Threats and Political Instability in Authoritarian Regimes: A Dynamic Theoretical Analysis*

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Abstract: Non-democracies are seen as inherently unstable because of the high frequency of irregular and often-violent leadership turnovers. Our tractable stochastic game model investigates authoritarian stability and instability by portraying a world in which dictators are forced to tolerate threatening lieutenants because they are skillful at overcoming existential threats (shocks) to the regime. This unavoidable choice allows lieutenants to build up their own power bases, planting the seeds of various forms of authoritarian instability, including purges, coups, and civil war. Our model predicts, first and foremost, that changes in the frequency and severity of exogenous threats can have a profound impact on political stability. Contrary to research on the tradeoff between competence and loyalty, our model shows that when threats to the regime are existential and purges are an option, the dictator will always prefer to employ a competent lieutenant. Also, surprisingly, even with minimal institutional guarantees, we find that authoritarian regimes can be quite stable if the dictator and the lieutenant need each other for their unique skills in the face of major challenges. However, in accordance with the existing literature, credible institutions to ensure the welfare of ousted officials do, indeed, reduce the chance of internal conflict.
JEL Classification: C73, D74, D83.
Keywords: authoritarian instability, stochastic game, leadership turnover, skill, threats.

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* We would like to thank Chong-en Bai, Marco Battaglini, Debrah Beim, Jidong Chen, Ernesto Dal Bó, Alexandre Debs, Ruixue Jia, Alessandro Lizzeri, Peter Lorentzen, Branislav Slantchev, Kjetil Storesletten, Milan Svolik, Daniel Treisman, Zenan Wu, Sheng Xiao, Jingyi Ye, Bo Zhang and seminar participants at the Chinese Academy of Social Sciences; the panel on new political economics at Beijing Forum; UCSD-Tsinghua Political Economy Workshop; UPenn Comparative Politics Workshop; and Yale Leitner Political Economy seminar for their useful comments and suggestions. We are especially indebted to Joel Sobel for insightful and helpful comments and suggestions. Financial support from the National Natural Science Foundation of China (71273012), the Carnegie Corporation Grant, and the School of Economics at Peking University's Research Fund is gratefully acknowledged. All mistakes are our own.

1. Introduction

What engenders stability and instability in non-democracies? The literature has provided important insights into this question, exposing the numerous vulnerabilities of dictators, as well as possible countermeasures against the vulnerabilities. Indeed, although some dictators, such as Franco and Salazar, ruled in tranquility throughout their tenures, others, including Khrushchev and Park Chung-hee, fell from power or came close to it due to attempted coups. Some, such as Stalin and Mao, also felt compelled to fire or even execute officials who had served them loyally for years. Such periodic purges, coup attempts, and civil conflicts give rise to the impression that dictatorships are fundamentally less stable than democracies (Iqbal and Zorn, 2006). To be sure, the basic reason for authoritarian instability stemmed from these regimes' lack of a constitutional framework to constrain political actors' power, their range of actions, and the potential consequences of losing power struggles (Przeworski, 1991: 14; Svolik, 2012b; Wintrobe, 1998: 4; Myerson, 2008; Acemoglu, Robinson, and Verdier, 2004; Dal Bó, Hernandez, and Mazzuca, 2015). Yet, both within and across regimes, outcomes varied widely, ranging from decades of authoritarian stability to frequent purges and coups. This paper provides a novel way to interpret this variation.

A major strand of the scholarship on dictatorships maintains that the gravest threat facing dictators is a potential coup or usurpation by high-level officials employed by the dictator (Egorov and Sonin, 2011; Svolik, 2012b; Gregory, 2009; Wintrobe, 1998; Tullock, 1987; McMahon and Slantchev, 2016). To explain the rich variety of political outcomes in authoritarian regimes, we develop a tractable stochastic model (see Shapley (1953) and Vieille (2002), for example) of the interaction between the dictator and her closest lieutenant. First and foremost, our model departs from most existing models of principal-agent interaction, in that there is neither a perpetual principal nor a fixed agent therein. For this reason, we explicitly take into account not only the principal's expected lifetime utility if she chooses to launch a purge and to delegate an action to a new agent, but also the agent's potential expected lifetime utility if he chooses to launch a coup and becomes the principal one day. Our paper is in sharp contrast to the informational theory model in political economics (e.g., Egorov and Sonin, 2011; Guriev and Treisman, 2015; and Myerson, 2015),[1] which assumes an implementable contract between the principal and the agent. We believe that our

[1] Myerson (2015) develops a dynamic agency model to highlight the mechanisms that guarantee the long-term allocation of moral-hazard rents in government as a fundamental force to constrain rulers and regulate the allocation of power. We owe the reference of Myerson's (2015) work to Marco Battaglini.

setup has application not only in political science, but also in the vast literature on corporate finance and incomplete contracts (Tirole, 1999, 2001; Urgun, 2017).[2]

Second, departing from existing models' setup, in which dictators entrust tasks to lieutenants due to one particular skill that the lieutenant possesses (Myerson 2008, 2015; Egorov and Sonin, 2011; McMahon and Slantchev, 2016), we posit two different skills, one held by the dictator and one by the lieutenant. Different kinds of threats (shocks), such as fighting off external enemies versus ferreting out internal enemies, require the dictator to employ lieutenants with skills appropriate to the situation, or else face destruction.[3] Each shock can be strong or weak, and the strength of the shock is not observable *ex ante*. The skill level of elites can be high or low. Both high- and low-skilled elites with the right type of skills can successfully deal with corresponding weak shocks. However, only elites with both the right type of skills *and* a high degree of those skills can deal with a corresponding strong shock, else the regime collapses.[4] Furthermore, although the skill *type* of the elite is public information, the skill *level* of the elite is private information and can be known by other players only after she has dealt with at least one shock. Thus, besides orthogonal skill types, the dictator and the lieutenant potentially have a great need for each other, even if each is resourceful enough to unseat the other because of uncertainty about the skill level of a new lieutenant drawn from the pool of potential elites. Thus, unlike some models of authoritarian politics (e.g., Acemoglu, Egorov, Sonin, 2008; McMahon and Slantchev, 2015; Egorov and Sonin, 2011), heightened power of the lieutenant or the dictator, as well as the temptation of higher payoffs for the dictator, do not necessarily generate instability. If actors need the skills of their rivals, stability can persist.

In our model, because there is always some positive probability that the dictator will choose a high-skilled lieutenant from among the potential elites, the dictator will definitely purge the low-skilled lieutenant as soon as her skill level becomes public information. In contrast to some existing models (Egorov and Sonin, 2011; Zakharov, 2016), in which the lieutenant's skill level is public information, we see a much narrower scope for a competence/loyalty tradeoff in dictators' employment of lieutenants because shocks that pose existential threats to the regime make the

[2] In 1980, Apple Computer became a publicly traded company, and Steve Jobs looked to marketing expert John Sculley of Pepsi-Cola to take over the role of CEO for Apple. Unfortunately, as the next several products from Apple suffered significant design flaws, Sculley believed Jobs was hurting Apple, and the company's executives began to phase him out. Thus, Jobs left Apple in 1985 (Steve Jobs Biography.com). Available from: https://www.biography.com/people/steve-jobs-9354805.

[3] We use threat and shock interchangeably.

[4] Importantly, the successful overcoming of external shocks requires only skills and the might of the state apparatus, which we assume that all officials entrusted with the task have equal access to.

selection of incompetent lieutenants risky for the dictator.[5]

As emphasized by a major strand of the authoritarian literature (e.g., Myerson, 2008, 2015), dictators can maintain their regimes' internal stability by appointing and credibly paying off the right kind of officials in the right positions. We are quite sympathetic to the view that a successful dictator needs, first and foremost, a reputation for reliably rewarding supporters. Yet our model departs from the received wisdom, in that the high payoffs to the lieutenant *per se* are neither necessary nor sufficient to achieve internal stability in authoritarian regimes, as long as the payoffs to the lieutenant are still lower than the dictator's payoffs.

Third, this theoretical account also introduces an explicit mechanism to illustrate the tradeoff between eliminating external threats and developing internal vulnerabilities. We propose a model in which exogenous threats to the regime lying outside of the dictator's own core competence will compel her to delegate to (hopefully) skillful lieutenants. The skillful lieutenants will extinguish the threats but build up internal power bases that can, one day, challenge the dictator's own power.[6] Besides skills, elites in the system are also endowed with political resources. We distinguish between skills, which are used to deal with exogenous shocks, and political resources, which are purely for domestic political struggles. Whoever holds greater political resources at the moment of the struggle will be the victor when at least one side initiates offensive action—i.e., a purge by the dictator and/or a coup by the lieutenant. Rather than relying on information asymmetry between the dictator and the lieutenant (e.g., Myerson, 2008, 2015; Egorov and Sonin, 2011; McMahon and Slantchev, 2016) or exogenous reshuffling (e.g., Acemoglu, Egorov, and Sonin, 2008) to distribute power between actors, we introduce the intuitive mechanism that the lieutenant will accumulate more and more political resources relative to the dictator when he resolves crises for the regime.

More specifically, we assume that elites have two sources of political resources. First, every member of the elite is endowed with some level of initial political resources, which never diminishes. His initial political resource is an independent and identically distributed (i.i.d.) random variable and private information, but its distribution is public information. Thus, although one elite does not know how the amount of initial resources another has, he knows where he stands in the overall distribution and, thus, can assess his likelihood of defeating the other. Second, with each successive

[5] Saddam Hussein placed incompetent loyalists in crucial positions, and, as a result, the Iraqi government and military collapsed within three weeks of the beginning of the U.S.-led 2003 invasion of Iraq on March 20.

[6] A similar assumption is adopted by Francois, Rainer and Trebbi (2015), who posit that more-experienced ministers are more adept at capturing a larger share of the value that they produce for the leader statically. Thus, time spent inside the palace increases the capacity for ministers to become a serious threat to the leader dynamically. We owe the reference to Francois, Rainer and Trebbi's (2015) work to Ernesto Dal Bó and Alessandro Lizzeri.

period of survival, we assume that the entire authoritarian regime receives a constant political surplus, which is public information and completely disappears by the next period.[7] In every period, the constant political surplus will be divided between the dictator and the lieutenant, who engage in implicit bargaining with one another on the basis of their political power bases within the regime and on their ability to resolve different shocks (Cramton, 1984; Sobel and Takahashi, 1983). Appointments to powerful positions allow these skillful lieutenants to obtain larger shares of political resources when they resolve successive challenges for the regime. Therefore, we assume that the fraction of political surplus appropriated by the lieutenant is an increasing function of the number of shocks that he has resolved consecutively.

The intuition here is that in helping the regime resolve major crises, lieutenants obtain ever-increasing control over a subset of institutions in the regime by intimately understanding how they work and by appointing trusted followers to key positions in these institutions. Also, by resolving key crises for the regime, skillful lieutenants signal both skills and political style to the other senior leaders of the regime, which, over time, can make these lieutenants increasingly viable alternatives to the incumbent in the eyes of the elite selectorate. Finally, by overcoming major shocks for the regime, skillful lieutenants become core members of the inner circles of power and accumulate crucial knowledge that is useful in a coup, including the dictator's weaknesses, grudges against the incumbent, and the possible coalitions that may favor the removal of the incumbent.

Fourth, this model explicitly links the severity and frequency of external threats to the internal stability of an authoritarian regime. In our model, unlike any previous model, the type and severity of external crises directly affect domestic stability in authoritarian regimes. The main engine of change in our model is the dynamic evolution of the relative distribution of political resources between the lieutenant and the dictator. Over time, through resolving successive challenges for the regime, these lieutenants construct their own empires within the regime, thus posing serious challenges to the incumbents. Incumbents then face a difficult choice between purging the skillful lieutenants, which risks regime destruction from future shocks, and allowing them to stay, which risks potential coups by the lieutenants. The ambitious lieutenants likewise grapple with the payoffs from usurping the dictator and the risks of failed coups, as well as the risk of overthrowing a uniquely talented dictator who may be able to deal with future shocks. Both the dictator and the lieutenant make guesses about the relative political resources of the other actor, the trajectory of

[7] Even if the depreciation rate were less than unity, it would not affect our qualitative results. Unfortunately, necessary and sufficient conditions for all equilibria could be obtained in our model only when the depreciation rate of the political surplus was equal to unity.

future shocks, and the pool of potential talent that is skillful in dealing with various shocks in their calculation of maintaining or changing the status quo. When at least one actor decides to change the status quo, a temporary period of instability ensues, and when both actors decide to change the status quo, the result may be a calamitous civil conflict.

Fifth, this model describes the game between the dictator and her lieutenant in a dynamic setting with an infinite horizon. We see this as necessary because, for both the dictator and her lieutenant who aspires to be a dictator, the expected future payoffs of various current actions can have a profound impact on whether these actors decide to change the status quo today. Even if a lieutenant has a strong incentive and the ability to overthrow the dictator today, he may need the dictator tomorrow, which compels him to defer a coup, perhaps indefinitely. If the dictator knew this, she would defer a purge of the ambitious lieutenant. Therefore, just as our model predicts, even when the lieutenant has a sufficient power base for overthrowing the incumbent, he may refrain from doing so due to his knowledge that the incumbent will not purge him because she needs him to deal with future shocks. Surprisingly, even with minimal institutional guarantees, we find that authoritarian regimes can be quite stable if both the dictator and the lieutenant need each other for their unique skills in the face of major challenges.

Sixth, we strive to obtain explicit solutions with this extremely complicated model with numerous parameters and "moving parts." To make the derivation more tractable, we assume that all constant political surpluses accrue to the dictator if she deals with the shock herself. Furthermore, we also assume that (1) even if the lieutenant has the upper bound level of initial political resources, his political resources remain less than the dictator's when he has consecutively dealt with no more than n shocks; (2) after the lieutenant resolves at least $n+2$ successive shocks, his higher contemporary political surplus over the dictator will provide the lieutenant with sufficient political resources to unseat the incumbent, even if the incumbent has the upper bound level of initial political resources; and (3) when the lieutenant successfully deals with $n+1$ consecutive shocks, neither the dictator nor the lieutenant can be sure of having sufficient political resources to unseat the other. As our model reveals later, this uncertainty about each other's political resources lays the foundation for a bloody political fight between the dictator and the lieutenant. In the above assumptions, $n \geq 2$ is an exogenous positive integer and merely some threshold below which a lieutenant can never be a threat to the dictator. The larger the n, the more slowly the lieutenant can accumulate political resources by resolving shocks. Under the above assumptions, we can obtain all expected lifetime utilities for both dictators and lieutenants in all equilibria by just solving the system

of linear equations with n, $n+1$, or $n+2$ unknowns. With these equilibrium expected lifetime utilities, we provide not only the necessary and sufficient conditions for all equilibria, but also the equilibrium probabilities that the dictator and the lieutenant will take political actions in a mutual conflict equilibrium.

Seventh, departing from the dichotomous (stability-instability) predictions of existing models, the theoretical account introduced here provides a rich variety of instability outcomes in authoritarian regimes. In particular, this account explains why dictators need to appoint capable lieutenants and why their subsequent rise to power may compel dictators to purge them. Alternatively, these capable lieutenants may obtain sufficient power to usurp the dictator. When both the dictator and the lieutenant have an incentive to act against each other, an equilibrium civil war may ensue. Furthermore, this model can provide explicit predictions of whether the dictator or the lieutenant can be expected to triumph in a given type of political contest. Unlike most models of authoritarian politics, which predict the dichotomous scenarios of stability and instability, this model generates four scenarios—stability, purges, coups, and civil war—and seven different outcomes that specify who wins in three different kinds of political struggle. To the best of our knowledge, this is the first model that generates the diversity of outcomes by just changing the frequency of exogenous threats (see Table 4 on page 51 in the main text).

Finally, this model agrees with the extant literature on the importance of credible institutions that guarantee payoffs to regime supporters for political stability (Svolik, 2012b; Svolik and Boix, 2007; Gandhi, 2008). Nevertheless, in the present model, the relative payoffs between the dictator and the lieutenant and, perhaps more important, the payoff to the passive losers of political struggles have a significant impact on political actors' likelihood of changing the status quo. If the payoff to losers who did not initiate the political struggle can be made credible, dictators will have less incentive to purge a talented lieutenant. Essentially, the dictator can be comforted by the fact that even if a talented but increasingly powerful lieutenant eventually forces the dictator into retirement, his lifetime payoff would still be a better outcome than regime collapse or a failed purge. Much like states engaged in bargaining, we think it likely that if being removed from office is better than death, there are equilibria whereby the dictator or the lieutenant would leave office without fighting when challenged (Fearon 1995). This finding suggests that, perhaps, Deng's willingness to bestow extremely generous retirement benefits on senior officials, even ones who had been purged, laid the groundwork for relative political stability in China, until recently (Manion 1993).

The remainder of the paper is organized as follows. Section 2 briefly reviews the relevant

literatures. Section 3 describes the model setup. Section 4 analyzes the model and provides the theoretical and numerical results for a stable authoritarian regime. Based on the players' expected lifetime utilities for all equilibria derived in Section 4, Section 5 turns to the theoretical and numerical results for an unstable authoritarian regime. Finally, Section 6 concludes the paper.

2. The Literature on Authoritarian Stability

A major strand of the literature on dictatorships agrees that the gravest threat facing dictators is a potential coup or usurpation by high-level officials employed by the dictator (Egorov and Sonin, 2011; Svolik, 2012b; Gregory, 2009; Wintrobe, 1998; Tullock, 1987). Scholars have proposed various mechanisms that may heighten the risk of potential coups (Debs, 2016; Svolik, 2009; Egorov and Sonin, 2011; Bueno de Mesquita et al., 2003). In many cases, the dictator's own choices increase the chances of a coup, including deploying excessive violence against potential enemies (Debs, 2016); allowing local leaders to develop regional power bases (Debs, 2007); hoarding spoils without paying supporters (Bueno de Mesquita et al., 2003; Svolik, 2009); reneging on promises made to the elite or to the military (Svolik, 2012a; Myerson, 2008); allocating too many resources to ambitious lieutenants (McMahon and Slantchev, 2015); and choosing advisors who are too smart to remain loyal to the dictator (Egorov and Sonin, 2011).

A major thread of the authoritarian literature has argued that, despite the dearth of credible constitutions, dictators can maintain their regimes' internal stability by appointing and credibly paying off the right kind of officials in the right proportions from the pool of potential officials (Svolik, 2009; Svolik and Boix, 2007; Bueno de Mesquita et al., 2003; Gandhi, 2008). We concur with the view that a successful dictator, first and foremost, needs a reputation for reliably rewarding his supporters. Yet, under certain circumstances, perhaps a high payoff to a lieutenant *per se* is *neither necessary nor sufficient* for achieving internal stability in authoritarian regimes.

