dictator has to commit $Q = qI$ "units" of repression capacity at time 2. We assume that the dictator assigns repression resources to each potential opposition member already at time 2; these may include personalized surveillance, investigators focused on individual elite members etc. Therefore, at time 2, each individual elite member understands that the dictator has the capacity to repress him and repression will follow if he joins the opposition.[25]

For simplicity, we assume away the financial cost of repression. However, repressing the elite involves an additional risk as with probability $Q/\widehat{Q}$ the general public observes the act of repression; this reveals that

[25] We can also consider a more general setting allowing for differential intensity of repression against different elite members. In our simple model, however, the dictator would always choose the same level of repression, q, for each disloyal elite member in equilibrium.

the dictator is incompetent, and the public revolts.[26] Here $\widehat{Q}$ is an exogenous parameter that measures the "quantity" of repression that changes the probability that the public notices the repression from zero to one.

As we show in the Appendix, the equilibrium with censorship does not change. Indeed, in this equilibrium, using repression is counterproductive—the elite joins the opposition anyway and extra repression just risks revealing the dictator's incompetence to the public without providing any benefit. By contrast, in the equilibrium with co-optation, the dictator may invest a non-trivial amount in repression against the elite. Here, the investment in repressive capacity allows the dictator to save on co-optation rewards. Indeed, the elite's incentive constraint is $r + q \geq (\beta\bar{\theta} - K)\left[\Pi(m+1) - \Pi(m)\right]$. The greater the repression threatened against disloyal elite members, q, the less reward, r, is needed to keep them co-opted. However, more repression means a higher risk of public exposure. As one might expect, the dictator only uses violence against members of the elite if the probability of being observed is low. Were we to add in the financial cost of repression, this would further reduce the set of cases in which anti-elite repression is used.

6.5 Heterogeneity of elites and signal structure

In the baseline model, the elite is homogeneous. All its members have the same payoffs, $C + r$. Suppose now that members of the elite differ in terms of the moral cost they bear if co-opted. One part of the elite (call them "group H") has a high moral cost of being co-opted, while the other part ("group L") has a low cost. Then, unlike in the original model, in which co-optation and censorship could not both emerge in equilibrium, the dictator may now simultaneously censor group H and co-opt group L.

This has implications for the substitutability between co-optation and censorship. In the baseline model, co-optation and censorship are substitutes because both reduce the probability of a negative signal from the elites ($z = 0$). The more the dictator spends on co-optation, the lower are the returns to censorship: if everyone is co-opted, no one needs to be censored and vice versa. Given linear costs, the dictator invests just in whichever instrument is cheaper. However, in the model with heterogeneous elites, the most cost-effective way to increase the odds that $z = 1$ may be to co-opt group L and censor group H. In this case, the returns to co-opting L are higher, the more likely it is that group H will be censored. Co-optation and censorship become complements.

Another simple extension concerns the quality of signal transmission. Suppose that the elite is homogeneous but that the public observes both the dictator's propaganda message and the elites' signals with noise. Denote the true messages p and z and the signals observed by the public $\tilde{p}$ and $\tilde{z}$. Now, suppose that, even if the true propaganda message is $p = 1$, the public observes $\tilde{p} = 0$ with a small probability. And even if the true message from the elites is $z = 1$, the public observes $\tilde{z} = 0$ with a small probability. Finally,

[26] A similar argument, of course, applies to co-optation and censorship. These are also never employed by a competent dictator, so an incompetent one uses them only to the extent that they can be concealed. We assume that co-optation and censorship are much easier to hide than repression. Indeed, by definition, censorship allows hiding information about the very fact of censorship. Similarly, if the public observes payments to the members of the elite, the dictator can plausibly claim to be paying for legitimate services.

suppose that there are now three possible levels of income: $Y \in \{Y^L, Y^M, Y^H\}$, with different probabilities of occurring.

In such a setting, there may still be equilibria similar to those in the baseline model, for instance one in which the public supports the dictator if (1a) $C = Y^L$ and $\tilde{p} = \tilde{z} = 1$ or if (1b) $C = Y^M$ or $C = Y^H$ whatever the signals. In these equilibria, propaganda and censorship are complements. But there may also be equilibria in which the public supports the regime if: (2a) $C = Y^L$ and *at least one of the signals* is positive ($\tilde{p} = 1$ and/or $\tilde{z} = 1$) or if (2b) $C = Y^M$ or $C = Y^H$, whatever the signals. In such equilibria, propaganda and censorship are *substitutes*. The dictator no longer needs to ensure that *both* $\tilde{p} = 1$ and $\tilde{z} = 1$. He only needs at least one of the signals to be positive. Third, there may be an equilibrium in which the public supports the regime if (3a) $C = Y^L$ and $\tilde{p} = \tilde{z} = 1$, or if (3b) $C = Y^M$ and at least one of the signals is positive ($\tilde{p} = 1$ and/or $\tilde{z} = 1$), or if (3c) $C = Y^H$, whatever the signals. In this case propaganda and censorship are complements in outcome (3a) but substitutes in outcome (3b).[27]

6.6 Rent extraction by dictators

In the baseline model, the dictator maximizes the probability of staying in power. In the terms of Wintrobe (1990), he is a "totalitarian." We can extend the model to include Wintrobe's "tinpot" motive—that is, rent extraction—as well. Suppose that the dictator can divert a certain amount of resources, T, for his own consumption. We assume that there is a transaction cost of diversion, $\tau(T)$, where $\tau(\cdot)$ is an increasing convex function such that $\tau(0) = \tau'(0) = 0$.

Such a dictator maximizes the expected rent $\pi(\Psi + T)$ subject to the budget constraint $C + P + R + X + T + \tau(T) \leq Y$. Here π is the probability of survival, and Ψ is the ego rent of staying in office.

In this setting, there is a trade-off between survival and rent extraction. If the dictator extracts more rents, he has either to cut public consumption, C, or to spend less on propaganda, co-optation and censorship, $P + R + X$; both result in a lower probability of survival in equilibrium.

This trade-off directly implies that at least in some equilibria even a lucky competent dictator ($\theta = 1$, $Y = Y^H$) extracts a non-trivial quantity of rent $T_1 > 0$ and sets $C_1(Y^H) = Y^H - T_1 - \tau(T_1) < Y^H$. Indeed, consider an equilibrium in which the lucky incompetent dictator pools with the competent one by choosing $C_0(Y^H) = C_1(Y^H)$ (and extracting rent $T_0 = T_1 - (P + R + X)$). In this case, the general public supports the regime with probability 1 since

$$E(\theta | C = Y^H - T_1, p = z = 1) = \frac{\bar{\theta}\xi_1}{\bar{\theta}\xi_1 + (1 - \bar{\theta})\xi_0\rho(P + R + X)} > \bar{\theta} > \bar{\theta} - K/\beta.$$

Therefore, the competent dictator receives a strictly higher payoff relative to the strategy of extracting no rent.

[27] The formal analysis of this extension is available from authors on request.

Under certain parameter values the equilibrium may involve pooling of both lucky and unlucky competent dictators and lucky and unlucky incompetent dictators $C_1(Y^H) = C_1(Y^L) = C_0(Y^H) = C_0(Y^L) < Y^L$. In this case, both lucky and unlucky competent dictators survive with probability 1. An interesting feature of this equilibrium is that even the unlucky incompetent dictator can survive with a positive probability (although he would be able to extract much lower rent).

A characteristic of all these equilibria is that the competent incumbent extracts more rents than the incompetent one. However, the logic resembles that in the baseline model. In the cases when incompetent dictators are able to pool with competent ones, both provide the same level of consumption and the incompetent dictator spends considerable resources on manipulating information. The main difference is that in the model with rent extraction consumption is not necessarily at $C = Y^H$ or $C = Y^L$.

7 The impact of economic shocks

The model developed so far allows only limited analysis of comparative statics with regard to economic shocks. In the setting with two output levels, if the incompetent dictator's output decreases he is overthrown with probability one, so his spending on propaganda, censorship, and co-optation are not relevant. In this section, we consider a version of the model with a continuous distribution of economic shocks, in which such shocks can have a non-trivial impact on co-optation, censorship and propaganda.

7.1 Setting

Let us assume that Y is distributed on $[Y^L, Y^H]$ with the density function $f_1(Y)$ if the dictator is competent and $f_0(Y)$ if he is incompetent. We assume that the density is positive for all $Y \in [Y^L, Y^H]$ and that there are no mass points. Higher output is more likely for the competent types and less likely for the incompetent types; we assume that $f_0(Y)$ is a (weakly) monotonically decreasing function and $f_1(Y)$ is a (weakly) monotonically increasing function.

As the informed citizens observe both the output and the type of the dictator, the game between the dictator and the informed citizens remains the same. In this game, there is no asymmetric information. Therefore, the structure of equilibria is similar to that in the previous model: there can be equilbria with co-optation ($n = N$) and with censorship ($n = 0$). We will denote by $B(Y)$ the total budget for censorship, co-optation and propaganda as a function of output (in the model with binary output, $B(Y^H) = \Delta Y$ and $B(Y^L)$ would not matter as the dictator is overthrown anyway).

We assume that $\alpha \geq 2$ and $\widehat{X}$ is sufficiently large so that the existence conditions hold: $\Delta Y < 4\widehat{X}\frac{1}{\alpha+1}$ and $\Delta Y < 4\widehat{X}\frac{\frac{\alpha}{2}-1}{\alpha-1}$ for both the equilibrium with co-optation and the equilibrium with censorship.

As we show below (Lemma 3), the model with continuous output has no equilibrium in pure strategies. We therefore consider equilibria in mixed strategies. In such equilibria, the public chooses a probability of

supporting the dictator as a function of the observed consumption level: $\gamma(C) \in [0,1]$ if $p = z = 1$. If $p = 0$ or $z = 0$, the public knows with certainty that the dictator is incompetent and protests with probability 1.

In equilibrium, the public's choice of $\gamma(C)$ is optimal:

$$\begin{aligned} \gamma(C) = 0 \quad &\text{if} \quad E(\theta|C, p = z = 1) \leq \bar{\theta} - K/\beta, \\ 0 < \gamma(C) < 1 \quad &\text{if} \quad E(\theta|C, p = z = 1) = \bar{\theta} - K/\beta, \\ \gamma(C) = 1 \quad &\text{if} \quad E(\theta|C, p = z = 1) \geq \bar{\theta} - K/\beta. \end{aligned}$$

As in the model with binary output, it is easy to show that the competent dictator always chooses $C_1(Y) = Y$.

The incompetent dictator faces the following trade-off: if he spends more on propaganda, co-optation and censorship, the probability is higher that the public will receive the positive signal, $p = z = 1$; however, as this spending comes at the cost of lower consumption C, it implies a lower probability of survival *given* the positive signal. His choice of consumption level, $C_0(Y)$, solves the following optimization problem:

$$C_0(Y) = \arg \max_{0 \leq C \leq Y} \gamma(C)\rho(Y - C). \tag{19}$$

7.2 Equilibrium

Lemma 3. *If the distribution density $f_1(\cdot)$ does not have mass points, there is no equilibrium in pure strategies. The equilibrium in mixed strategies has the following properties:*

(i) The public's strategy, $\gamma(C)$, is weakly monotonic. If $\gamma(C) < 1$, it is strictly monotonic. The incompetent dictator's strategy, $C_0(Y)$, is also strictly monotonic.

(ii) There exists a $C^{**} \in (Y^L, Y^H]$ such that $\gamma(C) = 1$ for all $C \geq C^{**}$;

(iii) $\gamma(Y^L) = 0$;

(iv) $0 < \gamma(C) < 1$ for all $C \in (Y^L, C^{**})$.

(v) $C_0(Y)$ is a differentiable, invertible function. In equilibrium, its first derivative equals

$$C_0'(Y) = \frac{f_0(Y)\rho(Y - C_0(Y))}{f_1(C_0(Y))} \frac{(\bar{\theta} - K/\beta)(1 - \bar{\theta})}{(1 - \bar{\theta} + K/\beta)\bar{\theta}}. \tag{20}$$

(vi) In the worst economic outcome, $Y = Y^L$, the incompetent dictator spends all resources on consumption:

$$C_0(Y^L) = Y^L. \tag{21}$$

(vii) Total spending on co-optation, censorship and propaganda, $B(Y) = Y - C_0(Y)$, monotonically increases with Y.

The Lemma implies that both $\gamma(C_0(Y))$ and $B(Y)$ increase with Y; therefore the higher the realization of the economic shock, Y, the higher the probability of survival, $\gamma(C_0(Y))\rho(B(Y))$.

In order to find the equilibrium, we need to solve the differential equation (20) given the initial condition (21). To complete the description of the equlibrium, we should find $\gamma(C)$ using the first-order condition from (19), which yields the following differential equation: $\gamma'(C_0(Y)) = \gamma(C_0(Y))\frac{\rho'(Y-C_0(Y))}{\rho(Y-C_0(Y))}$. This equation determines $\gamma(\cdot)$ up to a scalar multiplier. To find this multiplier, we need to use the boundary condition: $\gamma(C_0(Y^H)) = 1$.

7.3 Comparative statics

In this section, we carry out the comparative statics analysis with regard to the parameters of the model. We also compare the behavior of an incompetent dictator in an equilibrium with co-optation with the behavior of such a dictator in an equilibrium with censorship.

Proposition 4. *In either the equilibrium with co-optation or the equilibrium with censorship, for given distributions $f_0(\cdot)$ and $f_1(\cdot)$, and for a given realization of the economic shock, Y, an incompetent dictator spends more on censorship, co-optation and propaganda and less on consumption if K increases, $\widehat{P}$ increases, $\widehat{X}$ increases (in the equilibrium with censorship), $\beta I/N$ increases (in the equilibrium with co-optation), or if both $\bar{\theta}$ and K increase, holding $(\beta\bar{\theta} - K)$ constant.*

The intuition for the comparative statics is straightforward. If $\widehat{P}$ increases, a dollar spent on propaganda is less effective than before at rendering a false message convincing. The public therefore increases its estimate of the incumbent's competence by more when it receives a convincing message, $p = z = 1$, even if the consumption level is somewhat lower. Understanding this, an incompetent dictator has an incentive to provide a lower level of consumption and spend more on increasing the probability of a positive signal, $p = z = 1$. Similar logic applies for the cost of censorship, $\widehat{X}$, (in the equilibrium with censorship), and for the parameter $\beta I/N$ (that determines the size of rewards in the equilibrium with co-optation). An increase in K lowers the expected value of revolution; hence the public will accept a lower consumption level from the incumbent.

Finally consider the impact of an increase in the expected quality of dictators, $\bar{\theta}$, holding the quality of the alternative regime $\beta\bar{\theta} - K$ constant. The higher is $\bar{\theta}$, the stronger is the public's expectation that the incumbent is competent, and so he can afford to offer a lower level of consumption. This result is especially important for the analysis of the dynamics. Suppose that, as in section 6.2, if the dictator is lucky enough to survive, his reputation, $\bar{\theta}$, increases next period; and that the expected quality of the alternative, $\beta\bar{\theta} - K$,

does not change. In this case, the equilibrium trajectory involves the surviving dictator's reputation growing over time and the consumption level declining over time.

Notice that the comparative statics results in Proposition 4 are very different from those that a naive 'partial equilibrium' model would produce. For example, if we did not take into account the endogenous equilibrium inference of the public, an increase in the cost of propaganda should result in lower spending on propaganda and higher spending on consumption. However, as the public is rational and can decipher this logic, the 'general equilibrium' result is that a higher cost of propaganda results in *lower* consumption and *higher* spending on propaganda.

Equation (20) also allows us to compare the reaction to economic shocks in equilibria with co-optation (where $\rho(Y - C_0(Y))$ is proportional to $Y - C_0(Y)$) and equilibria with censorship (where $\rho(Y - C_0(Y))$ is proportional to $(Y - C_0(Y))^2$). Consider two countries, with the same ex ante distributions of economic shocks, $f_0(\cdot)$ and $f_1(\cdot)$. Suppose that we observe the same output $\widetilde{Y} > Y^L$ and the same consumption $\widetilde{C}$ in both countries, but that the first country is in the equilibrium with co-optation, while the second one is in the equilibrium with censorship. Our theory predicts that if these countries are hit by similar economic shocks (e.g., Y declines to a certain level $\bar{Y} \in (Y^L, \widetilde{Y})$), then the first country will respond with a smaller decrease in consumption (and a greater decrease in the total budget for co-optation, censorship and propaganda) than the second country. In other words, regimes with censorship react to negative economic shocks with a greater reallocation of resources towards censorship, co-optation and propaganda than do regimes with co-optation (which reallocate relatively more resources to consumption).