Indeed, as Acemoglu, Egorov and Sonin's (2008) seminal paper points out, stable coalitions can emerge in authoritarian politics if coalitions are self-enforcing, in the sense that none of the sub-coalitions can secede without the regime degenerating into instability.[8] Because this model is very general, it remains vague about when and why a subgroup secedes from or sidelines the status quo self-enforcing coalition. The hint that Acemoglu, Egorov and Sonin (2008) provide is that

[8] In Acemoglu, Egorov, and Sonin (2008), there are still some predetermined rules for the members of the ultimate ruling coalition to distribute society's resources among themselves.

self-enforcing coalitions are generally "fragile." History may provide a clue as to when status quo coalitions become fragile. Many cases of attempted coups or purges have taken place after major challenges to the regime. For example, Stalin did not initiate his purge of the upper echelon of the CPSU until the late 1920s, when Tsarist forces had been quelled completely and Japan had withdrawn from the Far East (Thurston, 1996; Volkogonov, 1998). Likewise, Mao purged Peng Dehuai, the commander of Chinese forces in Korea, after the end of the Korean War in 1958 (Li, 1989). Did these episodes display a coincidental correlation, or might there be theoretical reasons why the timing of external shocks was often linked with occurrences of internal instability?

In Egorov and Sonin's (2011) path-breaking paper, for example, they propose a model in which the vizier observes an external crisis and tells the dictator what it would take to overcome the crisis. If the smart vizier thinks that allowing the dictator to fall from power would bring greater advantage, he would provide false information about the size of an external threat, thus making the dictator's ouster more likely. The dictator's rational course of action is to choose less-able lieutenants whose limitations also extend to an inability to calculate the benefits of betraying the dictator—an inability that makes them less willing to betray. Zakharov (2016) likewise models a loyalty-competence tradeoff for dictators who may choose a less-competent subordinate with few outside options, thus increasing his level of loyalty.

In these models, the subordinates are not the direct challengers to the dictator and, therefore, cannot enjoy the high payoffs of being a dictator. As such, the dictator has less to fear from the subordinates, who are not tempted by the high payoffs of being the dictator. This assumption is also made in the power-sharing literature, in which the biggest challenge facing dictators and their supporters is one of credibly guaranteeing payoffs to supporters (Svolik and Boix, 2007; Svolik, 2009). In reality, close subordinates of dictators are their most likely replacements because they have the best access to the dictators and a keener sense of the expected payoffs of being a dictator—both the benefits and the pitfalls. With the possibility of becoming dictators, subordinates potentially have very high incentives to launch coups if the perceived payoff of being a dictator is high. Subordinates, though, also have to think about a possible future in which a successful coup installs them as dictators, which compels them to face many of the same challenges that the dictator faces today. If a subordinate sees his future as dictator as highly challenging, even a powerful and competent subordinate's best response may be to maintain the status quo.

If dictators can foresee that their lieutenants are likely to become threatening in the future, why did dictators such as Mao and Stalin put fearsome individuals—e.g., Beria, Lin Biao, and

Kuznetsov—in charge of important institutions and then lose sleep over the possibility that they may hatch plots to usurp them? Departing from existing models in which a dictator entrusts tasks to a lieutenant because he possesses one particular skill (Egorov and Sonin, 2011; McMahon and Slantchev, 2016), we posit two different skills held by the dictator and the lieutenant, respectively. Because these skills are orthogonal and necessary to resolve existential threats, both the dictator and the lieutenant potentially have great need of one another, thus creating an incentive for perpetual stability even when there *is not* asymmetric information about the relative political power of the actors.

One avenue for lieutenants to build sufficient power and resources to launch coups is information asymmetry in which the lieutenant obtains more power than the dictator realizes. Indeed, the model by McMahon and Slantchev (2015) captures this dynamic. Using asymmetric information on the size of external threats and the dictator's transfer of resources to her lieutenants as key mechanisms of change, this model predicts that if the dictator were to mistakenly transfer to the generals more resources than are necessary to deal with external crises, the generals would have the ability to launch a coup. In contrast, if the generals needed all the transferred resources to deal with crises, they would remain loyal because insufficient resources for external crises would mean a total loss for everyone in the regime. Importantly, the dictator is incentivized to entrust the battle against external enemies to generals because they have higher skills. We also agree that the need to entrust skillful generals or lieutenants with important tasks is the beginning of political instability in authoritarian regimes. We find asymmetric information about the initial endowment of political resources and the skill level of the lieutenant—rather than about the strength of a crisis—a more realistic source of uncertainties for the dictator because she can presumably rely on multiple channels to ascertain the severity of a crisis. Also, this model seems to underestimate the potentially lethal consequences of transferring insufficient resources to a lieutenant in the face of possible regime-ending shocks. Therefore, we assume that when a lieutenant is entrusted with the task of resolving a crisis, the entire resources of the regime are put at his disposal.

History also presents a set of puzzling dynamic cases in which lieutenants, such as Himmler in Nazi Germany, built up large internal empires in the regime but never plotted to overthrow Hitler. (Delarue, 2008). The extant literature may explain this by citing the high payoffs that Hitler would have made to someone like Himmler (Gandhi and Przeworski, 2006; Svolik and Boix, 2007). Or in a one-shot game, insufficient resources transferred by the dictator may prevent a subordinate from launching a coup (McMahon and Slantchev, 2015). However, given his extensive control over much of the military and all of the secret police by 1944, why didn't Himmler want the even higher payoff of

being the *Fuhrer* himself (Delarue 2008)?[9] The same can be said of Peng Dehuai or even Lin Biao in the CCP, neither of whom actually tried to directly usurp Mao's power (MacFarquhar and Schoenhals, 2006: 336). Our model provides an explanation for the persistence of the status quo, even in the face of vast accumulation of power by the lieutenant.

In order to address the central puzzles of authoritarian instability and of appointing and purging capable officials, as well as the timing of purges, we propose a model in which exogenous shocks are existential threats to the regime that can immediately press dictators into making a difficult choice between a high probability of losing power today and empowering a talented underling who may challenge their power in the future. The starting point of this model is the fundamental insight of Acemoglu, Egorov, and Sonin (2008) that redistribution of power among members of the ruling coalition can destabilize a previously stable such coalition. When dictators are forced to entrust the resolution of shocks to capable lieutenants, redistribution of power takes place, planting the seeds of political instability in the future. Over time, lieutenants with the skills needed to deal with challenges to the regime come to acquire a larger share of political power and potentially usurp the incumbents.

The intuition here is that in helping the regime resolve major crises, lieutenants obtain ever-increasing control over a subset of institutions in the regime by intimately understanding how they work and by appointing trusted followers to key positions in these institutions. Also, by resolving key crises for the regime, skillful lieutenants signal both skills and political style to the other senior leaders of the regime, which, over time, can make these lieutenants increasingly viable alternatives to the incumbent in the eyes of the elite selectorate. Finally, by overcoming major shocks for the regime, skillful lieutenants become core members of the inner circles of power and accumulate crucial knowledge that is useful in a coup, including the dictator's weaknesses, grudges against the incumbent, and the possible coalitions that may favor the removal of the incumbent.

This accumulation of power will lead to deviation from the status quo of stable rule by the incumbent dictator. Sensing a lieutenant with rising power, the incumbent may choose to purge him preemptively, especially if the pool of officials with similar talent is ample relative to the frequency and severity of shocks. If the scarcity of talent or the high frequency and severity of shocks compel the dictator to allow the lieutenant to accumulate power by dealing with shocks, the dictator may one day be forced out of power by a coup. Alternatively, if the dictator herself possesses the rare and necessary skills to deal with future shocks, she may know that the lieutenant will never have an incentive to

[9] Although Himmler was in control of a sizable portion of the military and a vast network of secret police, he lacked the charisma to mobilize the population in a total war, a quality that Hitler had, and Hitler, of course, needed Himmler's fanatical Waffen SS and Gestapo to stay in power.

launch a coup, which renders a preemptive purge unnecessary. When both the dictator and the lieutenant feel uncertain about the future trajectory of shocks and about the relative levels of power, they may decide to attack each other simultaneously, giving rise to civil war.

This model is consistent with the findings in the extant literature that credible institutions that guarantee payoffs to regime supporters are important to political stability (Svolik, 2012b; Svolik and Boix, 2007; Gandhi, 2008; Myerson, 2008, 2015). In the model, the relative payoffs between the dictator and the lieutenant and, perhaps more important, the payoff to the loser in a political struggle have a significant impact on political actors' likelihood of changing the status quo. If the payoff to losers can be made credible, dictators will have less incentive to purge a talented lieutenant. As mentioned earlier, even if a talented but increasingly powerful lieutenant could eventually force the dictator into retirement, the dictator can find comfort in the fact that her lifetime payoff in retirement would still be a better outcome than regime collapse or a failed purge. This finding suggests that perhaps Deng's willingness to bestow extremely generous retirement benefits on senior officials, even those who had been purged, laid the groundwork for relative political stability in China, until recently (Manion 1993).

3. The Basic Model

This game is played between elites in three positions: the dictator (D), the lieutenant (L), and an infinite supply of latent/potential elites (P), who can be appointed as the lieutenant (L). Thus, the set of elites is given as $E = \{D, L, P\}$. Each elite is given an initial skill and political resources. We distinguish between skills, which are used to deal with exogenous shocks, and political resources, which are purely for domestic political struggles.[10] These two dimensions of endowment are orthogonal to each other. Furthermore, there are different types of shocks that require different skills. Formally, shocks are typed $i = a, b$, which are observable and orthogonal to each other. Each type of shock is an i.i.d. random variable across time. In any given time period, there is only one shock with type i, whose probability is denoted by $p(i)$. We assume that $p(i)$ satisfies $p(i) \in (0,1)$ and $p(a) + p(b) = 1$. Each shock can either be strong, s, or weak, w. And the strength of the shock i, which is denoted by $j(i) = \{s, w\}$, is not observable *ex ante*. Given that shock i has occurred, the conditional probability of the strength of this shock being equal to $j(i)$

[10] Importantly, to successfully overcome external shocks requires only skills and the might of state apparatus, which we assume all officials entrusted with the task have equal access to.

is denoted by $p(j|i)$. And Bayes' rule implies that, in a given time period, the *ex ante* probability of shock with type i and strength $j(i)$ is given by $p(ij) = p(j|i)p(i)$.

Corresponding to the types of shocks, elites in the dictatorship are also divided into two groups, $I = \{A, B\}$, which is public information. We assume that elite type A has the skills to deal only with shock a, while elite type B has the skills to deal only with shock b. Furthermore, the skill level of an elite $I = \{A, B\}$ can be high, h, or low, l, which is denoted by $J^I = \{h^I, l^I\}$. While both high- and low-skilled elites of type I, $J^I = h^I$ or $J^I = l^I$, can deal with weak shocks i, $j(i) = w$, only elites with the right type and high skill, $J^I = h^I$, can deal with a strong shock of type i, $j(i) = s$. Furthermore, although the type of elites is public information, their skill level is private information and can be known by other players only *after* they have dealt with at least one shock. And we assume that elites I have an *ex ante* probability of being highly skilled officials ($J^I = h^I$) to be γ^I, and, thus, the *ex ante* probability of their being low-skilled officials is $1-\gamma^I$.

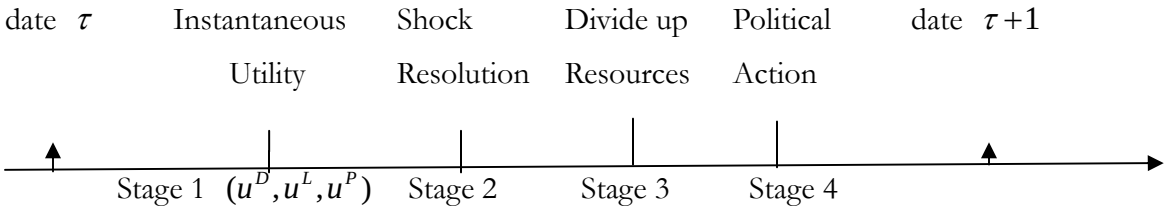
Besides skills, elites in the system are also endowed with political resources, which are used only for domestic political struggles. We denote elites I with position E's political resources at period t as K_t^{IE}. And we assume that elites I have two sources of political resources. First, elites I are endowed with some level of initial political resources R^I. Also, elites with position $E = \{D, L\}$ can obtain additional political resources by obtaining a share of the regime's political surplus for every period that the regime survives. The initial political resources R^I for each elite individual I is an i.i.d. random variable. We assume that the exact value of R^I is private information, but the overall distribution of R^I is publicly known, which has a distribution function of $G(\cdot)$ with bounds $[\underline{R}, \overline{R}]$. Thus, although elites do not know the amount of initial resources another elite has, they know where they stand in the overall distribution and, thus, can assess their likelihood of defeating other elites. Finally, we also assume that R^I has a depreciation rate of 0—i.e., each elite's initial political endowment never diminishes.

Second, with each successive period of survival, the entire authoritarian regime receives a constant political surplus K, which is public information. For simplicity, we assume that K has a depreciation rate of 100% in every period, meaning that political surplus from one period

completely disappears by the next period.[11] In every period, the constant political surplus K will be split between the dictator and the lieutenant.

As the authoritarian elite, players enjoy payoffs in accordance to their stations in the regime. As long as they obtain or are appointed to certain positions in a given time period, they will receive instantaneous utility for that period. Every period, the dictator, the lieutenant, and the latent/potential elite, which includes cadres forced into retirement by previous political struggles, will receive instantaneous, fixed payoffs of u^D, u^L, and u^P, respectively. We assume that $u^D > u^L > u^P \geq 0$, in accordance to these officials' ranks in the regime. Given the pyramidal nature of an authoritarian regime, we believe that this payoff structure is generally justifiable. Officials who die in the course of a political struggle will receive zero instantaneous utility for all subsequent periods. If a shock overwhelms the regime, both the dictator and the lieutenant will receive zero utility for all subsequent periods. For the sake of notational simplicity, we assume that the latent elite and retired officials will receive u^P even if the regime collapses in the future. However, depending on the credibility of benefit-sharing institutions in the regime, u^P can be either zero or higher than zero.

Figure 1: Timing of the Game



In its most basic form, this is a stochastic game with infinite horizon (see Shapley (1953) and Vieille (2002), for example). Each period, τ, is broken into the following four stages:

Stage 1: Receiving payoffs: The dictator, the lieutenant, and the latent elite receive instantaneous payoffs of of u^D, u^L, and u^P, respectively.

Stage 2: Shock with type $i = \{a, b\}$ and with strength $j(i) = \{s, w\}$ takes place. The dictator or

[11] Even if the depreciation rate were less than unity, it would not affect our qualitative results. It is worth noting that only sufficient conditions for all equilibria can be obtained when the depreciation rate of the political surplus is less than unity. By contrast, we will provide not only the necessary and sufficient conditions for all equilibria, but also the equilibrium probabilities in mutual conflict, when the depreciation rate of the political surplus is 100%.

the lieutenant will automatically deal with the shock for which she or he has the skills. If the skill level happens to be insufficient to deal with the shock, the regime will collapse, and both the dictator and the lieutenant will receive zero utility for all subsequent periods.

Stage 3: In successfully dealing with the shock, the dictator and the lieutenant will split the regime political surplus K in the following ways.

We denote the number of the shocks that elite I with position E has *consecutively* dealt with in stage 2 of period t to be $z_t^{IE}(i_t, i_{t-1})$,[12] when shock i_t and i_{t-1} have occurred at period t and $t-1$, respectively.[13] Given the number of shocks that type I lieutenant has *consecutively* dealt with in stage 2 of period t, z_t^{IL}, the fraction $f(z_t^{IL}) \in [0,1]$ of the constant political surplus K will be appropriated by the type I lieutenant, and the remaining fraction $1-f(z_t^{IL})$ of K will be reserved for the type $-I$ dictator. Therefore, the type I lieutenant's political resources in period t are given by $K_t^{IL}(z_t^{IL}) = f(z_t^{IL})K + R^I$, and the type $-I$ dictator's political resources in period t are given by $K_t^{-ID}(z_t^{IL}) = [1-f(z_t^{IL})]K + R^{-I}$. As to the property of function $f(z_t^{IL})$, we have the following assumption.

Assumption 1: (i) $f(z_t^{IL})K + \overline{R} \le [1-f(z_t^{IL})]K + \underline{R}$ for $z_t^{IL} \le n$, in which n is an exogenous positive integer. (ii) $f(z_t^{IL})K + \underline{R} \ge [1-f(z_t^{IL})]K + \overline{R}$ for $z_t^{IL} \ge n+2$. (iii) $f(z_t^{IL})K + \overline{R} \ge [1-f(z_t^{IL})]K + \underline{R}$ and $f(z_t^{IL})K + \underline{R} \le [1-f(z_t^{IL})]K + \overline{R}$ if $z_t^{IL} = n+1$.

Part (i) of assumption 1 states that the dictator could eliminate a lieutenant who has consecutively dealt with no more than n shocks with certainty. Even if he has the upper bound level of initial political resources, the lieutenant's political resources are still less than the dictator's. Part (ii) of assumption 1 implies that, after the lieutenant resolves at least $n+2$ successive shocks, the lieutenant's higher contemporary political surplus over the dictator will provide the lieutenant with sufficient political resources to unseat the incumbent, even if the incumbent has the upper bound level of initial political resources R^I. And, according to part (iii) of assumption 1, we know that when the lieutenant successfully deals with $n+1$ consecutive shocks, neither the dictator nor

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[12] In our notations, the subscript t represents the time period, while the first superscript I represents the elite's type, and the second superscript E represents the elite's position.

[13] It is obvious that the transition/evolution of $z_t^{IE}(i_t, i_{t-1})$ follows: $z_t^{AE}(b, i_{t-1}) = 0$, $z_t^{AE}(a,b) = 1$, $z_t^{AE}(a,a) = z_{t-1}^{AE}(a, i_{t-2}) + 1$, $z_t^{BE}(a, i_{t-1}) = 0$, $z_t^{BE}(b,a) = 1$ and $z_t^{BE}(b,b) = z_{t-1}^{BE}(b, i_{t-2}) + 1$.

the lieutenant can be sure that they have sufficient political resources to unseat one another. As our model reveals later, this uncertainty about each other's political resources lays the foundation for a bloody political fight between the dictator and the lieutenant.