Proposition 5. *Consider an equilibrium where $C_0(\widetilde{Y}) = \widetilde{C}$. For any $\bar{Y} \in (Y^L, \widetilde{Y})$, the decrease in consumption, $C_0(\widetilde{Y}) - C_0(\bar{Y})$, is smaller if the economy is in the equilibrium with co-optation (both before and after the decline in Y) than in the case in which it is in the equilibrium with censorship (both before and after the decline in Y).*

The intuition for this result is as follows. In the equilibrium with censorship, a given economic deterioration decreases citizens' belief in the dictator's competence by more than the same economic deterioration does in the equilibrium with co-optation (see Figure 4). Thus, in the censorship equilibrium, the dictator has to spend relatively more on censorship and propaganda to offset the induced loss of public confidence when the economy declines.

7.4 Example

To illustrate, we use a simple example. Let us assume that Y is distributed on $[0, \Delta Y]$.[28] The distribution is uniform for the bad type: $f_0(Y) = 1/\Delta Y$ and has linear increasing density for the good type $f_1(Y) = 2Y/(\Delta Y)^2$. We also assume that ΔY is sufficiently small so that the equilibrium existence conditions (12) are

[28]The lower bound of zero is a normalization to the lowest level of GDP above which income can be diverted to propaganda, censorship, and co-optation. The analysis for any other interval would be the same but would involve additional notation.

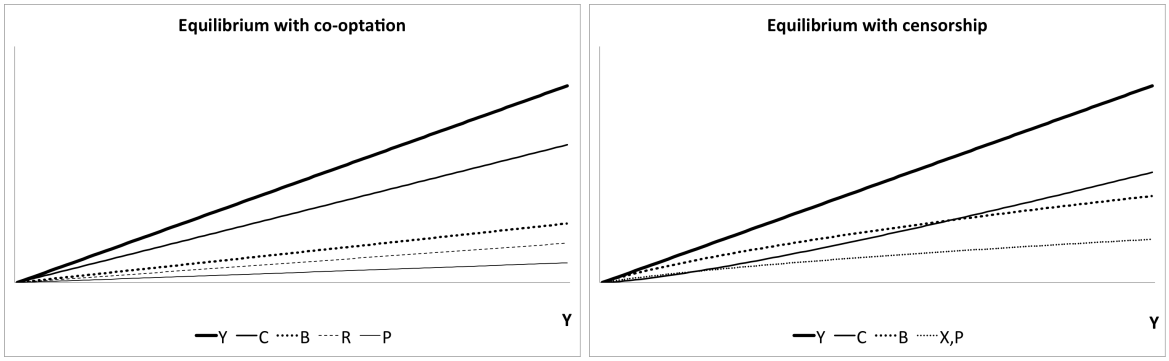


Figure 5: Consumption, C, and spending on censorship, X, co-optation, R, and propaganda, P, as a function of the economic shock Y in the numerical example in subsection 7.4. Here $B = X + P + R$ denotes the total spending on censorship, co-optation, and propaganda,

satisfied (indeed, in this case for all realizations of Y the budget for co-optation, censorship and propaganda, $B(Y) \leq Y \leq \Delta Y$, also satisfies these conditions).

We solve the example in the Appendix and find that in the equilibrium with co-optation, the spending on co-optation R and propaganda P as well as on consumption C are linear functions of realization of the output Y (see Figure 5). At the same time, in the equilibrium with censorship, the incompetent dictator spends relatively more on censorship and propaganda as the economy worsens: $B(Y)/Y$ increases as Y falls to zero. In the limit $Y \to 0$, the share of output spent on censorship and propaganda actually reaches 100 percent: $\lim_{Y \to 0} \frac{B(Y)}{Y} = 1$. Conversely, as output grows, the share spent on consumption increases. The amounts spent on censorship and propaganda in this equilibrium are equal to each other $X = P = B(Y)/2$. In proportion to total income, Y, their shares therefore also increase as output falls.

8 Conclusions

The totalitarian tyrants of the past used mass violence, ideological indoctrination, and closed borders to monopolize power. Most authoritarian leaders also used violent repression to inculcate fear. In a world of economic interdependence and modern communications technology, however, a growing number of non-democratic leaders have chosen a different strategy—that of manipulating information—to convince the public that they are doing a good job. We model the tradeoffs this generates, as today's informational autocrats choose from a repertoire of techniques, such as propaganda, censorship and co-optation, and citizens exploit the signals inherent in the dictator's actions to infer his type.

Our theory produces several insights into how such modern informational autocracies work. First, we show how incompetent dictators can survive as long as economic shocks are not too large, using censorship, propaganda, and cooptation in place of violent repression. Over time, an incompetent leader who lasts for a few years may even acquire a growing reputation for competence by virtue of rational Bayesian updating on

the part of the public. Major economic downturns destroy such equilibria, exposing the leader's true nature, and generating protests that can only be suppressed by force.

Second, the coordination problem of members of the informed elite leads to multiple equilibria. In one of these, the dictator focuses on co-optation, while in the other he relies instead on censoring private media. This multiplicity of equilibria may explain why otherwise similar autocracies sometimes exhibit very different levels of censorship and patronage.

Third, we show that a dictator relying on co-optation reacts to economic shocks differently from one who is committed to censorship. The latter is more likely to boost propaganda and media controls in response to an economic downturn than the former. Although we do not explicitly model the use of institutions such as legislatures, parties, and elections, it is clear that a dictator who succeeds in convincing the public that he is competent can enjoy the benefits of such "democratic" elements without fear of losing power. Such institutions—which are quite compatible with a strategy of co-optation of the elite—can be used to amplify the (accurate) perception of the dictator's popularity.

Our model also explains why in informational autocracies violence either is a last resort when all else has failed or is used sparingly when it can be concealed. Competent dictators do not need to use repression. Hence, violence reveals the dictator's incompetence to the public and ultimately results in his downfall. This is why dictators often seek some non-political pretext to imprison leaders of the political opposition. It also explains why dictators who arrange for the murder of political opponents usually deny responsibility. If the goal were to intimidate the opposition, such denials would be puzzling—an open acknowledgement would have a far greater deterrent effect.

The survival strategies we formalize are more compatible with a modernized society than totalitarian ones or those of monarchs who rely on traditional legitimacy. Yet, modernization ultimately undermines even such informational equilibria. As education and political knowledge spread to broader subsets of the population, it becomes harder to control how this informed elite communicates with the masses—by means of either co-optation or censorship.

Our model is hard to take to the data for at least three reasons. First, it is difficult to collect reliable measures of the extent of propaganda, censorship, and co-optation in modern informational autocracies. It is the essence of such regimes to conceal their nature. Second, the multiplicity of equilibria does not make for unambiguous testable implications. Third, given that informational autocracy is a reasonably recent phenomenon, there is still a limited number of observations on duration of these regimes and on determinants of their survival. However, as we show in Section 3, our theory is generally consistent with what evidence is available on modern informational autocracies.

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Appendix: Proofs and Extensions

Proof of Lemma 1. It is easy to show that for each type of the dictator $C(Y)$ is monotonic. Thus, as the competent dictator is more likely to have higher output Y, the public knows that the probability of having a competent dictator is monotonic in observed level of consumption C. In a pure strategy equilibrium, the public's action is binary. In principle, there can be a non-trivial range of $C \in [C_1, C_2]$ for which the public is indifferent between protesting or supporting the regime. Suppose that there is an equilibrium where the public, being indifferent for the whole range $C \in [C_1, C_2]$, decides to support the regime for *lower* values of consumption $C \in [C_1, \widetilde{C}]$ but protest for *higher* values $C \in [\widetilde{C}, C_2]$. If this is the case in equilibrium, the incompetent ruler will always choose $C = C_1$ in order to assure the unitary probability of support conditional on the positive information signals $p = z = 1$ while spending the maximum amount of resources on raising the probability of $p = z = 1$ though propaganda, co-optation, and censorship. Hence, $C_1 < C \leq C_2$ can only be set by the competent rulers, so in equilibrium the public will never protest if it observes such C. There may be equilibria in which the good rulers also choose C_1 rather than $C_1 < C \leq C_2$; in this case $C > C_1$ is never observed in equilibrium. In terms of outcomes, such equilibria are equivalent to the ones where the public supports the regimes for all $C \geq C_1$; in the latter equilibria, incompetent rulers also have a strict preference for choosing $C = C_1$. ■

Proof of Lemma 2. The dictator solves the problem of maximizing (6) in two steps. First, he chooses the level of consumption $C = C_0(Y)$ and therefore the total budget, $B = Y - C_0(Y)$, for propaganda, censorship and rewards. Second, given the choice of consumption and budget, B, he will choose the x, P, and r that maximize the probability of getting both high propaganda and high indepedent signal:

$$\rho(B) = \max_{X+R+P \leq B} \left[1 - (1-x)\frac{N - n(r)}{N}\right] \Lambda(P). \tag{22}$$

Let us first consider the optimal choice given the choice of consumption. The dictator solves (22) taking into account $R = n(r)rI/N$ and $X = \frac{N-n(r)}{N}\widehat{X}\min\{x, 1\}$. The choice of rewards for co-optation is binary: either (i) high rewards $r = r^*$ (so that $n = N$ and $R = R^* \equiv r^*I$), or (ii) no rewards $r = 0$ ($n = 0$ and $R = 0$). Indeed, rewards $0 < r < r^*$ are suboptimal for the dictator relative to $r = 0$—they do not reduce the number of opposition activists but are costly. Rewards $r > r^*$ are also suboptimal for the same reason.

The dictator can choose high rewards only if $R^* \leq B$. In this case, he spends $R = R^*$; censorship is useless (as there is no opposition), so all remaining resources are spent on propaganda: $P = B - R^*$. The probability of $p = z = 1$ is $\Lambda(B - R^*) = \frac{B-R^*}{\widehat{P}}$.

If the dictator chooses zero rewards ($r = 0$), he solves: $\max_{X+P=B} \frac{X}{\widehat{X}}\frac{P}{\widehat{P}}$. The solution is $P = X = \frac{B}{2}$. The probability of $p = z = 1$ is $\frac{B^2}{4\widehat{P}\widehat{X}}$.

The analysis above implies the equation (7) and the condition (8).

Let us now consider the optimal choice of consumption. The dictator solves

$$C_0(Y) = \arg\max_C \rho(Y - C)\mathbf{1}\{C \geq C^*\}$$

where $\rho(\cdot)$ is given by (7). As the function $\rho(B)$ is strictly increasing in B, the dictator will always choose $C_0(Y) = C^*$ and $B = Y - C^*$. ■

Proof of Proposition 1. Let us calculate the expected value of the type of the dictator that the public infers when observing $p = z = 1$ and $C = Y^L$. This outcome is possible if the dictator is competent and unlucky ($Y = Y^L$ which happens with probability $\bar{\theta}(1 - \xi_1)$) or if the dictator is incompetent but lucky $Y = Y^H$. In the latter case, the incompetent dictator spends ΔY on censorship, repression and propaganda.

Let us calculate the probability of the incompetent dictator having $p = z = 1$ and $C = Y^L$. The informed citizens understand that the incompetent dictator is overthrown with probability 1. Therefore they expect $\Pi(n) = 0$ for every $n = 0, ..., N$. Hence $\Pi(m + 1) - \Pi(m) = 0$, so that $r^* = R^* = 0$; the informed citizens join the pro-regime elite even for an infinitesimal reward. Since all elite groups are co-opted, there is no need for censorship, $x = 0$. The dictator spends all his resources on propaganda, $P = \Delta Y$. Therefore $\rho(\Delta Y) = \Delta Y/\widehat{P}$. Consequently, the probability of the incompetent dictator having $p = z = 1$ and $C = Y^L$ is $(1 - \bar{\theta})\xi_0 \Delta Y/\widehat{P}$.

The equilibrium exists whenever

$$E(\theta | C = Y^L, p = z = 1) = \frac{\bar{\theta}(1 - \xi_1)}{\bar{\theta}(1 - \xi_1) + (1 - \bar{\theta})\xi_0 \rho(\Delta Y)} \leq \bar{\theta} - K/\beta$$

which can be rewritten as (9).

Notice that $\rho(\Delta Y) = \Delta Y/\widehat{P}$ is the maximum probability for the incompetent dictator to have $p = z = 1$ and $C = Y^L$; in this equilibrium the incompetent dictator is overthrown anyway so he is indifferent whether to maximize this probability or to choose another strategy. However, if he spends less on propaganda and $C > Y^L$, this equilibrium does not exist. Also, if instead of spending all ΔY on propaganda, the dictator spends part of it on censorship or co-optation—the probability of having $p = z = 1$ is lower $\rho(\Delta Y)$. Hence. the condition above may not hold and the equilibrium no longer exists. ■

Proof of Proposition 2. Let us first calculate $\Pi(m + 1) - \Pi(m)$. Expression (22) implies

$$\Pi(m + 1) - \Pi(m) = \frac{1}{N} E\left[(1 - x)\Lambda(P)\mathbf{1}\{C \geq C^*\}\right]. \tag{23}$$

Two cases are possible. First, no opposition, $n = N$. In this case, $x = 0$, $\Lambda(P) = \frac{\Delta Y - R^*}{\widehat{P}}$. Hence, $\Pi(m + 1) - \Pi(m) = \frac{\Delta Y - R^*}{\widehat{P}N}$.

Second, all the informed citizens join the opposition, $n = 0$. In this case, $x = \Delta Y/(2\widehat{X})$ and $\Lambda(P) =$

$\Delta Y/(2\widehat{P})$. Now $\Pi(m+1)-\Pi(m)=\left(1-\frac{\Delta Y}{2\widehat{X}}\right)\frac{\Delta Y}{2\widehat{P}N}$.

1. Equilibrium with co-optation. Let us first consider the case in which $n=N$. In this case, $\Pi(m+1)-\Pi(m)=\frac{\Delta Y-R^*}{\widehat{P}N}$. Substituting $R^*=r^*I$ and r^* from (3), we find an equation for R^*:

$$R^*=r^*I=(\beta\bar{\theta}-K)I\left[\Pi(m+1)-\Pi(m)\right]=a(\Delta Y-R^*)$$

Solving for $R^*=\Delta Y\frac{\alpha}{\alpha+1}$ and substituting into (8), we find the following condition: $\frac{\alpha}{\alpha+1}<\left(1-\frac{\Delta Y}{4\widehat{X}}\right)$. Therefore, this equilibrium exists only if ΔY is sufficiently low

$$\Delta Y<4\widehat{X}\frac{1}{1+\alpha} \tag{24}$$

Finally, we need to check whether $\rho(\Delta Y)=\frac{\Delta Y-R^*}{\widehat{P}}=\frac{\Delta Y}{\widehat{P}(1+\alpha)}$ satisfies the condition (11). This gives us the condition (13).

2. Equilibrium with censorship and no co-optation, $n=0$. In this case, $R=0$, and $[\Pi(m+1)-\Pi(m)]=\frac{(1-x)P}{\widehat{P}N}=\left(1-\frac{\Delta Y}{2\widehat{X}}\right)\frac{\Delta Y}{2\widehat{P}N}$. Hence, the equation for R^* is

$$R^*=(\beta\bar{\theta}-K)I\left(1-\frac{\Delta Y}{2\widehat{X}}\right)\frac{\Delta Y}{2\widehat{P}N}=\alpha\Delta Y\left(\frac{1}{2}-\frac{\Delta Y}{4\widehat{X}}\right) \tag{25}$$

This equilibrium exists whenever the condition (8) must be violated. We therefore derive

$$\alpha\left(\frac{1}{2}-\frac{\Delta Y}{4\widehat{X}}\right)>\left(1-\frac{\Delta Y}{4\widehat{X}}\right).$$

Since R^* must be non-negative, the left-hand side in the inequality above is non-negative; this also implies that the right-hand side is also non-negative: $(1-\frac{\Delta Y}{4\widehat{X}}>1-\frac{\Delta Y}{2\widehat{X}}\geq 0)$. Hence this equilibrium exists only if $\alpha>2$ and if $\Delta Y<4\widehat{X}\frac{\frac{\alpha}{2}-1}{\alpha-1}$.