In the above assumption, n is merely some threshold below which a lieutenant can never be a threat to the dictator. When z_t^{IL} reaches n, the type $-I$ dictator knows that this is potentially the last period in which she can defeat the type I lieutenant with certainty. If, in the next period, the type I lieutenant solves another shock for the regime—i.e., $z_{t+1}^{IL} = n+1$—the type $-I$ dictator is no longer certain whether she can defeat the lieutenant. If, in the subsequent period, the type I lieutenant solves yet another shock for the regime such that $z_{t+2}^{IL} = n+2$, the type $-I$ dictator definitely will be unable to defeat the lieutenant in a political struggle. In essence, the core of this model predicts that all else being equal, the lieutenant's success in resolving multiple crises for the regime is a key mechanism for the subordinates to accrue political resources until they can challenge the incumbent's rule. In fact, we need only a monotonically increasing function $f(\cdot)$ in Assumption 1 to construct the novel mechanism in this paper. We provide a specific increasing function, $f(x)$, which satisfies assumption 1 as follows: $f'(x) \geq 0$, $f(x) \in [0,1]$, $f(0) = 0$, $f(n) = 1/3$, $f(n+1) = 1/2$, and $f(n+2) = 3/4$. If the relationship between the constant political surplus, which the entire authoritarian regime receives in every period, and the bounds of the elites' initial political resources satisfies $K/3 > \overline{R} - \underline{R}$, then it is obvious that assumption 1 will hold for the abovementioned function $f(x)$.

Stage 4: The dictator and the lieutenant each make a choice. The dictator chooses only whether or not to launch a purge against her lieutenant. The lieutenant chooses only whether or not to launch a coup. And we assume that the latent elites are passive. Not only do they not take political action; as officials in an authoritarian regime, they cannot refuse an appointment order from the dictator.[14]

Formally, for the dictator whose type is I, her choices are either to carry out a purge, $S^{ID} = 1$, or to not carry out a purge, $S^{ID} = 0$. For the lieutenant whose type is $-I$, the choices are, likewise, to carry out a coup, $S^{-IL} = 1$, or to not carry out a coup, $S^{-IL} = 0$. When one side initiates offensive action (either a coup or a purge), we assume that the two sides will begin a struggle that will result in victory for one side. Whoever holds more political resources at the moment of the

[14] Furthermore, we assume that the latent elites have no knowledge of the details of the game between the dictator and the lieutenant. They do not acquire such knowledge until they are appointed as lieutenants.

struggle will win in period t. More specifically, $K_t^{ID} > K_t^{-IL}$ will result in victory for the dictator; otherwise, $K_t^{ID} < K_t^{-IL}$ will result in victory for the lieutenant. The outcomes are then deterministic according to Table 1. In essence, in stage 4 of each period, actors decide whether or not to change the status quo and will enjoy or suffer from the consequences of moving from the status quo in all subsequent periods.

At the beginning of the next period, $\tau+1$, the dictator, the lieutenant, and the latent elites receive the utility bestowed upon them by their positions as of the end of the previous period.

Table 1: Actions and Possible Consequences in Stage 4

	Dictator	Purge $S^{ID}=1$		Not Purge $S^{ID}=0$	
Lieutenant		Victory	Defeat	Victory	Defeat
Coup $S^{-IL}=1$	Victory		D Dies/ L Becomes D/ P Becomes L		D *Retires*/ L Becomes D/ P Becomes L
	Defeat	D Lives/ L Dies/ P Becomes L		D Stays D/ L Dies/ P Becomes L	
Not Coup $S^{-IL}=0$	Victory		D Dies/ L Becomes D/ P Becomes L	Status Quo	
	Defeat	D Lives/ L *Retires*/ P Becomes L			

As Table 1 shows, the initiator of the action, whether it be a coup or a purge, bears enormous risks because failure means death, in which case one's instantaneous utility becomes zero forever. The victor of the struggle, whether it be the dictator or the lieutenant, will enjoy utility as the dictator, u^D, at least in the immediate future. The crucial difference is in what happens to the loser of the political struggle who did not initiate political change. When $u^P=0$, the loser of the political struggle suffers a fate equivalent to or worse than death, such as a life sentence in a Siberian gulag. When $u^P>0$, the purged lieutenant (the dethroned dictator) who did not choose to change

the status quo still can enjoy all future utility as a latent/potential elite, u^P. In the model, we assume that a retired elite can no longer be appointed as a lieutenant, but, nevertheless, can continue to enjoy u^P, regardless of whether the regime survives.

4. Analysis

Given the model's setup, what factors influence the actions of the dictator and the lieutenant in a given turn? For the elite I with position E in period t, knowledge of the skill levels of his rival (elite $-I$) is crucial for his decision in the same period, and his rival's track record of dealing with shocks provides that information. Conditional on shock i_t occurring in stage 2 of period t, let us denote the information set of elite I with position E's skill level, which will be revealed to his rival—i.e., elite $-I$ with position $-E$, at stage 4 of the same period as $\beta_t^{-I-E}(i_t) \in \{h^I, l^I, \gamma^I\}$.[15] If the elite I with position E has dealt with at least one shock before stage 3 of period t, this elite's skill level becomes public information at stage 4 of the same period—i.e., either a high skill level $\beta_t^{-I-E}(i_t) = h^I$ or a low skill level $\beta_t^{-I-E}(i_t) = l^I$.

More specifically, when shock $i_t = a$ has occurred in stage 2 of period t, the information on elite A's skill will be revealed as either high $\beta_t^{B-E}(a) = h^A$ or low $\beta_t^{B-E}(a) = l^A$; when shock $i_t = b$ has occurred in stage 2 of period t, the information on elite B's skill will be revealed as either high $\beta_t^{AE}(b) = h^B$ or low $\beta_t^{AE}(b) = l^B$. By contrast, if elite I with position E did not deal with a shock instage 2 of period t, his information set revealed in stage 4 of the same period will be the same as that in period $t-1$—i.e., $\beta_t^{A-E}(a) = \beta_{t-1}^{A-E}(i_{t-1})$ and $\beta_t^{BE}(b) = \beta_{t-1}^{BE}(i_{t-1})$. More specifically, if the elite I with position E has never dealt with a shock before stage 3 of period t, his skill level remains private information in stage 4 of the same period. Other elites, therefore, know only the *ex ante* probability of this elite being high-skilled, as denoted by γ^I—i.e., $\beta_t^{-I-E}(i_t) = \gamma^I$.

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[15] By a small abuse of notation, we could denote β_t^{-I-E} as elite $-I$ with position $-E$'s belief about his rival's skill level in period t. The probability that elite I is viewed as high-skilled must equal 1 (respectively 0) when $\beta_t^{-I-E} = h^I$ (respectively $\beta_t^{-I-E} = l^I$), and the probability that I is viewed as high-skilled equals γ^I when $\beta_t^{-I-E} = \gamma^I$.

In addition, both the dictator and the lieutenant also consider their own, as well as their rivals', level of political resources, which is crucial during a domestic political struggle. And the elite I with position $E=\{D,L\}$ could estimate his rival's political resources in period t by the distribution of elite $-I$'s initial endowment of political resources and the track record of the lieutenant's dealing consecutively with shocks.

Interestingly, because of ever-present shocks, both players also consider their alternatives in each other's absence. And both sides consider whether they need one another's skills and whether latent elites may have high enough skills to replace their rivals. For example, even if the dictator, whose skill is type A, doesn't have the skill to deal with shock b, when there are an abundance of high-skilled latent elites of skill type B—i.e., when γ^B is high enough—she is less afraid of purging her type B lieutenant. Finally, the elite's decision is further driven by the probability of a shock for which he has no skill, as well as by the conditional probability of the shock being a strong shock.

More specifically, the elite I who is the dictator in time t make s decision S_t^{ID} on the basis of his own political resources at time t, which include his initial endowment of resources R^I, the number of shocks that the type $-I$ lieutenant has dealt with *consecutively* at time t, z_t^{-IL}, which affects the split in the share of constant surplus K. The dictator must also consider the overall distribution of the elite $-I$'s initial political resources, $G(\cdot)$, the available information that she has on the lieutenant's skill in period t, β_t^{ID}, and the probability of drawing a high-skilled latent elite in an area in which the dictator herself has no skills, γ^{-I}. And the dictator's decision is further driven by the probability of a shock for which the dictator has no skills, $p(-i)$, as well as the conditional probability of a strong shock $-i$, $p(h|-i)$. In sum, the decision of the elite I who is the dictator at time t is given by $S_t^{ID}=S_t^{ID}[z_t^{-IL}(i_t,i_{t-1}),R^I,G(\cdot),\beta_t^{ID},\gamma^{-I},p(-i),p(s|-i)]$. By the same logic, the decision of the elite $-I$ who is the lieutenant at time t is given by $S_t^{-IL}=S_t^{-IL}[z_t^{-IL}(i_t,i_{t-1}),R^{-I},G(\cdot),\beta_t^{-IL},\gamma^I,p(i),p(s|i)]$. To save notation, we drop the time-unvarying variables $G(\cdot)$, R^I, γ^I, $p(i)$, and $p(s|i)$ in the elites' decision functions by denoting $S_t^{ID}=S_t^{ID}[z_t^{-IL},\beta_t^{ID}]$ and $S_t^{-IL}=S_t^{-IL}[z_t^{-IL},\beta_t^{-IL}]$.

In our initial scenario, we could assume, without loss of generality, that elite A is the dictator

and elite B is the lieutenant in period t. We assume that the dictator has dealt with at least one shock already, so that her skill level is public information to other elites. And we will focus the interesting case in which the skill level of the dictator is high instead of low, and, thus, we have $J^A = h^A$ and $\beta_t^{BL} = h^A$.[16] In addition, we will make the following assumption in the rest of the paper to simplify the notations in the analysis of the model.

Assumption 2: (i) We assume that $f(0) = 1$, which implies that all the constant political surplus K will be reserved for the dictator if she deals the shock herself. (ii) We assume that $f(n+1) = 1/2$, so that $G_t^{IE}(n+1) = G(R^I)$, in which $G_t^{IE}(n+1)$ is the probability that elite $I = A, B$ with position $E = D, L$ will be the victor in the struggle in stage 4 of period t when the lieutenant has dealt consecutively with $n+1$ shocks in stage 2 of the same period.

Assumption 2 implies that the elite who are endowed with more initial political resources will be the victors of domestic political struggles when they have dealt consecutively with $n+1$ shocks. When the number of shocks that the skill type B lieutenant has dealt with *consecutively* in the second stage of period t is given by z_t^{BL}, and the information available to the dictator on this lieutenant's skill level is given by β_t^{AD} in the fourth stage of the same period, the Bellman equation for Skillful type A dictator with initial resources R^A is given by

$$V_t^{AD}[z_t^{BL}, \beta_t^{AD}] = u^D + \delta \max_{S_t^{AD}} E_t \left\{ \begin{array}{c} (1-\delta)^{-1}(1-S_t^{AD})S_t^{BL}(1-G_t^{AD})u^P + \\ [S_t^{BL} + S_t^{AD}(1-S_t^{BL})]G_t^{AD} p(a) V_{t+1}^{AD}[0, \gamma^B] + \\ [S_t^{BL} + S_t^{AD}(1-S_t^{BL})]G_t^{AD} p(b) \Phi_{t+1}^{AD}[1, J^B] + \\ (1-S_t^{AD})(1-S_t^{BL}) p(a) V_{t+1}^{AD}[z_{t+1}^{BL}(a,\cdot), \beta_{t+1}^{AD}(a)] \\ (1-S_t^{AD})(1-S_t^{BL}) p(b) \Pi_{t+1}^{AD}[z_{t+1}^{BL}(b,\cdot), \beta_{t+1}^{AD}(b)] \end{array} \right\}. \quad (1)$$

where $\delta \in (0,1)$ is a common discount rate, $\Phi_{t+1}^{AD}[1, J^B] \equiv \gamma^B V_{t+1}^{AD}[1, h^B] + (1-\gamma^B) p(w|b) V_{t+1}^{AD}[1, l^B]$, and

$$G_t^{AD}(z_t^{BL}) \equiv \begin{cases} 0, & \text{if } z_t^{BL} \geq n+2 \\ G(R^A), & \text{if } z_t^{BL} = n+1 \\ 1, & \text{if } z_t^{BL} \leq n \end{cases}$$

[16] When the low-skilled dictator is faced with a strong shock that she cannot successfully deal with, the entire regime will collapse. Therefore, the case in which the skill level of the dictator is low is trivial, because either the game will end sooner or later, or the dictator will definitely be dethroned by the lieutenant at some point in time.

$$\Pi_{t+1}^{AD}[z_{t+1}^{BL}(b,\cdot),\beta_{t+1}^{AD}(b)]\equiv\begin{cases} p(w|b)V_{t+1}^{AD}[z_{t+1}^{BL}(b,\cdot),l^B], & \text{if } \beta_{t+1}^{AD}(b)=\beta_t^{AD}=l^B \\ V_{t+1}^{AD}[z_{t+1}^{BL}(b,\cdot),h^B], & \text{if } \beta_{t+1}^{AD}(b)=\beta_t^{AD}=h^B \\ \gamma^B V_{t+1}^{AD}[z_{t+1}^{BL}(b,\cdot),h^B]+(1-\gamma^B)\,p(w|b)V_{t+1}^{AD}[z_{t+1}^{BL}(b,\cdot),l^B] \end{cases}$$

Lemma 1: (i) The dictator will purge the low-skilled lieutenant as soon as the lieutenant's skill level becomes public information, $S_{t*}^{AD}[1,l^B]=1$.[17] (ii) The dictator will not purge a high-skilled lieutenant who has not successfully resolved more than n continuous shocks, $S_{t*}^{AD}[z_t^{BL},h^B]=0$ for all $0\le z_t^{BL}<n$.

Proof. (i) After the low-skilled type B lieutenant's first handling of a weak shock b in period t, he will definitely not carry out a coup in the same period, $S_{t*}^{BL}[1,l^B]=0$. Substituting $S_{t*}^{BL}[1,l^B]=0$, $\beta_t^{AD}=l^B$, $z_t^{BL}(b,\cdot)=1$, $z_{t+1}^{BL}(a,b)=0$, $z_{t+1}^{BL}(b,b)=2$, $\beta_{t+1}^{AD}=l^B$, and $G_t^{AD}(1)=1$ into Skillful type A dictator's Bellman equation obtains

$$V_t^{AD}[1,l^B]=u^D+$$
$$\delta\max_{S_t^{AD}}E_t\left\{\begin{array}{c}(1-S_t^{AD})\left[\,p(a)V_{t+1}^{AD}[0,l^B]+p(b)\,p(w|b)V_{t+1}^{AD}[2,l^B]\right]+S_t^{AD}\times \\ \{p(a)V_{t+1}^{AD}[0,\gamma^B]+p(b)[\gamma^B V_{t+1}^{AD}[1,h^B]+(1-\gamma^B)\,p(w|b)V_{t+1}^{AD}[1,l^B]]\}\end{array}\right\} \quad (2)$$

It is obvious that we have $V_{t+1}^{AD}[0,\gamma^B]\ge V_{t+1}^{AD}[0,l^B]$, $V_{t+1}^{AD}[1,l^B]\ge V_{t+1}^{AD}[2,l^B]$, and $V_{t+1}^{AD}[1,h^B]>V_{t+1}^{AD}[1,l^B]$. Therefore, equation (2) implies that the dictator will purge a low-skilled lieutenant as soon as this lieutenant's low skill level becomes public information, $S_{t*}^{AD}[1,l^B]=1$.

(ii) We must have $S_{t*}^{AD}[z_t^{BL},h^B]=0$ for all $z_t^{BL}<n$ if $S_{t*}^{AD}[n,h^B]=1$, or else we will have $S_t^{AD}[n,h^B]=\varnothing$. By contrast, if $S_{t*}^{AD}[n,h^B]=0$, substituting $S_{t*}^{BL}[n,h^B]=0$, $\beta_t^{AD}=h^B$, $\beta_{t+1}^{AD}=h^B$, $z_{t+1}^{BL}(a,\cdot)=0$, and $z_{t+1}^{BL}(b,\cdot)=n+1$, $G_t^{AD}(n)=1$ into Skillful type A dictator's Bellman equation yields

$$\begin{array}{c}p(a)V_{t+1}^{AD}[0,h^B]+p(b)V_{t+1}^{AD}[n+1,h^B]\ge \\ p(a)V_{t+1}^{AD}[0,\gamma^B]+p(b)\gamma^B V_{t+1}^{AD}[1,h^B]+p(b)(1-\gamma^B)\,p(w|b)V_{t+1}^{AD}[1,l^B]\end{array} \quad (3)$$

Owing to $V_t^{AD}[n+1,h^B]\le V_t^{AD}[x,h^B]$ for all $x\le n$, inequality (3) implies that

[17] From now on, we will use * as the second subscript to indicate the optimal strategies for the dictator and the lieutenant.

$$p(a)V_{t+1}^{AD}[0,h^B]+p(b)V_{t+1}^{AD}[x,h^B]\geq$$
$$p(a)V_{t+1}^{AD}[0,\gamma^B]+p(b)\gamma^B V_{t+1}^{AD}[1,h^B]+p(b)(1-\gamma^B)\,p(w|b)V_{t+1}^{AD}[1,l^B]$$

And, thus, we have $S_{t*}^{AD}[z_t^{BL},h^B]=0$ for all $z_t^{BL}<n$ if $S_{t*}^{AD}[n,h^B]=0$. Summarizing the above analysis, we find that the dictator will not purge a high-skilled lieutenant who has never successfully resolved more than n consecutive shocks. *Q.E.D.*

Part (i) of lemma 1 implies that $V_t^{AD}[1,l^B]=V_t^{AD}[0,\gamma^B]$. Substituting $V_t^{AD}[1,l^B]=V_t^{AD}[0,\gamma^B]$ and $S_{t*}^{AD}[1,l^B]=1$ into equation (2), the maximum expected lifetime utility of a high-skilled type A dictator facing a low-skilled type B lieutenant is given by

$$V_t^{AD}[1,l^B]=V_t^{AD}[0,\gamma^B]=\frac{u^D+\delta\,p(b)\gamma^B V_t^{AD}[1,h^B]}{1-\delta[\,p(a)+p(b)(1-\gamma^B)\,p(w|b)]}. \qquad (4)$$

Contrary to the existing literature on the competence-loyalty tradeoff, lemma 1 implies that the game between a high-skilled dictator and a low-skilled lieutenant is trivial because the dictator will always purge incompetent lieutenants after uncovering their skill levels. Our results differ from those in the existing literature because we see strong shocks as existential threats that can reduce the utility of both dictators and lieutenants to zero for the indefinite future. It is worth noting that this setup would still be compatible with the stylized fact that personalist dictatorships are especially marred by incompetence because weak institutions in such dictatorships channel a higher share of low-skilled individuals into the pool of potential elite. We still believe that, within this smaller pool, systematically cultivating incompetent lieutenants is a costly gambit for dictators seeking to maximize the chance of regime survival.