This equilibrium exists if $\rho(\Delta Y)=\frac{(\Delta Y)^2}{4\widehat{P}\widehat{X}}$ satisfies the condition (11); this is the case whenever (15) holds.

Asymmetric equilibria. In this paper, we only consider symmetric equilibria in pure strategies. In principle, there can also be an asymmetric equilibrium where the elites are indifferent on whether to join the opposition. Suppose that precisely $\tilde{m}$ elite groups support the regime and $N-\tilde{m}$ join the opposition. The budget spent on rewards is

$$\tilde{m}r^*I/N=(\beta\bar{\theta}-K)\left[\Pi(\tilde{m}+1)-\Pi(\tilde{m})\right]\tilde{m}I/N=(\beta\bar{\theta}-K)\tilde{m}I\frac{(1-x)P}{\widehat{P}N}$$

This equilibrium can only exist if the condition (8) holds as equality

$$(\beta\bar{\theta}-K)\tilde{m}I\frac{(1-x)P}{\widehat{P}N}=\Delta Y\left(1-\frac{\Delta Y}{4\widehat{X}}\right).$$

The dictator solves

$$\max_{X+P\leq\Delta Y-(\beta\bar{\theta}-K)\tilde{m}I\frac{(1-x)P}{\widehat{P}N}}\left(1-\frac{N-\tilde{m}}{N}\left(1-\frac{X}{\frac{N-\tilde{m}}{N}\widehat{X}}\right)\right)\frac{P}{\widehat{P}}=\max_{X+P\leq\Delta Y-(\beta\bar{\theta}-K)\tilde{m}I\frac{(1-x)P}{\widehat{P}N}}\frac{\left(\frac{\tilde{m}}{N}\widehat{X}+X\right)P}{\widehat{P}\widehat{X}}$$

This equilibrium is unstable. Suppose that one of the $\tilde{m}$ co-opted elite groups decides to deviate and join the opposition. In this case, the dictator will spend less on co-optation and more on propaganda. This will immediately increase the informed citizens' returns to joining the opposition in equilibrium (a higher level of propaganda will increase $\Pi(m+1)-\Pi(m)$, so the remaining $\tilde{m}-1$ will now strictly prefer joining the opposition. ■

Robustness to removing the assumption that $\widehat{X}$ and $\widehat{P}$ are large. In the Proof of Proposition 2 above we used the assumption that $\widehat{X}$ and $\widehat{P}$ are sufficiently large so that in equilibrium $X<\widehat{X}$ and $P<\widehat{P}$. What would change in the structure of equilibria if $\widehat{X}$ and $\widehat{P}$ are small?

Let us consider the case where $\widehat{X}$ is small so in equilibrium we may have situations $X=\widehat{X}$. In this case, $x=1$ (the dictator can silence the opposition through censorship). In the equilibrium with censorship and no-cooptation the dictator would spend $\widehat{X}$ on censorship and the rest $\Delta Y-\widehat{X}$ on propaganda. However, this cannot be the case in equilibrium as in this case: indeed, the threshold payment for co-optation is trivial: $R^*=r^*I=(\beta\bar{\theta}-K)I\left[\Pi(m+1)-\Pi(m)\right]=0$. This is the case because censorship is complete, so the impact of an additional opposition member on the probability regime change is zero: $\Pi(m+1)-\Pi(m)=0$, see (23). This implies that the dictator would prefer to co-opt the elites at zero cost (and spend ΔY on propaganda) rather than to censor them (and spend only $\Delta Y-\widehat{X}$ on propaganda). Thus this cannot be an equilibrium.

The fact that the equlibirum with opposition and censorship does not exist is in line with our analysis above (where we assume that the inequality $X<\widehat{X}$ does bind). Indeed, in that analysis, the equlibirum with opposition and censorship does not exist if $\frac{\Delta Y}{4\widehat{X}}$ is sufficiently high — exactly because R^* goes down to zero (see equation (25).

Now let us discuss the case where $\widehat{X}$ is large but $\widehat{P}$ is sufficiently small so that $P=\widehat{P}$ binds in equilibrium. First, let us consider the analysis of the equilibrium with co-optaion in the Proof of Proposition 2 above. In that analysis, $P=\frac{\Delta Y}{\alpha+1}$. Therefore, if $\widehat{P}$ is sufficiently small $\widehat{P}<\frac{\Delta Y}{\alpha+1}$, the inequality $P=\widehat{P}$ is binding and the probability of the positive signals $p=z=1$ is one. Now let us consider the equlibirum with opposition and censorship. In this equilibrium, the dictator spends on censorship $\Delta Y-\widehat{P}$ hence the probability of censoring the opposition signals is $x=\frac{\Delta Y-\widehat{P}}{\widehat{X}}$. If ΔY is sufficiently low, both equilibria exist and the probability of survival is higher in the equilibrium with co-optation.

Analysis of the extension from Section 6.3. How are the equilibria affected if we allow the dictator the possibility of investing in repression? Consider first the equilibrium with co-optation ($n=N$). This equilibrium exists if $\Delta Y-G<\frac{4\widehat{X}}{1+\alpha(G)}$. The higher the level of repression, G, the likelier this inequality is

to hold. Therefore, repression makes this equilibrium more likely to exist. However, given that it exists, the probability of survival $\rho(\Delta Y - G) = \frac{\Delta Y - G}{\widehat{P}(1+\alpha(G))}$ decreases monotonically with G. This is because repression is not cost-effective—it makes more sense to spend money on rewards and propaganda. Consequently, if an equilibrium without repression exists, the dictator will not spend anything on repression.[29]

If, by contrast, no equilibrium without repression exists, the dictator is better off spending just enough on repression to assure the existence of a co-optation equilibrium. Suppose that $\alpha(0) < 2$ and $\Delta Y > \frac{4\widehat{X}}{1+\alpha(0)}$. Then without any repression, the equilibrium unravels and the dictator is removed from office with probability 1. In this case, he would benefit from choosing the minimum level of repression that satisfies:

$$\Delta Y - G \leq \frac{4\widehat{X}}{1 + \frac{\beta I(\bar{\theta} - G/\widehat{G})}{\widehat{P}N}}. \tag{26}$$

This level of repression is the smaller root of the corresponding quadratic equation.[30] This solution always exists (at $G = 0$, the left-hand side of (26) is greater than the right-hand side, while at $G = \Delta Y$ the left-hand side is zero while the right-hand side is positive).

Given this level of repression, the dictator survives with a non-trivial probability $\rho(\Delta Y - G) = \frac{4\widehat{X}}{\widehat{P}(1+\alpha(G))^2}$. The intuition is simple. The dictator understands that without any investment in repressive capacity, the elite is too costly to silence. So he uses some repression to make sure that the elite is less interested in regime change and is therefore cheaper to bribe. This allows him to free up additional resources for propaganda and therefore make ends meet in equilibrium.

Now consider the equilibrium with censorship ($n = 0$). In this equilibrium, the probability of survival decreases in the level of repression: $\rho(\Delta Y - G) = \frac{(\Delta Y - G)^2}{4\widehat{P}\widehat{X}}$. There are no incentives to spend on repressive capacity in this equilibrium.

However, it may also be the case that this equilibrium does not exist without any repression. Consider the situation where $\alpha(0) > 2$ and $\Delta Y > 4\widehat{X}\frac{\frac{\alpha(0)}{2}-1}{\alpha(0)-1} = 2\widehat{X}\left(1 - \frac{1}{\alpha(0)-1}\right)$. Again, by spending a certain amount of resources on repression, the dictator can ensure that the equilibrium does exist. This level of repression is the minimum G that satisfies:

$$\Delta Y - G \leq 2\widehat{X}\left(1 - \frac{1}{\frac{\beta I}{\widehat{P}N}\left(\bar{\theta} - \frac{G}{\widehat{G}}\right) - 1}\right).$$

This level of repression is also the smaller root of the quadratic equation.[31]

Thus, spending on repression against potential protesters cannot increase the probability of survival in

[29] This result holds because the repression technology is linear. If it were non-linear, there could be a non-trivial amount of repression in equilibrium.