Although the dictator cannot eliminate low-skilled lieutenants *ex ante*, after watching a lieutenant resolve a shock, the dictator observes his skill level and can eliminate an unskillful lieutenant in the hope of drawing a skillful one from the pool of latent elites to deal with future shocks. The dictator has no need to worry about skillful lieutenants challenging her power until they have resolved n number of shocks consecutively, after which the tradeoff between resolving external crises and internal stability becomes acute. In our remaining discussion, we will focus on the more interesting dynamics—at least in our model—between a high-skilled dictator and a high-skilled lieutenant.

Faced with a high-skilled type A dictator, the Bellman equation for a high-skilled type B lieutenant, who possesses initial resources R^B and has successfully dealt consecutively with z_t^{BL}

shocks in the second stage of period t, is given by

$$V_t^{BL}[z_t^{BL}, h^A] = u^L + \delta \max_{S_t^{BL}} E_t \left\{ \begin{array}{c} (1-\delta)^{-1}(1-S_t^{BL})S_t^{AD}(1-G_t^{BL})u^P + \\ [S_t^{AD} + S_t^{BL}(1-S_t^{AD})]G_t^{BL} p(b)V_{t+1}^{BD}[0, \gamma^A] \\ [S_t^{AD} + S_t^{BL}(1-S_t^{AD})]G_t^{BL} p(a)\Phi_{t+1}^{BD}[1, J^A] \\ +(1-S_t^{AD})(1-S_t^{BL})\, p(b)V_{t+1}^{BL}[z_{t+1}^{BL}(b,\cdot), h^A] \\ +(1-S_t^{AD})(1-S_t^{BL})\, p(a)V_{t+1}^{BL}[z_{t+1}^{BL}(a,\cdot), h^A] \end{array} \right\}. \qquad (5)$$

where $\Phi_{t+1}^{BD}[1, J^A] \equiv \gamma^A V_{t+1}^{BD}[1, h^A] + (1-\gamma^A)\, p(w|a) V_{t+1}^{BD}[1, l^A]$ and

$$G_t^{BL}(z_t^{BL}) \equiv \begin{cases} 1, & \text{if } z_t^{BL} \geq n+2 \\ G(R^B), & \text{if } z_t^{BL} = n+1 \\ 0, & \text{if } z_t^{BL} \leq n \end{cases}$$

Lemma 2: If a high-skilled lieutenant will never launch a coup against the dictator, $S_{t*}^{BL}[z_t^{BL}, h^A] \equiv 0$ for all $z_t^{BL} \geq 0$, then the best strategy for the dictator is never to purge her loyal lieutenant, $S_{t*}^{AD}[z_t^{BL}, h^B] \equiv 0$ for all $z_t^{BL} \geq 0$.

Proof. Substituting $S_{t*}^{BL}[z_t^{BL}, h^A] \equiv 0$, $\beta_t^{AD} = h^B$ and $\beta_{t+1}^{AD} = h^B$ into the dictator's Bellman equation (1) obtains

$$V_t^{AD}[z_t^{BL}, h^B, S_{t*}^{BL} \equiv 0] = u^D +$$
$$\delta \max_{S_t^{AD}} E_t \left\{ \begin{array}{c} S_t^{AD} G_t^{AD}(z_t^{BL}) \{ p(a)V_{t+1}^{AD}[0, \gamma^B] + p(b)\gamma^B V_{t+1}^{AD}[1, h^B] \\ + p(b)(1-\gamma^B)\, p(w|b) V_{t+1}^{AD}[1, l^B] \} + (1-S_t^{AD}) \times \\ \{ p(a)V_{t+1}^{AD}[0, h^B, S_{t+1*}^{BL} \equiv 0] + p(b)V_{t+1}^{AD}[z_t^{BL}+1, h^B, S_{t+1*}^{BL} \equiv 0] \} \end{array} \right\} \qquad (6)$$

And thus, the maximum expected lifetime utility for a high-skilled type A dictator who faces a high-skilled type B loyal lieutenant who will never launch a coup is given by

$$\max V_t^{AD}[z_t^{BL}, h^B, S_{t*}^{BL} \equiv 0] = (1-\delta)^{-1} u^D \text{ for all } z_t^{BL} \geq 0.$$

Equation (6) implies that we have $S_{t*}^{AD}[z_t^{BL}, h^B, S_{t*}^{BL} \equiv 0] \equiv 0$ owing to $(1-\delta)^{-1}u^D > V_{t+1}^{AD}[0, \gamma^B] = V_{t+1}^{AD}[1, l^B]$. And, thus, the dictator will never purge her loyal lieutenant, who will never launch a coup. *Q.E.D.*

4.1 Benchmark Equilibrium: Stable Authoritarian Regime

In a stable authoritarian regime, both the dictator and the lieutenant are expected to serve in their

respective positions forever because nobody wants to change the status quo, and the stochastic game degenerates into an infinitely repeated game. Therefore, in a stable authoritarian regime, a high-skilled type B lieutenant has a lifetime utility of $(1-\delta)^{-1}u^L$, and a high-skilled type A dictator has a lifetime utility of $(1-\delta)^{-1}u^D$. On the basis of Lemma 2 above and Lemmas 3 and 4 below, we prove the existence of perpetual stability.

4.1.1 The Theoretical Results in a Stable Authoritarian Regime

Lemma 3: When a high-skilled type B lieutenant has successively resolved $n+2$ shocks in period t but does not launch a coup in the same period, $S_{t*}^{BL}[n+2,h^B]=0$, then the regime is in a stable equilibrium in which both the dictator and the lieutenant are expected to maintain the status quo forever, owing to both $S_{t*}^{BL}[z_t^{BL},h^B]\equiv 0$ and $S_{t*}^{AD}[z_t^{BL},h^B]\equiv 0$ for all $z_t^{BL}\geq 0$.

Proof. (i) When a high-skilled type B lieutenant does not launch a coup after having successively resolved $n+2$ shocks, substituting $S_{t*}^{AD}[n+2,h^B]=0$ into type B lieutenant's Bellman equation (5) implies that

$$\begin{aligned}&[p(b)+p(a)(1-\gamma^A)p(w|a)]V_{t+1}^{BD}[0,\gamma^A]+p(a)\gamma^A V_{t+1}^{BD}[1,h^A]\\&<p(b)V_{t+1}^{BL}[n+3,h^A]+p(a)V_{t+1}^{BL}[0,h^A]\end{aligned}\tag{7}$$

Owing to the fact that $V_{t+1}^{BL}[z_{t+1}^{BL},h^A]$ is a non-decreasing function of z_{t+1}^{BL} when $z_{t+1}^{BL}\geq n+2$, inequality (7) implies that for all $z_{t+1}^{BL}\geq n+3$, we have

$$\begin{aligned}&[p(b)+p(a)(1-\gamma^A)p(w|a)]V_{t+1}^{BD}[0,\gamma^A]+p(a)\gamma^A V_{t+1}^{BD}[1,h^A]\\&<p(b)V_{t+1}^{BL}[z_{t+1}^{BL},h^A]+p(a)V_{t+1}^{BL}[0,h^A]\end{aligned}$$

Therefore, this high-skilled type B lieutenant will not launch a coup even when he has successively resolved more than $n+2$ shocks. Now, we just need to prove that this lieutenant also will not launch a coup when he has successively resolved $n+1$ shocks.

(ii) When a high-skilled type B lieutenant does not launch a coup after successively resolving $n+1$ shocks, lemma 2 implies that high-skilled type A dictator will never purge this lieutenant. Substituting $S_t^{AD}[z_t^{BL},h^B]=0$ and $S_t^{BL}[z_t^{BL},h^B]=0$ for all $z_t^{BL}\geq 0$ into Bellman equation (5), the maximum expected lifetime utility of this lieutenant when he has resolved $n+1$ consecutive shocks but does not launch a coup in the same period is given by

$$V_t^{BL}[z_t^{BL}, h^A, S_t^{BL} \equiv 0] = (1-\delta)^{-1}u^L, \quad \text{for all } z_t^{BL} \geq 0. \tag{8}$$

Substituting equation (8) into inequality (7) obtains

$$[p(b) + p(a)(1-\gamma^A)p(w|a)]V_t^{BD}[0, \gamma^A] + p(a)\gamma^A V_t^{BD}[1, h^A] < (1-\delta)^{-1}u^L. \tag{9}$$

In contrast, when a high-skilled type B lieutenant launches a coup after successively resolving $n+1$ shocks, substituting $S_t^{BL}[n+1, h^B] = 1$ into Bellman equation (5) implies that this lieutenant's maximum expected lifetime utility is given by

$$\begin{aligned} V_t^{BL}[n+1, h^A, S_t^{BL} = 1] &= u^L + \\ \delta G_t^{BL}(n+1)E_t &\left\{[p(b) + p(a)(1-\gamma^A)p(w|a)]V_{t+1}^{BD}[0, \gamma^A] + p(a)\gamma^A V_{t+1}^{BD}[1, h^A]\right\} \end{aligned} \tag{10}$$

Inequality (9) and equation (10) imply that we have

$$V_t^{BL}[n+1, h^A, S_t^{BL} = 0] > V_t^{BL}[n+1, h^A, S_t^{BL} = 1].$$

Therefore, this high-skilled type B lieutenant can enjoy more expected lifetime utility if he does not launch a coup after successively resolving $n+1$ shocks. Summarizing the above analysis, we find that when a high-skilled type B lieutenant does not launch a coup after successively resolving $n+2$ shocks, he will never launch a coup. And lemma 2 implies that the type A dictator will never purge this high-skilled type B lieutenant. Therefore, the regime in this case will be in a stable equilibrium, in which both the dictator and the lieutenant are expected to continue their rule forever. *Q.E.D.*

Substituting $V_t^{BL}[z_t^{BL}, h^A, S_t^{BL} \equiv 0] = (1-\delta)^{-1}u^L$ and equation (4) into inequality (7) obtains the following lemma.

Lemma 4: The necessary and sufficient condition for a high-skilled type I lieutenant never to launch a coup is given by

$$\delta^{-1}\{V_t^{ID}[0, \gamma^{-I}] - u^D\} < (1-\delta)^{-1}u^L. \tag{11}$$

Because the new type I dictator will not know the skill level of the type $-I$ lieutenant, much of the new dictator's utility will depend on the overall pool of skillful type $-I$ latent elites, γ^{-I}. If the pool of type $-I$ latent elites is small, the new type I dictator may face the prospect of a short tenure before strong shock i overwhelms the regime. Therefore, equation (11) suggests that even if a type I lieutenant could successfully launch a coup and become the new dictator, he may prefer the status quo if γ^{-I} is sufficiently low.

Substituting equation (4) and $V_{t+1}^{BD}[1, h^A] \leq (1-\delta)^{-1}u^D$ into inequality (11), the maximum value

for the right-hand side (RHS) of inequality (11) is given by

$$\frac{[p(b)+p(a)(1-\gamma^A)p(w|a)](1-\delta)+p(a)\gamma^A}{\{1-\delta[p(b)+p(a)(1-\gamma^A)p(w|a)]\}(1-\delta)}u^D.$$

Therefore, the sufficient condition for a high-skilled type B lieutenant to never launch a coup against a skillful type A dictator can be written as

$$u^L/u^D > 1-\frac{1}{\delta}+\frac{1}{\delta}\frac{\delta p(a)\gamma^A+1-\delta}{1-\delta[p(b)+p(a)(1-\gamma^A)p(w|a)]}. \quad (12)$$

And the sufficient condition for a high-skilled type A lieutenant to never launch a coup against a type B dictator can be written symmetrically as

$$u^L/u^D > 1-\frac{1}{\delta}+\frac{1}{\delta}\frac{\delta p(b)\gamma^B+1-\delta}{1-\delta[p(a)+p(b)(1-\gamma^B)p(w|b)]}.$$

A comparative statics analysis of inequality (12) implies that its RHS is an increasing function of γ^A and $p(w|a)$, and a decreasing function of $p(a)$. Therefore, when $\gamma^A=1$, $p(w|a)=1$, and/or $p(a)=0$, the maximum value that the RHS of inequality (12) can achieve is unity. And the left-hand side (LHS) of inequality (12) will achieve its maximum value, which is also unity, when the lieutenant's instantaneous fixed payoff equals the dictator's instantaneous fixed payoff, $u^L=u^D$. Summarizing the comparative statics analysis obtains the following proposition.

Proposition 1: (i) The larger the lieutenant's instantaneous fixed payoff is relative to the dictator's, the more likely it is that an authoritarian regime will be stable. (ii) The lower the *ex ante* probability of a type A latent/potential elite being high-skilled, the more likely it is that an authoritarian regime will be stable, and both skillful type A dictator and skillful type B lieutenant will be expected to continue their rule forever. (iii) The lower the conditional probability of shock a being a weak shock, the more likely it is that an authoritarian regime with a skillful type A dictator and skillful type B lieutenant will be stable forever. (iv) The higher the probability of shock a occurring, the more likely it is that an authoritarian regime with a skillful type A dictator and skillful type B lieutenant will be stable forever.

In essence, proposition 1 lays out some conditions for stable authoritarian rule. First, the dictator can credibly lower her own utility relative to the lieutenant's to ensure stability. This logic has been widely discussed in the literature (Svolik and Boix, 2007; Gandhi, 2008; Svolik, 2009). Second, stability will be enhanced when the latent pool of elites with skill A, the same skill as the dictator's,

is diminished. This may explain why dictators such as Mao, Stalin, and Pol Pot expunged those with similar backgrounds and experience as their own from the regime. Third and fourth, both the escalation of the severity and the increase in frequency of shock a will enhance stability in the regime. Because the type A dictator is skillful at resolving shock a, potential type B coup plotters must think twice before removing someone who can help them resolve future shocks.

4.1.2 Numerical Results in a Stable Authoritarian Regime

We now undertake a numerical analysis to investigate the lieutenant's minimum instantaneous fixed payoff, $\min u^L$, required for an authoritarian regime to remain stable, under different exogenous parameter values of the model. This is an important analysis because how much and when to pay lieutenants are key questions explored by the extant literature on authoritarian politics (Svolik, 2012b; Svolik, 2009; Egorov and Sonin, 2011; Bueno de Mesquita and Smith, 2011). The results below are consistent with existing findings that credible payoffs to members of the ruling coalition constitute a foundation for authoritarian stability. Deviating from some of the existing predictions, our model suggests that even when a high-skilled lieutenant is employed, the scarcity of latent elite with skills mastered by the dictator relative to the severity and frequency of shocks consistent with the dictator's skills will lower the "stability price" of the lieutenant. In the numerical analysis below, we will set $n=2$ to avoid excessively prolonged calculations in Mathematica. For ease of calculation, we set the dictator's instantaneous fixed payoff at $u^D=100$, the retired elite's instantaneous fixed payoff at $u^P=1$, and the standard parameter value for the annual discount rate at $\delta=0.95$.

To generate Figure 1, we set the conditional probability of shock a being a weak shock at 0.5, $p(w|a)=0.5$, and assume that the initial political resources of the type B lieutenant will place him above 75% of his potential enemies if he fights after resolving three type b shocks consecutively ($n+1=3$ in this set up), $G(R^B)=0.75$. Figure 1 depicts the relationship between this lieutenant's minimum instantaneous fixed payoff, $\min u^L$, required for an authoritarian regime to remain stable as the *ex ante* probability of type A latent elite being high-skilled, γ^A, increases. We further draw three lines to represent the minimum payoff required for stability under different *ex ante* probability for shock a, $p(a)$.

Figure 1. Type B Lieutenant's Minimum Instantaneous Payoff for an Authoritarian Regime to Remain Stable as the *Ex Ante* Probability of Type A Latent Elite being High-skilled, γ^A, Rises

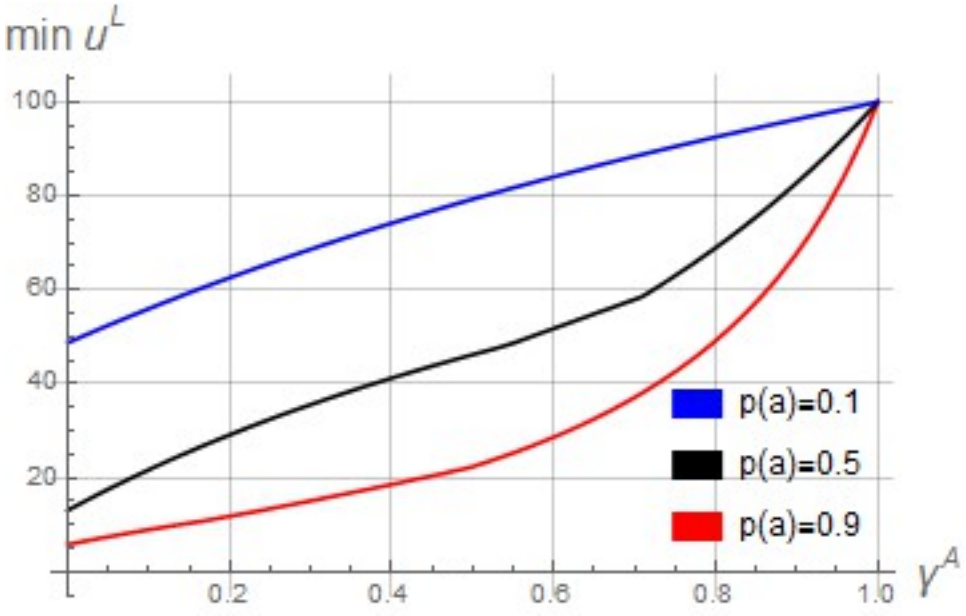


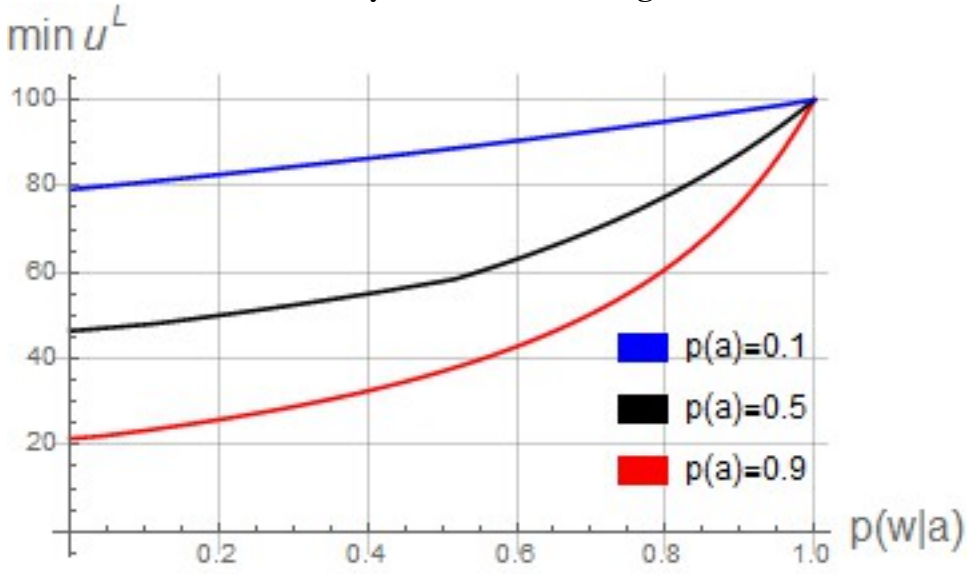
Figure 1 shows that as the pool of talented officials of *Type* A grows, it takes a greater instantaneous payoff to lieutenant type B to maintain stability in an authoritarian regime. Under most values of γ^A, a lower probability of shock a, $p(a)$, also requires higher payoffs to type B lieutenant to maintain stability. The intuition here is that if the pool of high-skilled type A officials is large, the lieutenant with type B skills is more willing to launch a coup, knowing that he can rely on latent talent to deal with strong shocks a in the future. Also, a lower probability of shock a means a higher probability of shock b, which allows the type B lieutenant to accumulate more political resources, paving the way to a possible coup or to a preemptive purge by the dictator. The only exception is when the probability of drawing a high- skilled official with A type skill is 1, in which case the type B lieutenant is highly motivated to launch a coup, regardless of the probability of shock a.

Next, we set the *ex ante* probability that a type A potential elite is highly skilled at 0.7, $\gamma^A = 0.7$, and assume that the initial political resources of the type B lieutenant will give him a 75% chance of victory should political struggle ensue after he has dealt with three shocks consecutively. Figure 2 depicts this lieutenant's minimum instantaneous fixed payoff, $\min u^L$, required for authoritarian stability under different conditional probabilities of shock a being weak

shock, $p(w|a)$.

Similar to Figure 1, Figure 2 shows that as the *ex ante* probability of a weak shock a rises, a lieutenant with type B skills will require higher instantaneous payoffs, relative to the dictator's payoffs, to deviate from the status quo of authoritarian stability. Again, this is because when there is a high chance that shock a is weak, even if the lieutenant launched a coup and became the new dictator with type B skills, he could appoint a low-skilled type A lieutenant to deal with a likely weak shock. For most values of $p(w|a)$, a higher probability of shock a, $p(a)$, also means lower minimum instantaneous payoffs to the lieutenant to maintain stability. For example, if shock a occurred with a 10% probability, and the conditional probability of a weak shock a was 80%, the probability of a strong shock a would be only 2%. In this case, the type B lieutenant would require over 90% of the dictator's instantaneous payoff to maintain the status quo of authoritarian stability. To be sure, this scenario assumes a relatively strong lieutenant to begin with, $G(R^B) = 0.75$, but it suggests two possibilities: (i) that the dictator has a high incentive to make her own skills unique by reducing the pool of latent elites who share her skills; or (ii) that the dictator has a high incentive to engender severe shocks that she has a relatively unique ability to resolve; doing so will allow her to lower the price that differently skilled lieutenants require to maintain the status quo.

Figure 2. Type B Lieutenant's Minimum Instantaneous Payoff to Maintain Authoritarian Stability as the Conditional Probability of Shock a Being Weak Rises

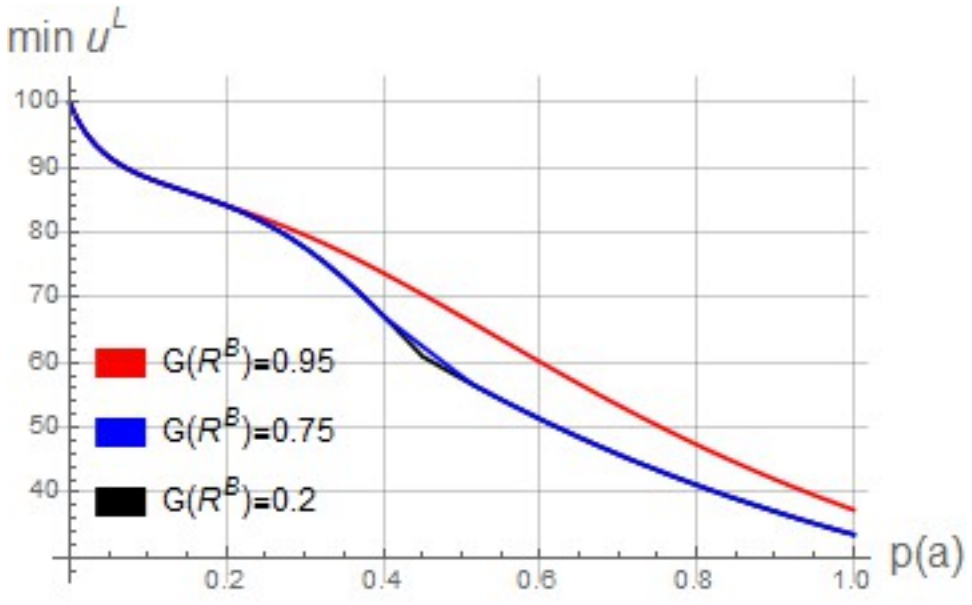


Finally, we set the conditional probability of shock a being weak at 0.5, $p(w|a) = 0.5$, and

the *ex ante* probability of type A potential elites being high-skilled at 0.7, $\gamma^A = 0.7$. Figure 3 depicts the relationship between the lieutenant's minimum instantaneous fixed payoff, $\min u^L$, required for authoritarian stability and the probability that shock a, $p(a)$, will rise. We further plot this relationship with the lieutenant being endowed with three levels of initial political resources: $G(R^B)$=0.2, $G(R^B)$=0.75 and $G(R^B)$=0.95.

Figure 3 shows, as expected, that as the probability of shock a rises, the lieutenant with type B skills demands an smaller instantaneous payoff to maintain stability. This is not surprising because it suggests the lieutenant's greater need for the skills mastered by the dictator to deal with future shocks. What is surprising is that even with different levels of initial endowment in political resources R^B, type B lieutenants demand smaller payoffs as the probability of shock a rises. Quite surprisingly, even when a lieutenant had sufficient initial political resources to win against 95% of potential enemies after he had consecutively dealt with three shocks, $G(R^B)$=0.95, he would require only slightly less than 50% of the dictator's instantaneous payoff if the probability of shock a were 80%. This is just a few percent more than that demanded by lieutenants with initial resources to win against only 20% of potential enemies, $G(R^B)$=0.2. Why demand so little? The intuition here is that even with a high chance of victory, the aspiring dictator—today's lieutenant type B—still must consider how often and how much the dictator's type A skills would be needed in the indefinite future. If the dictator's skills are unique enough, and the future brings enough sufficiently severe shocks that can be solved only by those with skills similar to the dictator's, even a powerful lieutenant's best course of action may be to settle for the status quo, which means that he would accept lower payoffs.

Figure 3: Type B Lieutenant's Minimum Instantaneous Payoff to Maintain Authoritarian Stability as the Probabilities of Shock a Rises, given Different Levels of Initial Political Endowment for the Lieutenant



4.2 The Analysis in an Unstable Authoritarian Regime

We now turn to cases in which the type B lieutenant and/or the type A dictator have incentives to deviate from the above stable authoritarian regime and engage in either a coup or a purge. Thus, we need to assume that the reverse of inequality (11) holds so that the high-skilled type A dictator and/or the high-skilled type B lieutenant cannot maintain a stable authoritarian regime.

Assumption 3: We assume that inequality $\delta^{-1}\{V_t^{BD}[0,\gamma^A]-u^D\}>(1-\delta)^{-1}u^L$ holds through the rest of the model so that a high-skilled type B lieutenant has incentives to launch a coup.

Based on the dictator's and the lieutenant's optimal strategies, which depend on the exogenous parameters of the model, there are three types of equilibria:[18]

Definition 1: The *purging equilibrium* is defined as the case in which the dictator chooses to launch a purge, but the lieutenant chooses to do nothing—i.e., $S_{t*}^{AD}=1$ and $S_{t*}^{BL}=0$.

We use the upper bar to denote the purging equilibrium. It is obvious that the dictator could choose to launch a purge after the high-skilled lieutenant has dealt consecutively with n or $n+1$ shocks—i.e., $S_t^{AD}(n)=1$ or $S_t^{AD}(n+1)=1$—and we denote the former case an n purging equilibrium and the latter case an $n+1$ purging equilibrium. Based on the outcome, there are successful and unsuccessful purging equilibria. The successful purging equilibrium, in which the lieutenant can do nothing but take early retirement, corresponds to either an n purging equilibrium

[18] The solution concept being used here is Perfect Bayesian Equilibrium (PBE).

or an $n+1$ purging equilibrium when the dictator is endowed with more initial political resources. By contrast, the unsuccessful purging equilibrium, in which the dictator will be replaced by the lieutenant, refers to an $n+1$ purging equilibrium when the lieutenant is endowed with more initial political resources and, thus, can defeat an attempted purge.

Definition 2: We define the *mutual conflict equilibrium* as the case in which both the dictator and the lieutenant want to change the status quo at the same time. It is obvious that a mutual conflict can occur only in a period in which the lieutenant has consecutively dealt with $n+1$ shocks—i.e., $S_{t*}^{AD}(n+1)=1$ and $S_{t*}^{BL}(n+1)=1$.

Definition 3: The *coup equilibrium* is defined as the case in which the lieutenant chooses to launch a coup, but the dictator chooses to do nothing—i.e., $S_{t*}^{AD}=0$ and $S_{t*}^{BL}=1$.

We use the lower bar to denote the coup equilibrium. The lieutenant could choose to launch a coup after he has consecutively dealt with $n+1$ or $n+2$ shocks—i.e., $S_t^{BL}(n+1)=1$ or $S_t^{BL}(n+2)=1$—and we denote the former case an $n+1$ *coup equilibrium* and the latter case an $n+2$ *coup equilibrium*. Based on the outcome, there are also successful and unsuccessful coup equilibria. The successful coup equilibrium, in which the dictator retires after the lieutenant launches a coup, corresponds to either the $n+2$ *coup equilibrium* or the $n+1$ *coup equilibrium* when the lieutenant is endowed with more initial political resources. By contrast, the unsuccessful coup equilibrium, in which the lieutenant dies due to a failed coup, refers to the $n+1$ *coup equilibrium* when the dictator is endowed with more initial political resources.

4.2.1 The expected lifetime utility in the n purging equilibrium

Substituting $z_t^{BL}=n$, $S_{t*}^{AD}(n)=1$, $S_{t*}^{BL}(n)=0$ and $\beta_t^{AD}=h^B$ into Bellman equation (1), we know that the skillful type A dictator's expected lifetime utility in the n purging equilibrium is determined recursively by

$$\begin{aligned}\overline{V}_t^{AD}[n,h^B,S_{t*}^{AD}(n)=1]&=u^D+\delta p(b)\gamma^B\overline{V}_t^{AD}[1,h^B,S_{t*}^{AD}(n)=1]\\&+\delta[p(a)+p(b)(1-\gamma^B)p(w|b)]\overline{V}_t^{AD}[0,\gamma^B,S_{t*}^{AD}(n)=1]\end{aligned}\tag{13}$$

and

$$\begin{aligned}\overline{V}_t^{AD}[x,h^B,S_{t*}^{AD}(n)=1]&=u^D+\delta p(a)\overline{V}_t^{AD}[0,h^B,S_{t*}^{AD}(n)=1]\\&+\delta p(b)\overline{V}_t^{AD}[x+1,h^B,S_{t*}^{AD}(n)=1],\quad \text{for } x\in[0,n)\end{aligned}\tag{14}$$

in which $\overline{V}_t^{AD}[n, h^B, S_{t*}^{AD}(n)=1] = \overline{V}_t^{AD}[0, \gamma^B, S_{t*}^{AD}(n)=1]$, and $\overline{V}_t^{AD}[x, h^B, S_{t*}^{AD}(n)=1]$ is the skillful type A dictator's expected lifetime utility in the n purging equilibrium when the high-skilled type B lieutenant has consecutively dealt with $x \in [0, n]$ shocks.

Solving the system of $n+1$ linear equations (13) and (14) with $n+1$ unknowns—i.e., $\overline{V}_t^{AD}[x, h^B, S_{t*}^{AD}(n)=1]$ for $x \in [0, n]$—we can obtain high-skilled type A dictator's expected lifetime utility in the n purging equilibrium.

4.2.2 The expected lifetime utility in the $n+1$ purging equilibrium

Substituting $z_t^{BL} = n+1$, $S_{t*}^{AD}(n+1)=1$, $S_{t*}^{BL}(n+1)=0$ and $\beta_t^{AD} = h^B$ into Bellman equation (1), we know that the skillful type A dictator's expected lifetime utility in the $n+1$ purging equilibrium is determined recursively by

$$\begin{aligned} \overline{V}_t^{AD}[n+1, h^B, S_{t*}^{AD}(n+1)=1] &= u^D + \\ \delta G(R^A) \left[\begin{array}{c} p(b)\gamma^B \overline{V}_t^{AD}[1, h^B, S_{t*}^{AD}(n+1)=1] + \\ [p(a) + p(b)(1-\gamma^B)p(w|b)] \overline{V}_t^{AD}[0, \gamma^B, S_{t*}^{AD}(n+1)=1] \end{array} \right] \end{aligned} \tag{15}$$

and

$$\begin{aligned} \overline{V}_t^{AD}[x, h^B, S_{t*}^{AD}(n+1)=1] &= u^D + \delta p(a) \overline{V}_t^{AD}[0, h^B, S_{t*}^{AD}(n+1)=1] \\ &+ \delta p(b) \overline{V}_t^{AD}[x+1, h^B, S_{t*}^{AD}(n+1)=1], \quad \text{for } x \in [0, n+1) \end{aligned} \tag{16}$$

in which $\overline{V}_t^{AD}[0, \gamma^B, S_{t*}^{AD}(n+1)=1] = \dfrac{u^D + \delta p(b)\gamma^B \overline{V}_t^{AD}[1, h^B, S_{t*}^{AD}(n+1)=1]}{1 - \delta[p(a) + p(b)(1-\gamma^B)p(w|b)]}$ is the direct result of equation (4), and $\overline{V}_t^{AD}[x, h^B, S_{t*}^{AD}(n+1)=1]$ is the high-skilled type A dictator's expected lifetime utility in the $n+1$ purging equilibrium when the high-skilled type B lieutenant has dealt consecutively with $x \in [0, n+1]$ shocks.

Substituting $z_t^{BL} = n+1$, $S_{t*}^{AD}(n+1)=1$, and $S_{t*}^{BL}(n+1)=0$ into Bellman equation (5), we know that the skillful type B lieutenant's expected lifetime utility in the $n+1$ purge equilibrium is determined recursively by

$$\overline{V}_t^{BL}[n+1, h^A, S_{t*}^{AD}(n+1)=1] = u^L + \delta(1-\delta)^{-1}[1 - G(R^B)]u^P + G(R^B)\{V_t^{BD}[0, \gamma^A] - u^D\} \tag{17}$$

and

$$\begin{aligned}\overline{V}_t^{BL}[x,h^A,S_{t*}^{AD}(n+1)=1] &= u^L+\delta p(b)\overline{V}_t^{BL}[x+1,h^A,S_{t*}^{AD}(n+1)=1]\\ &+\delta p(a)\overline{V}_t^{BL}[0,h^A,S_{t*}^{AD}(n+1)=1],\quad \text{for } x\in[0,n]\end{aligned} \tag{18}$$

in which $\overline{V}_t^{BL}[x,h^A,S_{t*}^{AD}(n+1)=1]$ is the skillful type B lieutenant's expected lifetime utility in the $n+1$ purging equilibrium when he has dealt consecutively with $x\in[0,n+1]$ shocks, and $V_t^{BD}[0,\gamma^A]$ is the new skillful type B dictator's *equilibrium* expected lifetime utility when her new type A lieutenant has never dealt with a shock. As part of the type B lieutenant's calculation of whether or not to launch a coup after resolving $n+1$ shocks, he must consider how he will fare when he defeats the incumbent and becomes the new dictator.

By solving the system of $n+1$ linear equations (18) with $n+1$ unknowns—i.e., $\overline{V}_t^{BL}[x,h^A,S_{t*}^{AD}(n+1)=1]$ for $x\in[0,n]$—we can obtain the high-skilled type B lieutenant's expected lifetime utility in the $n+1$ purging equilibrium.

4.2.3 The expected lifetime utility in the $n+1$ coup equilibrium

Substituting $z_t^{BL}=n+1$, $S_{t*}^{AD}(n+1)=0$, and $S_{t*}^{BL}(n+1)=1$ into Bellman equation (5), we know that the skillful type B lieutenant's expected lifetime utility in the $n+1$ coup equilibrium is determined recursively by

$$\begin{aligned}\underline{V}_t^{BL}[n+1,h^A,S_{t*}^{BL}(n+1)=1] &= u^L+G(R^B)\{V_t^{BD}[0,\gamma^A]-u^D\}=\\ u^L+\delta G(R^B)\{[p(b)+p(a)p(w|a)(1-\gamma^A)]V_{t+1}^{BD}[0,\gamma^A]&+p(a)\gamma^A V_{t+1}^{BD}[1,h^A]\}\end{aligned} \tag{19}$$

and

$$\begin{aligned}\underline{V}_t^{BL}[x,h^A,S_{t*}^{BL}(n+1)=1] &= u^L+\delta p(b)\underline{V}_t^{BL}[x+1,h^A,S_{t*}^{BL}(n+1)=1]\\ &+\delta p(a)\underline{V}_t^{BL}[0,h^A,S_{t*}^{BL}(n+1)=1],\quad \text{for } x\in[0,n]\end{aligned} \tag{20}$$

in which $\underline{V}_t^{BL}[x,h^A,S_{t*}^{BL}(n+1)=1]$ is the skillful type B lieutenant's expected lifetime utility in the $n+1$ coup equilibrium when he has consecutively dealt with $x\in[0,n+1]$ shocks.

By solving the system of $n+1$ linear equations (20) with $n+1$ unknowns—i.e., $\underline{V}_t^{BL}[x,h^A,S_{t*}^{BL}(n+1)=1]$ for $x\in[0,n]$—we can obtain high-skilled type B lieutenant's expected lifetime utility in $n+1$ coup equilibrium.