[30] The solution is $G = \frac{\widehat{G}\widehat{P}N}{2\beta I}\left(1 + \frac{\beta I}{\widehat{P}N}\left(\bar{\theta} + \frac{\Delta Y}{\widehat{G}}\right) - \sqrt{\left(1 + \frac{\beta I}{\widehat{P}N}\left(\bar{\theta} + \frac{\Delta Y}{\widehat{G}}\right)\right)^2 - \frac{4\beta I}{\widehat{G}\widehat{P}N}\left(\Delta Y\left(1 + \frac{\beta I\bar{\theta}}{\widehat{P}N}\right) - 4\widehat{X}\right)}\right)$.

[31] The solution is $G = \frac{\widehat{G}\widehat{P}N}{2\beta I}\left(-1 + \frac{\beta I}{\widehat{P}N}\left(\bar{\theta} + \frac{\Delta Y - 2\widehat{X}}{\widehat{G}}\right) - \sqrt{\left(-1 + \frac{\beta I}{\widehat{P}N}\left(\bar{\theta} + \frac{\Delta Y - 2\widehat{X}}{\widehat{G}}\right)\right)^2 + \frac{4\beta I}{\widehat{G}\widehat{P}N}\left(\Delta Y + \frac{\beta I\bar{\theta}}{\widehat{P}N}\left(2\widehat{X} - \Delta Y\right)\right)}\right)$.

equilibrium. However, by raising the cost of revolution, some small amount of spending on repression can ensure the existence of an equilibrium with either cooptation or censorship. This rationale for repression works when ΔY is sufficiently high. In this case, the economic decline is so large that the public does not believe the propaganda any more; hence the dictator prefers to spend money on repression.

Analysis of the extension from Section 6.4. In this section we analyze the equilibrium with co-optation where the incompetent dictator can threaten repression against the elite. The dictator's optimization problem is as follows:

$$\rho(\Delta Y) = \max_{R+X+P\leq\Delta Y,\quad R+Q\geq R^*} \frac{P}{\widehat{P}}\left(1-\frac{Q}{\widehat{Q}}\right)$$

where ΔY is the total budget for censorship, propaganda, and co-optation (recall that repression involves no cost), and where $R^* = I(\beta\bar{\theta}-K)\left[\Pi(m+1)-\Pi(m)\right]$.

We immediately find that $X=0$, $P=\Delta Y-R$, $R=R^*-Q$. The dictator's optimization problem becomes:

$$\rho(\Delta Y) = \max_{0\leq Q\leq R^*} \frac{(\Delta Y - R^* + Q)(\widehat{Q}-Q)}{\widehat{P}\widehat{Q}}$$

The solution is as follows:

(i) If $\Delta Y \leq \widehat{Q}-R^*$ then $Q=R^*$, $R=0$, and $\rho(\Delta Y) = \frac{(\Delta Y-R^*)(\widehat{Q}-R^*)}{\widehat{P}\widehat{Q}}$.

(ii) If $\Delta Y \in \left(R^*+(\widehat{Q}-2R^*), R^*+\widehat{Q}\right)$ then $Q=\frac{\widehat{Q}+R^*-\Delta Y}{2}$, $R=R^*-Q>0$, and $\rho(\Delta Y) = \frac{\left(\widehat{Q}-R^*+\Delta Y\right)^2}{4\widehat{P}\widehat{Q}}$.

(iii) If $\Delta Y \geq R^*+\widehat{Q}$ then $Q=0$, $R=R^*$, and $\rho(\Delta Y) = \frac{\Delta Y-R^*}{\widehat{P}}$.

In order to complete the description of the equilibrium with co-optation, we use $\Pi(m+1)-\Pi(m) = \frac{(1-x)\Lambda(P)}{N}\left(1-\frac{Q}{\widehat{Q}}\right)$ to find $R^* = \frac{I(\beta\bar{\theta}-K)P}{\widehat{P}N}\left(1-\frac{Q}{\widehat{Q}}\right) = a\widehat{P}\rho(\Delta Y)$. Finally, the strategies above are equilibrium strategies if and only if the dictator does not gain from deviating to $R=Q=0$, using only censorship and propaganda. In other words, for each of the three cases above, we need to compare $\rho(\Delta Y)$ with $\frac{\Delta Y^2}{4\widehat{P}\widehat{X}}$.

The analysis above implies that if the equilibrium with co-optation existed in the original model, it will continue to exist as long as $\widehat{Q}\geq(1+\alpha)\Delta Y$ (corresponding to the case (iii) above). If this condition does not hold, there will be a non-trivial amount of repression in the equilibrium with co-optation. If $\widehat{Q}/\Delta Y$ is very low then the dictator will only use repression and no rewards (case (i) above). If $\widehat{Q}/\Delta Y$ takes intermediate values, then the equilibrium with co-optation involves both rewards and the threat of repression against the elites: $R>0, Q>0$ (case (ii)).

Case (iii) implies that if repression against the elites is possible but is quite likely to be observed then the equilibrium involves neither repression nor even the threat of repression: $Q=0$. The equilibrium is exactly the same as in the original model.

In the analysis above we assumed that repression of the elite is not costly and is limited only by the fact that it is hard to conceal. If we assume that repression is also financially costly—and therefore has to

be funded at the expense of the public's consumption—the model becomes more involved but has similar properties. In particular, for a range of parameters, repression is not used in equilibrium: $Q = 0$ (as in case (iii) above); the higher the financial cost of repression, the larger this range of parameters.

Proof of Lemma 3. *Non-existence of equilibrium in pure strategies.* Suppose there is an equilibrium in pure strategies. In this equilibrium, if $p = z = 1$, the public protests with probability 1 if $C < C^*$ and does not protest with probability 1 if $C \geq C^*$. Then there exists a certain threshold, Y^*, such that the incompetent dictators with $Y \geq Y^*$ choose $C_0(Y) = C^*$ and survive with probability $\rho(Y - C^*)$. Indeed, if an incompetent dictator with Y_1 chooses $C = C^*$, then any luckier incompetent dictator with $Y_2 > Y_1$ will also choose $C = C^*$ and spend the additional resources $(Y_2 - C^*) - (Y_1 - C^*)$ on censorship, co-optation and propaganda. There is no rationale for the dictator with Y_2 to increase consumption as it does not decrease the probability of being overthrown.

The competent dictators still choose $C = Y$; there is no incentive for them to spend any money on censorship, co-optation and propaganda.

Now let us calculate the expected type of the dictator, given observed consumption. If the public observes C^* and $p = z = 1$, it knows that this may be the case if the dictator is competent and $Y = C^*$ (which happens with infinitesimal probability, $f_1(C^*)dY$), or if the dictator is incompetent and $Y \geq Y^*$ (which happens with probability $\int_{Y^*}^{Y^H} \rho(Y - C^*) f_0(Y) dY$). Unless there is a mass point of competent dictators at $Y = C^*$, the inferred probability that the dictator is good is actually zero—and the public strictly prefers to overthrow him. Therefore this is not an equilibrium.

Properties of the equilibrium in mixed strategies.

(i) First, let us show that $\gamma(\cdot)$ is a monotonically increasing function. Suppose there are two values of consumption, C_1 and C_2, such that $C_1 < C_2$ but $\gamma(C_1) > \gamma(C_2)$. If this is the case, no incompetent dictator will choose $C = C_2$. Indeed, if a dictator chooses C_2, he can do better by choosing $C = C_1$, assuring him a higher $\gamma(C)$ and higher ρ (by spending additional $C_2 - C_1$ on propaganda, censorship and co-optation). Hence, if the public observes $C = C_2$, it knows that the dictator cannot be incompetent. Therefore, $\gamma(C_2)$ must be equal to 1. But this is impossible since $\gamma(C_2) < \gamma(C_1) \leq 1$.

Similarly, we can prove that $\gamma(C_1) = \gamma(C_2)$ is only possible if both are equal to 1.