Substituting $z_t^{BL}=n+1$, $S_{t*}^{AD}(n+1)=0$, $S_{t*}^{BL}(n+1)=1$ and $\beta_t^{AD}=h^B$ into Bellman equation (1), we know that the skillful type A dictator's expected lifetime utility in the $n+1$ coup equilibrium is determined recursively by

$$\underline{V}_t^{AD}[n+1, h^B, S_{t*}^{BL}(n+1)=1] = u^D + \delta(1-\delta)^{-1}[1-G(R^A)]u^P + \delta G(R^A)\begin{bmatrix} p(b)\gamma^B \underline{V}_t^{AD}[1, h^B, S_{t*}^{BL}(n+1)=1] + \\ [p(a)+p(b)(1-\gamma^B)p(w|b)]\underline{V}_t^{AD}[0, \gamma^B, S_{t*}^{BL}(n+1)=1] \end{bmatrix} \quad (21)$$

and

$$\underline{V}_t^{AD}[x, h^B, S_{t*}^{BL}(n+1)=1] = u^D + \delta p(a)\underline{V}_t^{AD}[0, h^B, S_{t*}^{BL}(n+1)=1] + \delta p(b)\underline{V}_t^{AD}[x+1, h^B, S_{t*}^{BL}(n+1)=1], \quad \text{for } x \in [0, n+1) \quad (22)$$

in which $\underline{V}_t^{AD}[x, h^B, S_{t*}^{BL}(n+1)=1]$ is the skillful type A dictator's expected lifetime utility in the $n+1$ coup equilibrium when the high-skilled type B lieutenant has dealt consecutively with $x \in [0, n+1]$ shocks.

By solving the system of $n+2$ linear equations (21) and (22) with $n+2$ unknowns—i.e., $\underline{V}_t^{AD}[x, h^B, S_{t*}^{BL}(n+1)=1]$ for $x \in [0, n+1]$—we can obtain skillful type A dictator's expected lifetime utility in the $n+1$ coup equilibrium.

4.2.4 The expected lifetime utility in the $n+2$ coup equilibrium

Substituting $z_t^{BL} = n+2$ and $S_{t*}^{BL}(n+2)=1$ into Bellman equation (5), we know that the skillful type B lieutenant's expected lifetime utility in the $n+2$ coup equilibrium is determined recursively by

$$\underline{V}_t^{BL}[x, h^A, S_{t*}^{BL}(n+2)=1] = u^L + \delta p(a)\underline{V}_t^{BL}[0, h^A, S_{t*}^{BL}(n+2)=1] + \delta p(b)\underline{V}_t^{BL}[x+1, h^A, S_{t*}^{BL}(n+2)=1] \quad \text{for } x \in [0, n+1] \quad (23)$$

in which $\underline{V}_t^{BL}[n+2, h^A, S_{t*}^{BL}(n+2)=1] = u^L + V_t^{BD}[0, \gamma^A] - u^D$ and $\underline{V}_t^{BL}[x, h^A, S_{t*}^{BL}(n+2)=1]$ is the skillful type B lieutenant's expected lifetime utility in the $n+2$ coup equilibrium when he has dealt consecutively with $x \in [0, n+2]$ shocks.

By solving the system of $n+2$ linear equations (23) with $n+2$ unknowns—i.e., $\underline{V}_t^{BL}[x, h^A, S_{t*}^{BL}(n+2)=1]$ for $x \in [0, n+1]$—we can obtain high-skilled type B lieutenant's expected lifetime utility in $n+2$ coup equilibrium.

Substituting $z_t^{BL} = n+2$, $S_{t*}^{BL}(n+2)=1$ and $\beta_t^{AD} = h^B$ into Bellman equation (1), we know that the skillful type A dictator's expected lifetime utility in the $n+2$ coup equilibrium is determined recursively by

$$\begin{aligned}\underline{V}_t^{AD}[x, h^B, S_{t*}^{BL}(n+2)=1] &= u^D + \delta p(a)\underline{V}_t^{AD}[0, h^B, S_{t*}^{BL}(n+2)=1] \\ &+ \delta p(b)\underline{V}_t^{AD}[x+1, h^B, S_{t*}^{BL}(n+2)=1] \quad \text{for } x \in [0, n+1]\end{aligned} \tag{24}$$

in which $\underline{V}_t^{AD}[n+2, h^B, S_{t*}^{BL}(n+2)=1] = u^D + \delta(1-\delta)^{-1}u^P$ and $\underline{V}_t^{AD}[x, h^B, S_{t*}^{BL}(n+2)=1]$ is skillful type A dictator's expected lifetime utility in the $n+2$ coup equilibrium when the high-skilled type B lieutenant has dealt consecutively with $x \in [0, n+2]$ shocks.

By solving the system of $n+2$ linear equations (24) with $n+2$ unknowns—i.e., $\underline{V}_t^{AD}[x, h^B, S_{t*}^{BL}(n+2)=1]$ for $x \in [0, n+1]$ —we can obtain high-skilled type A dictator's expected lifetime utility in the $n+2$ coup equilibrium.

4.2.5 The expected lifetime utility in the mutual conflict equilibrium

The comparison of equation (15) with equation (21) and of equation (17) with equation (19) implies that the following lemma will play a pivotal role in the calculation of expected lifetime utility in the mutual conflict equilibrium.

Lemma 5: If the purged lieutenant (the dethroned dictator) who did not choose to change the status quo still can enjoy all future utility as a latent/potential elite, $u^P > 0$, then the best strategy for the lieutenant is not to launch a coup if a high-skilled dictator chooses to launch a purge, and the best strategy for the dictator is not to launch a purge if a high-skilled lieutenant chooses to launch a coup.

Proof. (i) When a high-skilled dictator chooses to launch a purge in period t, $S_t^{AD}=1$, substituting $S_t^{AD}=1$ into a high-skilled lieutenant's Bellman equation (5) obtains

$$V_t^{BL}[z_t^{BL}, h^A] = u^L + \delta \max_{S_t^{BL}} E_t \left\{ \begin{array}{c} (1-\delta)^{-1}(1-S_t^{BL})(1-G_t^{BL})u^P + \\ G_t^{BL} p(b) V_{t+1}^{BD}[0, \gamma^A] + G_t^{BL} p(a) \Phi_{t+1}^{BD}[1, J^A] \end{array} \right\}. \tag{25}$$

If the purged lieutenant who did not choose to change the status quo still can enjoy all future utility as a latent/potential elite, $u^P > 0$, it is obvious from equation (25) that the best strategy for this lieutenant is not to launch a coup in period t, when a high-skilled dictator chooses to launch a purge in the same period owing to $(1-G_t^{BL})u^P \geq 0$. We can prove the dictator's best strategy by the same logic. *Q.E.D.*

Lemma 5 implies that there is no pure strategy equilibrium, but a mixed strategy equilibrium, in the mutual conflict between dictator and lieutenant if $u^P > 0$. In the mixed strategy equilibrium,

given the rival's best strategy, both the dictator and the lieutenant must be indifferent between changing from the status quo to mutual conflict. Therefore, the dictator's (lieutenant's) expected lifetime utility in the mutual conflict equilibrium is the same as if she (he) had chosen to launch a purge (coup) in the same period. This implies that

$$\widehat{V}_t^{AD}[x,h^B]=\overline{V}_t^{AD}[x,h^B,S_{t*}^{AD}(n+1)=1] \quad \text{for } x\in[0,n+1], \tag{26}$$

and

$$\widehat{V}_t^{BL}[x,h^A]=\underline{V}_t^{BL}[x,h^A,S_{t*}^{BL}(n+1)=1] \quad \text{for } x\in[0,n+1], \tag{27}$$

in which $\widehat{V}_t^{AD}[x,h^B]$ (respectively $\widehat{V}_t^{BL}[x,h^A]$) is skillful type A dictator's (type B lieutenant's) expected lifetime utility in the mutual conflict equilibrium when the high-skilled type B lieutenant has dealt consecutively with $x\in[0,n+1]$ shocks.

5. The Results for an Unstable Authoritarian Regime

5.1 The Theoretical Results for an Unstable Authoritarian Regime

After proving the conditions for stability, now we prove the conditions for three instability outcomes in authoritarian politics: purges, coups, and civil war.

5.1.1 The necessary and sufficient condition for the n purge equilibrium

Substituting the high-skilled type A dictator's expected equilibrium lifetime utility in the n purging equilibrium in equation (13) into Bellman equation (1), the necessary and sufficient condition for a the dictator to launch a purge when the high-skilled type B lieutenant has dealt consecutively with n shocks, $S_{t*}^{AD}(n)=1$, is given by

$$\overline{V}_t^{AD}[n,h^B,S_{t*}^{AD}(n)=1]\geq u^D+\max\delta\{p(a)V_{t+1}^{AD}[0,h^B]+p(b)V_{t+1}^{AD}[n+1,h^B]\}. \tag{28}$$

Combining inequality (28) with equations (16), (22) and (24) when $x=n$, we have the following proposition.

Proposition 2: There exists a unique pure strategy n purging equilibrium, in which the type A dictator will purge the high-skilled type B lieutenant as long as the latter has dealt consecutively with n shocks, $S_{t*}^{AD}(n)=1$, if and only if the exogenous parameters of the model satisfy inequalities

$$\overline{V}_t^{AD}[n,h^B,S_{t*}^{AD}(n)=1]\geq\overline{V}_t^{AD}[n,h^B,S_{t*}^{AD}(n+1)=1],$$

$$\overline{V}_t^{AD}[n, h^B, S_{t*}^{AD}(n)=1] \geq \underline{V}_t^{AD}[n, h^B, S_{t*}^{BL}(n+1)=1]$$

and

$$\overline{V}_t^{AD}[n, h^B, S_{t*}^{AD}(n)=1] \geq \underline{V}_t^{AD}[n, h^B, S_{t*}^{BL}(n+2)=1].$$

In essence, the dictator will purge the lieutenant after the lieutenant resolves n shocks if the dictator is unwilling to abdicate after the lieutenant resolves $n+1$ or $n+2$ shocks and also is unwilling to carry out a purge after the lieutenant has resolved $n+1$ shocks.[19]

5.1.2 The necessary and sufficient condition for the $n+1$ purge equilibrium

When inequality $\overline{V}_t^{AD}[n, h^B, S_{t*}^{AD}(n)=1] \leq \overline{V}_t^{AD}[n, h^B, S_{t*}^{AD}(n+1)=1]$ holds, proposition 2 implies that a high-skilled type A dictator will not purge a high-skilled type B lieutenant when he has dealt consecutively with n shocks, $S_{t*}^{AD}(n)=0$. Given $S_{t*}^{AD}(n)=0$, substituting high-skilled type A dictator's expected equilibrium lifetime utility in the $n+1$ purging equilibrium in equation (15) into Bellman equation (1), we find that this dictator will launch a purge when a high-skilled type B lieutenant has dealt consecutively with $n+1$ shocks, if and only if

$$\begin{aligned} G(R^A)\left[\begin{array}{c} p(b)\gamma^B \overline{V}_t^{AD}[1, h^B, S_{t*}^{AD}(n+1)=1]+ \\ [p(a)+p(b)(1-\gamma^B)p(w|b)]\overline{V}_t^{AD}[0, \gamma^B, S_{t*}^{AD}(n+1)=1] \end{array}\right] \geq \\ S_{t*}^{BL}(n+1)(1-\delta)^{-1}[1-G(R^A)]u^P + \\ S_{t*}^{BL}(n+1)G(R^A)\left[\begin{array}{c} p(b)\gamma^B \underline{V}_t^{AD}[1, h^B, S_{t*}^{BL}(n+1)=1]+ \\ [p(a)+p(b)(1-\gamma^B)p(w|b)]\underline{V}_t^{AD}[0, \gamma^B, S_{t*}^{BL}(n+1)=1] \end{array}\right]+ \\ [1-S_{t*}^{BL}(n+1)]\left[p(a)\underline{V}_t^{AD}[0, h^B, S_{t*}^{BL}(n+2)=1]+p(b)\underline{V}_t^{AD}[n+2, h^B, S_{t*}^{BL}(n+2)=1]\right] \end{aligned} \quad (29)$$

Substituting $S_{t*}^{BL}(n+1)=0$, equations (15) and (24) with $x=n+1$ into inequality (29) obtains $\overline{V}_t^{AD}[n+1, h^B, S_{t*}^{AD}(n+1)=1] \geq \underline{V}_t^{AD}[n+1, h^B, S_{t*}^{BL}(n+2)=1]$. Finally, considering that a high-skilled type A dictator will definitely purge the high-skilled type B lieutenant after he has dealt consecutively with $n+1$ shocks, according to lemma 5, the best strategy for the lieutenant in the $n+1$ purging equilibrium is not to launch a coup in the same period, $S_{t*}^{BL}(n+1)=0$. Summarizing the above analysis yields the following proposition.

[19] We should recall that after resolving $n+1$ consecutive shocks, the lieutenant may have sufficient political resources to defeat the dictator in the event of a purge.

Proposition 3: The necessary and sufficient conditions for the existence of a pure strategy $n+1$ purging equilibrium, in which the type A dictator will purge a high-skilled type B lieutenant when the latter has dealt consecutively with $n+1$ shocks but still has chosen to do nothing in the same period, $S_{t*}^{AD}(n+1)=1$ and $S_{t*}^{BL}(n+1)=0$, are given by

$$\overline{V}_t^{AD}[n,h^B,S_{t*}^{AD}(n)=1]\le\overline{V}_t^{AD}[n,h^B,S_{t*}^{AD}(n+1)=1]$$

and

$$\overline{V}_t^{AD}[n+1,h^B,S_{t*}^{AD}(n+1)=1]\ge\underline{V}_t^{AD}[n+1,h^B,S_{t*}^{BL}(n+2)=1].$$

According to proposition 3, the dictator will carry out a purge after the lieutenant has resolved $n+1$ shocks if the dictator does not carry out a purge after the lieutenant resolves n shocks and does not want the prospect of a successful coup after the lieutenant resolves $n+2$ shocks.

5.1.3 The necessary and sufficient condition for the $n+1$ coup equilibrium

Substituting the high-skilled type B lieutenant's expected equilibrium lifetime utility in the $n+1$ coup equilibrium in equation (19) into Bellman equation (5), this lieutenant will launch a coup after he has dealt consecutively with $n+1$ shocks, but the dictator does not launch a purge in the same period, $S_{t*}^{BL}(n+1)=1$ and $S_{t*}^{AD}(n+1)=0$, if and only if

$$\begin{aligned}&G(R^B)\{[p(b)+p(a)p(w|a)(1-\gamma^A)]V_{t+1}^{BD}[0,\gamma^A]+p(a)\gamma^A V_{t+1}^{BD}[1,h^A]\}\ge\\&(1-S_{t*}^{AD}(n+1))\left\{p(b)\underline{V}_{t+1}^{BL}[n+2,h^A,S_{t*}^{BL}(n+2)=1]+p(a)\underline{V}_{t+1}^{BL}[0,h^A,S_{t*}^{BL}(n+2)=1]\right\}\quad(30)\\&+S_{t*}^{AD}(n+1)\left\{\begin{array}{c}(1-\delta)^{-1}[1-G(R^B)]u^P+\\G(R^B)\{[p(b)+p(a)p(w|a)(1-\gamma^A)]V_{t+1}^{BD}[0,\gamma^A]+p(a)\gamma^A V_{t+1}^{BD}[1,h^A]\}\end{array}\right\}\end{aligned}$$

Substituting $S_{t*}^{AD}(n+1)=0$, equations (19) and (23) with $x=n+1$ give $\underline{V}_t^{BL}[n+1,h^A,S_{t*}^{BL}(n+1)=1]\ge\underline{V}_t^{BL}[n+1,h^A,S_{t*}^{BL}(n+2)=1]$. Since the skillful type B lieutenant will definitely launch a coup when he has dealt consecutively with $n+1$ shocks, according to lemma 5, the best strategy for the dictator in the $n+1$ purging equilibrium is not to launch a purge, $S_{t*}^{AD}(n+1)=0$. Furthermore, when inequality $\overline{V}_t^{AD}[n,h^B,S_{t*}^{AD}(n)=1]\le\underline{V}_t^{AD}[n,h^B,S_{t*}^{BL}(n+1)=1]$ holds, proposition 2 implies that a skillful type A dictator will not launch a purge when the high-skilled type B lieutenant has dealt consecutively with n shocks. Summarizing the above analysis, we have the following proposition.

Proposition 4: The necessary and sufficient conditions for the existence of a pure strategy $n+1$

coup equilibrium, in which the skillful type B lieutenant will launch a coup when he has dealt consecutively with $n+1$ shocks, but the skillful type A dictator will choose to do nothing in the same period, $S_{t*}^{AD}(n+1)=0$ and $S_{t*}^{BL}(n+1)=1$, are given by

$$\underline{V}_t^{BL}[n+1,h^A,S_{t*}^{BL}(n+1)=1]\geq \underline{V}_t^{BL}[n+1,h^A,S_{t*}^{BL}(n+2)=1]$$

and

$$\overline{V}_t^{AD}[n,h^B,S_{t*}^{AD}(n)=1]\leq \underline{V}_t^{AD}[n,h^B,S_{t*}^{BL}(n+1)=1].$$

In other words, because the lieutenant does not want to wait until he has resolved $n+2$ shocks to launch a coup, and the dictator does not carry out a purge after the lieutenant resolves n and $n+1$ shocks, there will be a pure strategy $n+1$ coup equilibrium in which the lieutenant will launch the coup without opposition from the dictator.

5.1.4 The necessary and sufficient condition for the $n+2$ coup equilibrium

In the $n+2$ coup equilibrium, neither the skillful type A dictator nor the skillful type B lieutenant changes the status quo, except in the period in which the type B lieutenant has dealt consecutively with $n+2$ shocks, $S_{t*}^{AD}(n)=0$, $S_{t*}^{AD}(n+1)=0$, $S_{t*}^{BL}(n+1)=0$, $S_{t*}^{BL}(n+2)=1$. Therefore, we have the following proposition.

Proposition 5: The necessary and sufficient conditions for the existence of a unique pure strategy $n+2$ coup equilibrium, in which the skillful type A dictator will choose to abdicate when the skillful type B lieutenant launches a coup after consecutively dealing with $n+2$ shocks, are given by

$$\overline{V}_t^{AD}[n,h^B,S_{t*}^{AD}(n)=1]\leq \underline{V}_t^{AD}[n,h^B,S_{t*}^{BL}(n+2)=1],$$
$$\overline{V}_t^{AD}[n+1,h^B,S_{t*}^{AD}(n+1)=1]\leq \underline{V}_t^{AD}[n+1,h^B,S_{t*}^{BL}(n+2)=1]$$

and

$$\underline{V}_t^{BL}[n+1,h^A,S_{t*}^{BL}(n+1)=1]\leq \underline{V}_t^{BL}[n+1,h^A,S_{t*}^{BL}(n+2)=1].$$

The intuition behind proposition 5 is very simple. Because the dictator does not carry out a purge prior to the lieutenant resolving $n+2$ shocks, and the lieutenant does not risk launching a coup until he has resolved $n+2$ shocks, the dictator knows clearly that he cannot win in a contest with the lieutenant and will abdicate when the lieutenant launches the coup after resolving $n+2$ shocks.