The fact that $C_0(Y)$ is monotonic directly follows from the monotonic comparative statics of the optimization problem (19). As $\rho(\cdot)$ is a linear or quadratic function of $Y - C$ (depending on whether the equilibrium is the one with co-optation or the one with censorship, respectively), it is easy to show that the solution of the optimization problem increases with Y. Moreover, if $\gamma(C) < 1$, the function $C_0(Y)$ strictly increases with Y.

(ii) If $C = Y^H$ and $p = z = 1$, the public understands that the dictator is competent with probability 1

(if the dictator is incompetent, he needs to spend a non-trivial amount on propaganda to send a signal $p = 1$ so he cannot ensure $C = Y^H$). Therefore, $\gamma(Y^H) = 1$.

Let us denote as C^{**} the choice of consumption by the incompetent dictator with the highest $Y = Y^H$, i.e. $C^{**} = C_0(Y^H)$. Then, by definition, for all $C \geq C^{**}$, the public infers that the dictator is competent with probability 1, so that $\gamma(C)$ must be equal to 1.

(iii) Now we shall prove that $\gamma(Y^L)$ must be equal to zero. If this is not the case, then there exists a certain $\widetilde{Y} > Y^L$ such that for an incompetent ruler with this $\widetilde{Y}$ it is optimal to spend $\widetilde{Y} - Y^L$ on censorship, co-optation and propaganda. (Indeed, the incompetent dictator with $Y = Y^L$ cannot provide consumption $C = Y^L$ and ensure a positive signal $p = z = 1$). Let us now consider the choices of incompetent dictators with $Y \in (Y^L, \widetilde{Y})$. Monotonicity of $C_0(Y)$ implies that they should choose $C_0(Y) \leq Y^L$. If they choose $C < Y^L$, they are ousted with probability 1. Therefore they choose $C = Y^L$, as this choice gives a positive probability, $\gamma(Y^L)\rho(Y - Y^L)$, to stay in office. Therefore, if the public observes $C = Y^L$ and $p = z = 1$, it infers the dictator may be competent with $Y = Y^L$ or he may be incompetent with $Y \in (Y^L, \widetilde{Y})$. Since there are no mass points, the conditional probability of the dictator being competent is infinitesimal. Therefore, $E(\theta | C = Y^L, p = z = 1) = 0$, so $\gamma(Y^L)$ cannot be positive.

(iv) Now let us prove that there cannot be an equilibrium in which $\gamma(C) = 0$ for $C > Y^L$. If it were the case, there would be a certain $\widetilde{C} > Y^L$ such that $\gamma(C) = 0$ for all $C \in [Y^L, \widetilde{C}]$ and $\gamma(C) > 0$ for $C > \widetilde{C}$. In this case all incompetent dictators with $Y > \widetilde{C}$ would choose $C_0(Y) > \widetilde{C}$ as this would give them a positive probability to stay in office while $C \leq \widetilde{C}$ guarantees losing office with probability 1. Let us now consider the choice of the incompetent dictator with $Y = \widetilde{C}$. If he does not spend anything on propaganda, censorship, and co-optation, then the probability to achieve $p = z = 1$ is trivial; hence the public observing $C = \widetilde{C}$ and $p = z = 1$ knows with certainty that the dictator is competent. Therefore, $\gamma(\widetilde{C})$ must be equal to 1 rather than 0. Alternatively, if the incompetent dictator with $Y = \widetilde{C}$ does spend a non-trivial amount, $B(\widetilde{C}) > 0$, on propaganda, censorship, and co-optation, then $C_0(\widetilde{C}) < \widetilde{C}$. But this implies that there is no incompetent dictator that chooses consumption $C \in (C_0(\widetilde{C}), \widetilde{C})$. Therefore, if the public observes C in the range $(\widetilde{C} - B(\widetilde{C}), \widetilde{C})$, the public infers that the dictator must be competent. Hence, $\gamma(C)$ for $C \in (\widetilde{C} - B(\widetilde{C}), \widetilde{C})$ must be equal to 1 rather than 0. We arrive at a contradiction, which proves that $\gamma(C) = 0$ only for $C = Y^L$.

(v) We have already proved in (i) that incompetent dictators with different economic shocks cannot choose the same consumption level. Therefore, the function $C_0(Y)$ is invertible, and we can introduce the inverse function $y(C) = C_0^{-1}(C)$ (in other words, $Y = y(C)$ if and only if $C = C_0(Y)$).

Let us now calculate the $E(\theta | C, p = z = 1)$ given the equilibrium beliefs of the general public about $f_\theta(Y)$ and $C_0(Y)$. Suppose that the public observes consumption to be in the interval between C and

$C + dC$. This can be the case if the dictator is competent and has output $Y \in [Y, Y + dY]$; or it can be the case if the dictator is incompetent and the output is $Y \in [y(C), y(C) + y'(C)dC]$. Therefore

$$E(\theta|C, p = z = 1) = \frac{\bar{\theta} f_1(C)}{\bar{\theta} f_1(C) + (1 - \bar{\theta}) f_0(y(C))\rho(y(C) - C)y'(C)} = \frac{1}{1 + \frac{1-\bar{\theta}}{\bar{\theta}} \frac{f_0(y(C))y'(C)}{f_1(C)} \rho(y(C) - C)} \tag{27}$$

As $E(\theta|C, p = z = 1) = \bar{\theta} - K/\beta$ for all $C \in [Y^L, C^{**}]$, we can obtain a differential equation for $y(C)$:

$$y'(C) = \frac{f_1(C)}{f_0(y(C))\rho(y(C) - C)} \frac{(1 - \bar{\theta} + K/\beta)\bar{\theta}}{(\bar{\theta} - K/\beta)(1 - \bar{\theta})}.$$

This equation implies that $y'(C)$ is continuous, which implies that $C_0(Y)$ is also differentiable and its derivative is continuous. Using the inverse function theorem $y'(C)C_0'(y(C)) = 1$, we can use the differential equation for $y(C)$ above to obtain the differential equation (20).

(vi) If $y(Y^L) = \widetilde{Y} > Y^L$, this would be a suboptimal choice for the incompetent dictator with $Y = \widetilde{Y}$. If he chooses consumption $C = Y^L$, he will have a zero probability to stay in power, but he could do better by choosing a certain $C \in (Y^L, \widetilde{Y})$.

(vii) In order to prove that $B(Y)$ never decreases with Y, we need to prove that $C_0'(Y) = 1 - B'(Y)$ cannot be above 1. As $C_0(Y^L) = Y^L$, in the neighborhood of $Y = Y^L$ the difference $B(Y) = Y - C_0(Y)$ cannot decrease with Y, therefore $C_0'(Y) < 1$ for all Y sufficiently close to Y^L.

Therefore, if $C_0'(Y) > 1$ at least for some Y, there must exist Y such that $C_0'(Y)$ increases with Y and $C_0'(Y) > 1$. However, this is not possible. Indeed, for such Y the left-hand side of (20) increases in Y while the right-hand side decreases with Y (as $B(Y)$ is decreasing with Y at this Y, the term $\rho(Y - C_0(Y))$ is decreasing in Y, also, $f_0(Y)$ is decreasing by definition, and $f_1(C_0(Y))$ is decreasing as well).

■

Proof of Proposition 4. Let us consider a differential equation

$$C_0'(Y) = M\Phi(Y, C_0(Y)) \tag{28}$$

where M is a constant and $\Phi(\cdot)$ is a continuous function. Then a solution of this differential equation on $Y \in [Y^L, Y^H]$ with the initial condition (21) has the following comparative statics property: if $\widetilde{M} > M$ then for each $Y > Y^H$ the respective solution $\widetilde{C}_0(Y)$ is above the original solution $C_0(Y)$. Indeed, the equation (28) and the initial condition (21) jointly imply that $\widetilde{C}_0(Y) > C_0(Y)$ at least in some neighborhood of Y^L. Suppose that there exists a $Y > Y^L$ such that $\widetilde{C}_0(Y) = C_0(Y)$. Let us denote $\breve{Y}$ the intersection point

of $\widetilde{C}_0(Y)$ and $C_0(Y)$ which is closest to Y^L. Since $\widetilde{C}_0(Y) > C_0(Y)$ for all $Y \in (\widetilde{Y}, \breve{Y})$, we should have $\widetilde{C}_0'(\breve{Y}) < C_0'(\breve{Y})$. But since $\widetilde{C}_0(\breve{Y}) = C_0(\breve{Y})$, (28) and $\widetilde{M} > M$ imply that $\widetilde{C}_0'(\breve{Y}) > C_0'(\breve{Y})$.

Therefore for each Y, an increase in M implies an increase in $C_0(Y)$ and decrease in $B(Y) = Y - C_0(Y)$. In the equilibrium with co-optation, we can substitute (14) into (20):

$$C_0'(Y) = \frac{(\bar{\theta} - K/\beta)(1-\bar{\theta})}{(\widehat{P} + (\beta\bar{\theta} - K)I)(1-\bar{\theta}+K)\bar{\theta}} \frac{f_0(Y)(Y - C_0(Y))}{f_1(C_0(Y))}.$$

which has the form (28) for $M = \frac{(\bar{\theta}-K/\beta)(1-\bar{\theta})}{(\widehat{P}+\beta(\bar{\theta}-K/\beta)I)(1-\bar{\theta}+K/\beta)\bar{\theta}}$.

Similarly, (16) and (20) imply the equation (28) for the equilibria with censorship:

$$C_0'(Y) = \frac{(\bar{\theta} - K/\beta)(1-\bar{\theta})}{4\widehat{P}\widehat{X}(1-\bar{\theta}+K/\beta)\bar{\theta}} \frac{f_0(Y)(Y - C_0(Y))^2}{f_1(C_0(Y))}.$$

In this case $M = \frac{(\bar{\theta}-K/\beta)(1-\bar{\theta})}{4\widehat{P}\widehat{X}(1-\bar{\theta}+K/\beta)\bar{\theta}}$.

Differentiating the expressions for M with regard to parameters of the model, we obtain the comparative statics results. ■

Proof of Proposition 5. The equation (20) immediately implies that if both countries have the same Y and C, then the ratio of slopes of $C_0(Y)$ for the two countries is as follows

$$\frac{C_0^{(2)\prime}(Y)}{C_0^{(1)\prime}(Y)} = \frac{Y - C}{M} \tag{29}$$

where M is a constant depending on the parameters of propaganda and censorship, and the distributions of economic shocks.

Let us first consider $Y = Y^L$. At this level of output, the two countries have the same consumption: $C_0^{(1)}(Y^L) = C_0^{(2)}(Y^L) = Y^L$. Therefore (29) implies that in the vicinity of $Y = Y^L$ the slope $C_0^{(2)\prime}(Y)$ is below $C_0^{(1)\prime}(Y)$. Therefore there exists a range of Y for which $C_0^{(2)}(Y) < C_0^{(1)}(Y)$.

Suppose that at some Y the two curves $C_0^{(1)}(Y)$ and $C_0^{(2)}(Y)$ intersect. Let us denote as $\widetilde{Y}$ the intersection point closest to Y^L and $\widetilde{C}$ the respective level of consumption. As $C_0^{(2)}(Y) < C_0^{(1)}(Y)$ to the left of $\widetilde{Y}$, so we should have $C_0^{(1)\prime}(\widetilde{Y}) < C_0^{(2)\prime}(\widetilde{Y})$. Using (29), we find that $\widetilde{Y} - \widetilde{C} > M$.

Let us now prove that there cannot be another intersection (to the right of $\widetilde{Y}$. Indeed, suppose that there exist other intersection points. Let us denote as $\breve{Y}$ the intersection point which is closest to $\widetilde{Y}$. As $C_0^{(2)}(Y) > C_0^{(1)}(Y)$ for all $Y \in (\widetilde{Y}, \breve{Y})$, we should have $C_0^{(1)\prime}(\breve{Y}) > C_0^{(2)\prime}(\breve{Y})$. This implies $\breve{Y} - \breve{C} < M < \widetilde{Y} - \widetilde{C}$. But this contradicts monotonicity of $B(Y)$.

Therefore there can only be one intersection point $\widetilde{Y}$. To the left of this intersection point, $Y \in (Y^L, \widetilde{Y})$, the first country has a higher consumption, C, and lower budget for propaganda, censorship and co-optation than the second country. To the right of this intersection point, $Y \in (\widetilde{Y}, Y^H)$, the second country spends

more on consumption and less on propaganda, censorship and co-optation than the first country. ■

Solving the example from subsection 7.4 We shall solve (20) for the equilibrium with co-optation ($n = N$) and then for the equilibrium with censorship ($n = 0$). In the equilibrium with co-optation, $\rho(B) = \frac{B}{\widehat{P}(1+\alpha)}$. Using the boundary condition (21) (which takes the form $C_0(0) = 0$), we immediately find a solution for (20):

$$C_0(Y) = \zeta Y; \quad \gamma(C) = \left(\frac{C}{\zeta \Delta Y}\right)^{\frac{\zeta}{1-\zeta}}. \tag{30}$$

where $\zeta \in (0,1)$ is given by

$$\zeta = \frac{\sqrt{1 + \frac{8\widehat{P}(1+\alpha)}{\Delta Y}\frac{(1-\bar{\theta}+K/\beta)\bar{\theta}}{(\bar{\theta}-K/\beta)(1-\bar{\theta})}} - 1}{\frac{4\widehat{P}(1+\alpha)}{\Delta Y}\frac{(1-\bar{\theta}+K/\beta)\bar{\theta}}{(\bar{\theta}-K/\beta)(1-\bar{\theta})}}.$$

The solution is therefore simple: if output decreases, the incompetent dictator proportionally decreases total spending on co-optation and propaganda $B(Y) = (1-\zeta)Y$. Moreover, as follows from the Proof of Proposition 2, spending on co-optation and spending on propaganda also change proportionally: $R(Y) = \frac{\alpha}{\alpha+1}(1-\zeta)Y$ and $P(Y) = \frac{1}{\alpha+1}(1-\zeta)Y$.

Now let us consider the equilibrium with censorship. In this case, $\rho(B) = \frac{B^2}{4\widehat{P}\widehat{X}}$. Therefore, (20) turns into a non-linear differential equation that has no analytical solution. However, we can approximate the solution in the neighborhood of $Y = 0$:[32]

$$C = \sqrt{\frac{\Delta Y}{12\widehat{P}\widehat{X}}\frac{(1-\bar{\theta})(\bar{\theta}-K/\beta)}{\bar{\theta}(1-\bar{\theta}+K/\beta)}}Y^{\frac{3}{2}} + o\left(Y^{\frac{3}{2}}\right). \tag{31}$$

This means that in the equilibrium with censorship, the incompetent dictator spends relatively more on censorship and propaganda as the economy worsens: $B(Y)/Y$ increases as Y falls to zero. In the limit $Y \to 0$, the share of output spent on censorship and propaganda actually reaches 100 percent: $\lim_{Y\to 0}\frac{B(Y)}{Y} = 1$. Conversely, as output grows, the share spent on consumption increases: $C_0(Y)/Y$ is increasing with Y. The amounts spent on censorship and propaganda in this equilibrium are equal to each other $X = P = B(Y)/2$. In proportion to total income, Y, their shares therefore also increase as output falls.

The example also illustrates Proposition 4. Indeed, in the equilibrium with co-optation, ζ increases in $\frac{\Delta Y}{\widehat{P}(1+\alpha)}\frac{(1-\bar{\theta})(\bar{\theta}-K/\beta)}{\bar{\theta}(1-\bar{\theta}+K/\beta)}$. And it is easy to show, both analytically and numerically, that in the equilibrium with censorship, for any given Y, consumption $C_0(Y)$ increases in $\frac{\Delta Y}{\widehat{P}\widehat{X}}\frac{(1-\bar{\theta})(\bar{\theta}-K/\beta)}{\bar{\theta}(1-\bar{\theta}+K/\beta)}$.

In the right-hand side panel of Figure 5 we present the numerical solution and show that these properties hold for the whole range of Y and not just in the neighborhood of $Y = 0$.

[32] Here $o(\cdot)$ denotes any function such that $\lim_{Y\to 0}\frac{o\left(Y^{3/2}\right)}{Y^{3/2}} = 0$.