5.1.5 The necessary and sufficient condition for the mutual conflict equilibrium

Since there is no pure strategy, but a mixed strategy, equilibrium in the mutual conflict between dictator and lieutenant if $u^P > 0$, we denote the probability that the type A dictator will purge the lieutenant as P_t^{AD} and the probability that the type B lieutenant will launch a coup as P_t^{BL} in the mutual conflict equilibrium. Given the probability that the type B lieutenant will launch a coup in the mutual conflict equilibrium, the type A dictator's expected lifetime utility when she does not launch a purge in the same period is given by

$$(1-P_t^{BL})\underline{V}_t^{AD}[n+1,h^B,S_{t*}^{BL}(n+2)=1]+P_t^{BL}\underline{V}_t^{AD}[n+1,h^B,S_{t*}^{BL}(n+1)=1],$$

and the type A dictator's expected lifetime utility when she launches a purge in the same period is $\widehat{V}_t^{AD}[n+1,h^B]$ in equation (26). As the dictator is indifferent about changing the status in the mutual conflict equilibrium, we must have

$$\begin{aligned}(1-P_t^{BL})\underline{V}_t^{AD}[n+1,h^B,S_{t*}^{BL}(n+2)=1]+P_t^{BL}\underline{V}_t^{AD}[n+1,h^B,S_{t*}^{BL}(n+1)=1]\\ =\widehat{V}_t^{AD}[n+1,h^B]=\overline{V}_t^{AD}[n+1,h^B,S_{t*}^{AD}(n+1)=1]\end{aligned} \quad (31)$$

Substituting equations (15), (21) and (24) into equation (31) gives the probability that the type B lieutenant will launch a coup, P_t^{BL}, in the mutual conflict equilibrium.

$$P_t^{BL}=\frac{\overline{V}_t^{AD}[n+1,h^B,S_{t*}^{AD}(n+1)=1]-\underline{V}_t^{AD}[n+1,h^B,S_{t*}^{BL}(n+2)=1]}{\overline{V}_t^{AD}[n+1,h^B,S_{t*}^{AD}(n+1)=1]-\underline{V}_t^{AD}[n+1,h^B,S_{t*}^{BL}(n+1)=1]+\delta(1-\delta)^{-1}[1-G(R^A)]u^P}. \quad (32)$$

From equation (32), we know that P_t^{BL} will be the unique probability that the type B lieutenant will launch a coup in the mutual conflict equilibrium if and only if

$$\overline{V}_t^{AD}[n+1,h^B,S_{t*}^{AD}(n+1)=1]\geq\underline{V}_t^{AD}[n+1,h^B,S_{t*}^{BL}(n+2)=1].$$

Given the probability that the type A dictator will launch a purge in the mutual conflict equilibrium, the type B lieutenant's expected lifetime utility when he does not launch a coup in the same period is given by

$$(1-P_t^{AD})\underline{V}_t^{BL}[n+1,h^A,S_{t*}^{BL}(n+2)=1]+P_t^{AD}\overline{V}_t^{BL}[n+1,h^A,S_{t*}^{AD}(n+1)=1],$$

and the type B lieutenant's expected lifetime utility when he launches a coup in the same period is $\widehat{V}_t^{BL}[n+1,h^A]$ in equation (27). As the lieutenant is indifferent regarding changing the status in the mutual conflict equilibrium, we must have

$$\begin{aligned}(1-P_t^{AD})\underline{V}_t^{BL}[n+1,h^A,S_{t*}^{BL}(n+2)=1]+P_t^{AD}\overline{V}_t^{BL}[n+1,h^A,S_{t*}^{AD}(n+1)=1]\\ =\widehat{V}_t^{BL}[n+1,h^A]=\underline{V}_t^{BL}[n+1,h^A,S_{t*}^{BL}(n+1)=1]\end{aligned} \quad (33)$$

Substituting equations (17), (19), and (23) into equation (33) obtains the probability that the type A dictator will launch a purge, P_t^{AD}, in the mutual conflict equilibrium.

$$P_t^{AD} = \frac{\underline{V}_t^{BL}[n+1, h^A, S_{t*}^{BL}(n+1)=1] - \underline{V}_t^{BL}[n+1, h^A, S_{t*}^{BL}(n+2)=1]}{\underline{V}_t^{BL}[n+1, h^A, S_{t*}^{BL}(n+1)=1] - \underline{V}_t^{BL}[n+1, h^A, S_{t*}^{BL}(n+2)=1] + \delta(1-\delta)^{-1}[1-G(R^B)]u^P}. \quad (34)$$

From equation (34), we know that P_t^{AD} could be the unique probability that the type A dictator will launch a purge in the mutual conflict equilibrium if and only if

$$\underline{V}_t^{BL}[n+1, h^A, S_{t*}^{BL}(n+1)=1] \geq \underline{V}_t^{BL}[n+1, h^A, S_{t*}^{BL}(n+2)=1].$$

Finally, when inequality $\overline{V}_t^{AD}[n, h^B, S_{t*}^{AD}(n)=1] \leq \underline{V}_t^{AD}[n, h^B, S_{t*}^{BL}(n+1)=1]$ holds, proposition 2 implies that a skillful type A dictator will not launch a purge when the high-skilled type B lieutenant has dealt consecutively with n shocks. Summarizing the above analysis, we have the following proposition.

Proposition 6: (i) The necessary and sufficient conditions for the existence of a unique mutual conflict equilibrium in the period in which the type B lieutenant has dealt consecutively with $n+1$ shocks are given by

$$\overline{V}_t^{AD}[n, h^B, S_{t*}^{AD}(n)=1] \leq \underline{V}_t^{AD}[n, h^B, S_{t*}^{BL}(n+1)=1]$$

$$\overline{V}_t^{AD}[n+1, h^B, S_{t*}^{AD}(n+1)=1] \geq \underline{V}_t^{AD}[n+1, h^B, S_{t*}^{BL}(n+2)=1]$$

and

$$\underline{V}_t^{BL}[n+1, h^A, S_{t*}^{BL}(n+1)=1] \geq \underline{V}_t^{BL}[n+1, h^A, S_{t*}^{BL}(n+2)=1].$$

(ii) Moreover, if the purged lieutenant (the dethroned dictator) who did not choose to change the status quo still could enjoy all future utility as a latent/potential elite—i.e., $u^P > 0$—the unique equilibrium probability that the lieutenant and the dictator will change the status quo in the mutual conflict equilibrium is given by equations (32) and (34), respectively.[20]

A comparative static analysis of equations (32) and (34) with respect to u^P yields the following proposition.

Proposition 7: If the purged lieutenant (the dethroned dictator) who did not choose to change the status quo still could enjoy all future utility as a latent/potential elite—i.e., $u^P > 0$—then the equilibrium probability that the dictator and the lieutenant will change the status quo in the mutual conflict equilibrium is a strictly decreasing function of u^P—i.e., $\partial P_t^{AD} / \partial u^P < 0$ and

[20] When $u^P = 0$, equations (32) and (34) imply that there is only a pure strategy equilibrium in the mutual conflict.

$\partial P_t^{BL} / \partial u^P < 0$.

Proof. It is obvious from proposition 3 that the denominator of the RHS of equation (34) is a linear function of u^P with a positive intercept and a negative slope. Therefore, the RHS of equation (34) is a strictly increasing function of u^P, which further implies that the equilibrium probability that the dictator will change the status quo in the mutual conflict equilibrium is a strictly decreasing function of u^P—i.e., $\partial P_t^{AD} / \partial u^P < 0$. By the same logic, we could prove the equilibrium probability that the lieutenant will change the status quo in the mutual conflict equilibrium is a strictly decreasing function of u^P—i.e., $\partial P_t^{BL} / \partial u^P < 0$. *Q.E.D.*

According to proposition 7, we know that the lower the future utility the purged lieutenant (the dethroned dictator) who did not choose to change the status quo still can enjoy, the higher the probability of a mutual conflict equilibrium—i.e., civil war. Moreover, when the purged lieutenant (the dethroned dictator) who did not choose to change the status quo still can enjoy all future utility as a latent/potential elite—i.e., $u^P > 0$—and a mutual conflict between the dictator and the lieutenant occurs, proposition 3 implies that the dictator's best response is to carry out a purge if the lieutenant chooses not to change the status quo; and proposition 4 implies that the lieutenant's best response is to launch a coup if the dictator chooses not to change the status quo. Therefore, according to lemma 5, we have the following corollary.

Corollary 1: When the purged lieutenant (the dethroned dictator) who did not choose to change the status quo still can enjoy all future utility as a latent/potential elite—i.e., $u^P > 0$—and there exists a mutual conflict equilibrium between the dictator and the lieutenant in the period in which the lieutenant has dealt consecutively with $n+1$ shocks, then there also exist two pure strategy equilibria in the same period. In each pure strategy equilibrium, only one player will change the status quo with certainty, while the other player will do nothing.

5.2 Numerical Results for an Unstable Authoritarian Regime

We now undertake a numerical analysis to investigate the impact of the changing exogenous parameter values on the dictator's and the lieutenant's political actions, as well as the equilibrium outcomes of the game. Similar to our numerical analysis of the stable authoritarian regime, we set the key parameters as $n = 2$, $u^D = 100$, and $\delta = 0.95$. Unlike our numerical analysis for

authoritarian stability, for which we were concerned only with the conditions for deviation from the status quo, our model can predict various outcomes under the rubrics of instability. However, the emergence of instability in its various forms is much more complicated. We explore this below.

5.2.1 The Impact of the Frequency of Shock a, $p(a)$, on Political Stability

First, we assess how the changing probability of shock a, $p(a)$, changes the two actors' political actions and the equilibrium outcomes of the game, especially after the type B lieutenant has resolved two consecutive type b shocks. Contrary to our expectations, higher $p(a)$ can, under certain circumstances, lead to a complacent dictatorship, which opens the way to a coup or even a civil war.

Table 2: Benchmark Instability: Expected Actions of the Dictator and Lieutenant as $p(a)$ Rises from 0 to 1

The range of $p(a)$	[0, 0.564422]	[0.564422,1]
The dictator's action	The type A dictator purges a high-skilled type B lieutenant after the latter has dealt with 3 consecutive shocks	The type A dictator will never purge a high-skilled type B lieutenant
The lieutenant's action	The skillful type B lieutenant launches a coup when he has dealt with 4 consecutive shocks	
The equilibrium outcomes of the game	The skillful type B lieutenant will retire when he has dealt with 3 consecutive shocks	The type A dictator will retire when the high-type B lieutenant has dealt with 4 consecutive shocks
The values of the other parameters	$\gamma^B = 0.5$; $\gamma^A = 0.8$; $p(w\|b) = 0.5$; $p(w\|a) = 0.5$; $G(R^A) = 0.85$; $G(R^B) = 0.75$; $u^L = 45$; $u^P = 1$.	

Table 2 displays a common scenario for instability. In this scenario, the conditional probabilities of both shock a and shock b being strong are set at 0.5, while the lieutenant's instantaneous payoff in each turn is 45% that of the dictator, $u^L = 45$. At the same time, the lieutenant's initial endowment of political resources is lower, at 0.75, than the dictator's, at 0.85. Even if the lieutenant has dealt consecutively with $n+1$ shocks, the dictator will still triumph in a fight with the lieutenant. This scenario resembles several historical cases of fearsome lieutenants who, nevertheless, were weaker than the dictator. These include Lin Biao, Himmler, and Stalin prior to Lenin's death.

When $p(a)$ is below 0.564422, the type A dictator has a high incentive to preemptively

purge the type B lieutenant after the lieutenant has resolved three consecutive shocks. Recall that we have set n, the threshold for the lieutenant resolving consecutive crises, above which the dictator cannot be sure of victory, at two—$n=2$ in the numerical analysis. Thus, after the lieutenant has resolved three consecutive shocks, the dictator is taking a risk in purging him because he may defeat the dictator. Still, because low $p(a)$ means high $p(b)$, which can bestow additional resources on the high-skilled type B lieutenant, the type A dictator wants to eliminate the rising lieutenant before he can overthrow the dictator with certainty after four shocks. When $p(a)$ is above 0.564422, however, the dictator will refrain from purging the lieutenant, even after the lieutenant has resolved three shocks ($n+1$ in this scenario), thus paving the way for the lieutenant to launch a successful coup after resolving four shocks consecutively. Why is the dictator so *negligent* in this case? Because the initial political resources for the type B lieutenant, R^B, are private information, the dictator, who has a formidable 85th percentile in initial resources, $G(R^A)=0.85$, becomes confident that she will win in a political struggle. At the same time, when $p(a)$ increases, $p(b)$ also falls, which means that the type B lieutenant's ability to accumulate political resources through resolving shocks is lower, thus putting the dictator at ease. When the lieutenant actually resolves four consecutive shocks and can successfully launch a coup with certainty, the dictator is caught unprepared. Given the rich pool of elites with skill A, $\gamma^A=0.8$, and the lieutenant's higher-than-median initial political resources, $G(R^B)=0.75$, it was worthwhile for the type B lieutenant to launch a coup, even with a high probability of shock a.

In the next scenario, we see that information asymmetry about the initial level of political resources can lead to even more dire outcomes for the regimes as $p(a)$ changes. In Table 3, we make two minor adjustments to the scenario we presented in Table 2. In Table 3, we raise the conditional probability of a weak shock a, $p(w|a)$, from 0.5 to 0.9. We also increase the initial political resources of the type B lieutenant, $G(R^B)$, from 0.75 to 0.95. By making these adjustments, the type B lieutenant needs the type A dictator even less, while the dictator's information asymmetry about the lieutenant is exacerbated by the exceptional level of initial political resources that the lieutenant enjoys.

Table 3: Dictator's Negligence Leading to Potential Coup and Civil War: Expected Actions of the Dictator and Lieutenant as $p(a)$ Rises from 0 to 1

The range of $p(a)$	[0, 0.16617]	[0.16617, 0.564422]	[0.564422,1]
The dictator's action	Type A dictator purges a high-skilled type B lieutenant after the latter has dealt with 3 consecutive shocks		Type A dictator will never purge a high-skilled type B lieutenant
The lieutenant's action	High-skilled type B lieutenant launches a coup when he has dealt with 4 consecutive shocks	Skillful type B lieutenant launches a coup when he has dealt with 3 consecutive shocks	
The equilibrium outcomes of the game	The type A dictator falls from power, replaced by a high-skilled type B lieutenant after he has dealt with 4 consecutive shocks	Civil war erupts with some probability, resulting in the dictator's fall after the type B lieutenant has dealt with 3 consecutive shocks	Type A dictator will retire when type B lieutenant launches a coup after dealing with 3 consecutive shocks
Other parameters	$\gamma^B = 0.5$; $\gamma^A = 0.8$; $p(w\|b) = 0.5$; $p(w\|a) = 0.9$; $G(R^A) = 0.85$; $G(R^B) = 0.95$; $u^L = 45$; $u^P = 1$.		

Similar to the scenario presented in Table 2, the dictator will purge the lieutenant when $p(a)$ is below 0.564422. However, above this threshold, the dictator will not do so due to the expectation that the type B lieutenant's ability to accumulate political resources through resolving shocks will decrease as $p(a)$ increases. Meanwhile, given the unusually high level of initial political resources, $G(R^B) = 0.95$, the rich pool of latent elites with skill A, $\gamma^A = 0.8$, and the high probability of weak shock type a, $p(w|a) = 0.9$, the type B lieutenant will be highly motivated to change the status quo. As Table 3 shows, when $p(a)$ is below 0.16617, the type B lieutenant will wait until after resolving four shocks consecutively before launching a coup. Following Assumption 1, after resolving four consecutive shocks, the lieutenant can defeat the dictator with 100% certainty. However, as $p(a)$ rises, the type B lieutenant is motivated to act even sooner after dealing with three consecutive shocks, when victory is not yet certain. Thus, when $p(a)$ is in the range $p(a) \in [0.16617, 0.564422]$, both the dictator and the lieutenant will act with some probability, leading to the possibility of a civil war.

Unbeknownst to the type A dictator *ex ante*, the type B lieutenant's high level of initial resources means that after resolving three shocks consecutively, the type B lieutenant can defeat

the type A dictator regardless of the dictator's actions. As Table 3 shows, even when the dictator tries to purge the lieutenant after he has resolved three consecutive shocks, she fails to unseat the lieutenant and is, in fact, brought down by the failed coup. When both the dictator and the lieutenant fight, the outcome also brings about total loss to the dictator, although such civil conflict presumably damages the regime much more. When the dictator neglects to purge the lieutenant immediately after he has resolved two consecutive shocks, her best outcome is retirement after a coup.

Obviously, for any authoritarian regime, civil war is a fatal, or at least very destructive, outcome. Therefore, we focus on the range in which $p(a)$ lies between 0.16617 and 0.564422, where both the type A dictator and the type B lieutenant will act with some probability. For both actors, starting a conflict after the lieutenant has resolved 3 $(n+1)$ consecutive shocks is a mixed strategy equilibrium. Following Corollary 1, there also exist two pure strategy equilibria in the same period. In each pure strategy equilibrium, only one player will act with certainty, while the other player will do nothing. Plugging in all the other assumed parameters in this scenario, Figure 4 depicts the probability of the type A dictator carrying out a purge in the conflict, P_*^{AD}, as $p(a)$ rises, while Figure 5 shows the probability of the type B lieutenant launching a coup in the conflict, P_*^{BL}, as $p(a)$ increases.

As one can see in Figures 4 and 5, when $p(a)$ is just above 0.166176, the type A dictator has a relatively low probability of carrying out a purge, while the type B lieutenant is all but certain to launch a coup. In contrast, when $p(a)$ is just below 0.564422, the dictator will carry out a purge with high certainty, while the lieutenant has a low probability of launching a coup. When $p(a)$ is between 0.3 and 0.4, however, both sides have a high probability of fighting, thus making civil war a probable outcome after the type B lieutenant has resolved three consecutive shocks.

Figure 4: The Probability of the Type A Dictator Carrying out a Purge During a Conflict as $p(a)$ Rises

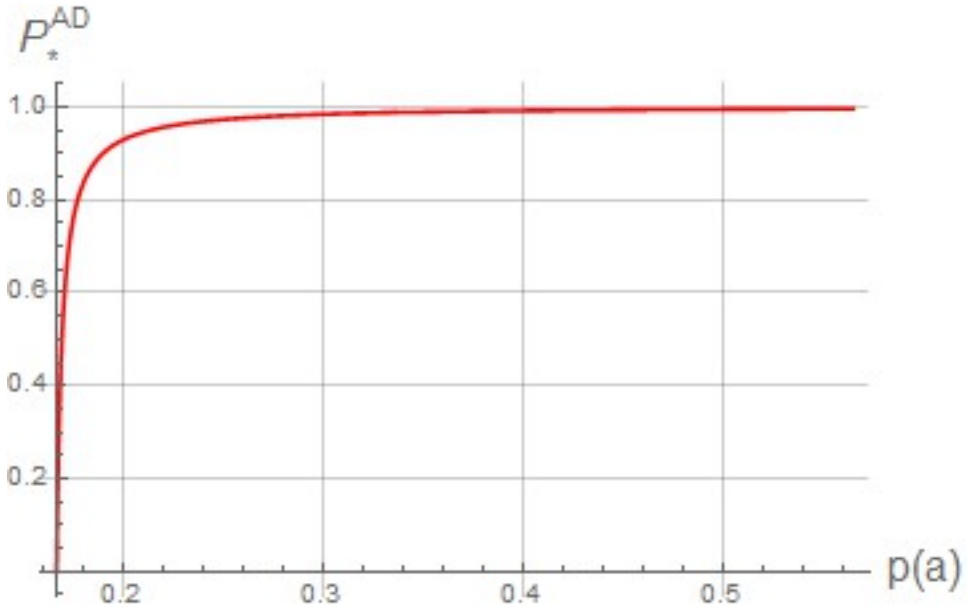
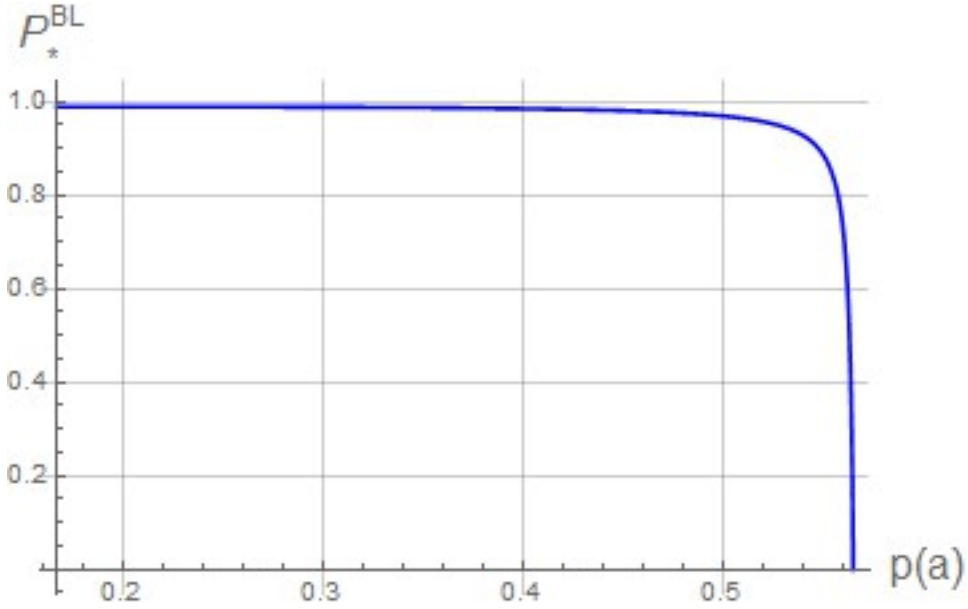


Figure 5: The Probability of the Type B Lieutenant Initiating a Coup During a Conflict as $p(a)$ Rises



5.2.2 The Impact of Instantaneous Payoffs to the Lieutenant, u^L, and to the Latent Elite, u^P, on Political Stability

We explore how different levels of instantaneous payoffs to the lieutenant u^L and to the latent elite u^P affect authoritarian instability. The literature has long pointed out that sharing spoils with members of the ruling coalition constitutes a central factor in determining authoritarian stability (Svolik, 2012b; Svolik, 2009; Bueno de Mesquita et al., 2003; Myerson, 2008). Interestingly, we find that when the lieutenant's initial level of political resources is unusually high, increasing u^L is not necessarily going to introduce much more authoritarian stability. However, elevating the retirement benefit of the purged dictator or lieutenant, u^P, has the potential of increasing the odds of stability, at least to the extent that civil war becomes a highly unlikely outcome.

In Table 4, we raise the lieutenant's instantaneous payoff to 60, u^L=60, but otherwise leave most other values of the parameters at reasonable levels. We again set n, the maximum number of consecutive shocks that the lieutenant can resolve without challenging the dictator's power, at 2, $n=2$. We also set the lieutenant type B's initial political resources at a high level, $G(R^B)$=0.95, while the pool of high-skilled type A elites also are relatively rich with γ^A=0.8. The analysis in Table 4 shows that when the lieutenant's initial political resources are high, he is emboldened to launch coups with most values of $p(a)$, even if his payoff is 60% that of the dictator's, u^L=60. Table 4 also displays the ability of this model to generate a range of possible outcomes in authoritarian politics, ranging from perpetual stability to purges and coups to civil war.

In Table 4, when $p(a)$ is below 0.309948, the type A dictator is motivated to purge the lieutenant even after he has resolved two shocks consecutively. This is because the dictator realizes that given low $p(a)$, which also means a high probability of shock b, the type B lieutenant can quickly accumulate power, which motivates the dictator to preemptively purge the lieutenant. As $p(a)$ rises, the type A dictator is first willing to wait another turn before purging the lieutenant, and then might even refrain from ever purging the lieutenant. Even when $p(a)$ is just above 0.367482, the type A dictator refrains from purging the type B lieutenant because the dictator does not expect the lieutenant to be motivated to successfully launch a coup given the dictator's own initial political resources and the 50% chance that shock a is a strong one, $p(w|a)$ = 0.5, thus

making the dictator necessary to the lieutenant. If the dictator has the misfortune of running into a type B lieutenant with an unusually high level of initial political resources, the lieutenant will be highly motivation to launch a coup even as $p(a)$ rises and his ability to accumulate power diminishes. Thus, when $p(a)$ ranges between 0.312626 and 0.367482, both sides may act after the lieutenant has resolved three consecutive shocks, possibly giving rise to a civil war. When $p(a)$ is above 0.755403, it becomes too risky for the type B lieutenant to eradicate the dictator, only to face a 37.77% chance of a strong shock a, which requires the high skill of a type A elite to resolve. Drawing from the pool would be too risky, especially given that the lieutenant's payoff is 60% that of the dictator. Thus, when shock a becomes likely, the type B lieutenant also refrains from initiating a coup, thus introducing perpetual stability to the regime.

Table 4: A Highly Paid, High-power Lieutenant: Expected Actions of the Dictator and Lieutenant as $p(a)$ Rises from 0 to 1

The range of $p(a)$	[0,0.309948]	[0.309948,0.312626]	[0.312626,0.367482]	[0.367482, 0.666995]	[0.666995,0.755403]	[0.755403,1]
The dictator's action	Type A dictator purges a skillful type B lieutenant after the latter has dealt consecutive-ly with 2 shocks	Type A dictator purges a skillful type B lieutenant after the latter has dealt consecutively with 3 shocks		Type A dictator will never purge a skillful type B lieutenant		
The lieutenant's action	Skillful type B lieutenant launches a coup when he has dealt consecutively with 4 shocks		Skillful type B lieutenant launches a coup when he has dealt consecutively with 3 shocks		Type B lieutenant launches a coup when he has dealt consecu-tively with 4 shocks	Skillful type B lieutenant will never launch a coup
The equilibri-um outcomes of the game	Type A dictator successfully forces type B lieutenant into retirement after the latter has dealt with *2* consecu-tive shocks	Type A dictator fails to purge and will fall from power after the lieutenant has dealt with 3 consecu-tive shocks	Civil war erupts when the lieutenant has dealt with 3 consecutive shocks	Type A dictator will retire when the type B lieutenant has dealt with 3 consecutive shocks and launches a coup	Type A dictator will retire when type B lieutenant launches a coup after dealing with 4 consecu-tive shocks	Perpetual stability: neither side changes the status quo through all shocks
Other parameters	$\gamma^B = 0.5$; $\gamma^A = 0.8$; $p(w\|b) = 0.5$; $p(w\|a) = 0.5$; $G(R^A) = 0.65$; $G(R^B) = 0.95$; $u^L = 60$; $u^P = 1$.					

In the following analysis, we adjust the instantaneous payoff of the latent elite, including both

former dictators and lieutenants forced into retirement by coups or purges. Holding all other parameters the same as in Table 4, Table 5 presents the results when the latent elite's payoffs, u^P, are increased to 20 or to 20% of the benefits enjoyed by the dictator.

When the payoff of the latent or retired elite is raised, the most interesting result is that even when $p(a)$ is low and $p(b)$ is high, the type A dictator has no incentive to undertake the risky action of purging a lieutenant, unlike the scenario in Table 4. In the payoff structure for this game presented in Table 1, as long as the dictator does not initiate a purge of the lieutenant, the worst outcome, aside from being killed by an external shock, will be going into retirement after a successful coup. If the retirement payment is 20% that of the dictator's payoff, $u^P = 20$, Table 5 shows that it simply is not worthwhile for the dictator to risk an unsuccessful purge, which would result in her death. By creating an incentive for the dictator to never purge the lieutenant, increasing retirement payoffs have the effect of eliminating civil war as a possible outcome since civil war, by definition, requires both the dictator and the lieutenant to initiate hostile action.

Because of the lieutenant's relatively high level of initial political resources, $G(R^B) = 0.95$, he still will carry out a coup after successfully resolving three consecutive shocks. However, because the dictator will not fight back, these tend to be "bloodless coups," which may be minimally disruptive to the regime. Similar to the equilibrium outcome in Table 4, when $p(a)$ is above 0.755403, neither the dictator nor the lieutenant will act, resulting in stable authoritarian rule. Again, the reason for the type B lieutenant to maintain the status quo is that given $p(w|a) = 0.5$, $p(a)$ above 0.755403 means at least a 37.77% probability of a strong shock a for all future periods. The type B lieutenant is better off having the dictator stay than risking regime destruction if a low-skilled type A lieutenant is chosen to deal with strong shock a.

Table 5: The Khrushchev Scenario: Expected Actions of the Dictator and Lieutenant as $p(a)$ Rises from 0 to 1

The range of $p(a)$	[0,0.312626]	[0.312626,0.666995]	[0.666995,0.755403]	[0.755403,1]
The dictator's action	The type A dictator will never purge a high-skilled type B lieutenant			
The lieutenant's action	Skillful type B lieutenant launches a coup when he has dealt with 4 consecutive shocks	Skillful type B lieutenant launches a coup when he has dealt with 3 consecutive shocks	Skillful type B lieutenant launches a coup when he has dealt with 4 consecutive shocks	Skillful type B lieutenant will never launch a coup
The equilibrium outcomes of the game	A coup forces the dictator to retire when the high-skilled type B lieutenant launches a coup upon dealing with 4 consecutive shocks	A coup forces the dictator to retire when the high-skilled type B lieutenant launches a coup upon dealing with 3 consecutive shocks	A coup forces the dictator to retire when the high-skilled type B lieutenant launches a coup upon dealing with 4 consecutive shocks	Stable Authoritarian Regime
Other parameters	$\gamma^B = 0.5$; $\gamma^A = 0.8$; $p(w\|b) = 0.5$; $p(w\|a) = 0.5$; $G(R^A) = 0.65$; $G(R^B) = 0.95$; $u^L = 60$; $u^P = 20$.			

5.2.3 The Impact of *ex ante* Probability of Type B Potential Elite Being High-skilled, γ^B, on Political Stability

When the dictator considers whether or not to purge a lieutenant with a different skill set, she must consider the pool of talent with the same skills as the purge target. If the lieutenant's skills are sufficiently unique, and shocks for which such skills are useful become common enough, the dictator's best course of action may be not to purge the lieutenant. Indeed, our analysis in Table 6 shows that when all other parameters are set at a reasonable level—including slightly lower initial political resources for the lieutenant than for the dictator—the type A dictator will not purge the type B lieutenant when γ^B is below 0.4228. That is, if after purging the type B lieutenant, the dictator were to have less than a 42.28% chance of drawing a high-skilled type B lieutenant as his replacement, the type A dictator would rather risk cultivating a powerful lieutenant by leaving him in place. At the same time, the chance of encountering a strong shock a, $p(a,s) = p(s|a)p(a)$, is 25% for all future periods. Given that unsuccessful resolution of a strong shock leads to regime collapse, the dictator would opt for keeping the lieutenant.

To be sure, as γ^B rises, the type A dictator's best course of action also changes. When γ^B is between 0.4228 and 0.809202, the dictator will purge the type B lieutenant after he has successfully dealt with three consecutive shocks. If the pool of talent with type B skills is plentiful, with γ^B above 0.809202, the type A dictator will purge the lieutenant after he has successfully resolved two consecutive shocks, lest the lieutenant become too powerful in future periods. Interestingly, this analysis implies that not only dictators have an incentive to eliminate those with skills similar to their own; lieutenants also have an incentive to eliminate those with similar skill sets. Thus, when followers of leaders engage in bloody rivalries, the ultimate target may be the dictator. If a crafty lieutenant manages to eliminate rivals with similar skills, he can prevent the dictator from purging him, thus paving the way for the lieutenant to accumulate enough power to unseat the dictator.

Table 6: Scarce Talent: Expected Actions of the Dictator and Lieutenant as γ^B Rises from 0 to 1

The range of γ^B	[0,0.4228]	[0.4228,0.809202]	[0.809202,1]
The dictator's action	Type A dictator will never purge a high-skilled type B lieutenant	Type A dictator purges a high-skilled type B lieutenant after the latter has dealt with 3 consecutive shocks	The type A dictator purges a high-skilled type B lieutenant after the latter has dealt with 2 consecutive shocks
The lieutenant's action	Skillful type B lieutenant launches a coup after he has dealt with 4 consecutive shocks		
The equilibrium outcomes of the game	Type A dictator will retire when the high-skilled type B lieutenant launches a coup after dealing with 4 consecutive shocks	Type B lieutenant will retire when he has dealt with 3 consecutive shocks	The high-skilled type B lieutenant will retire when he has dealt with 2 consecutive shocks
Other parameters	$\gamma^A = 0.8$; $p(a)=0.5$; $p(w\|b)=0.5$; $p(w\|a)=0.5$; $G(R^A)=0.85$; $G(R^B)=0.75$; $u^L=45$, $u^P=1$.		

5.3 The Case Study: Diminished Severity of Military Shocks and the Purge of Peng Dehuai

The Chinese Communist Party (CCP) from the 1940s to the 1960s represents a good testing ground for this model. Prior to Communist victory in China and the end of the Korean War, the top leadership, especially Mao, relied heavily on a few highly capable generals who had strong track

records of fighting large-scale conventional battles against well-equipped enemies. After the end of the Korean War and before the escalation of the Sino-Soviet split to armed conflicts, China enjoyed a reprieve from serious threats of conventional attacks by major powers, despite continual skirmishes with the US and its "running dogs" on the Taiwan Straits and in Vietnam. Given the decline in the severity of this threat for over a decade, Mao found it worthwhile to remove a brilliant military commander who had accumulated considerable power, Peng Dehuai. Our model can describe the relationship between Mao and Peng in 1959.

After successfully commanding several major military campaigns for the regime, Peng had accumulated sizable formal and informal power in the Chinese military. While China faced the threat of a direct ground battle with the US, Mao did not dare to remove him from power, despite his repeated disobedience of Mao. However, the threat of a US invasion subsided, and faced with increasingly obvious signs of Peng's ambition, Mao used the opportunity of the 1959 Lushan Conference to remove Peng from power, thus purging a serious contender for power. Had the Korean War not ended or had the Sino-Soviet relationship deteriorated much more by that point, Mao likely would not have removed Peng because he would have needed his military talent. Also, had Peng not been such a brilliant military commander who had brought the US to a standstill, he likely would not have accumulated so much internal authority in the military and in the party, which also might have spared him from Mao's wrath in 1959.

Unlike Mao and many peasant fighters in the early CCP, Peng Dehuai had had formal military training in the Hunan Military Academy and fought for the highly successful National Revolutionary Army in the mid-1920s (Whitson and Huang, 1973: 33). He was already a battalion commander by the time he defected from the KMT to join the CCP in the late 1920s. After joining the CCP as one of its few formally trained military commanders, he had substantial commands during all of the major engagements in the Jiangxi Soviet (Editorial Staff of One Spark Lighting the Plains, 2006). When the Second United Front with the KMT began and the CCP began to fight Japan, Peng was appointed the second in command of the Eighth Route Army, the designation of the main CCP fighting force in 1937 (Saich and Yang, 1996: 667). Despite suffering heavy losses, he shone at fighting the main Japanese invading forces in 1937 in Shanxi Province, in direct contradiction to Mao's wishes of not confronting Japanese forces directly. In 1940, without seeking Mao's approval, Peng again escalated a skirmish with Japanese forces to a large-scale battle in what would be known as the Hundred Regiment Campaign (Saich and Yang, 1996: 859). In 1943, Mao launched a campaign against Peng's "rightist surrenderism" for over a month (Gao, 2000: 621). Nevertheless,

because of the heavy threats faced by the CCP, Peng was back on the battlefield within a couple of months.

After Japan's defeat, Peng led a sizable field army and conquered much of northwestern China for the CCP. The First Field Army commanded by Peng was not a guerilla band of thousands of soldiers, like the one that Mao had led during the second half of the Long March. Rather, the First Field Army began the civil war with around 100,000 troops and, toward the end of the civil war in 1949, had 390,000 troops after absorbing hundreds of thousands of surrendered KMT soldiers (Whitson and Huang, 1973). If anything, Peng's success on the northwestern front against, at times, recalcitrant enemies (Yan Xishan, Ma Bufang) showed that he was capable of handling the logistics of running a sizable modern army.

Thus, it was no surprise that Mao put him in charge of the Chinese "volunteer" force to Korea, which numbered 2.4 million troops, to repel US-led United Nations intervention on the Korean Peninsula. Available evidence suggests that Mao did not feel that he had the option of taking a defensive posture as US forces pushed north along the Chinese-North Korean border. The fear of a US invasion or a prolonged bombing campaign on China staged from North Korea compelled Mao to deploy his best forces, led by his best general, in an offensive posture against approaching US forces in November 1950 (Christenson, 1992). Although suffering heavy losses, the volunteer force under Peng's command fought US troops to a draw, which resulted in the 38th parallel continuing to be the border between North and South Korea. After the July 1953 ceasefire took effect, it was another year before Chinese forces began to deploy back to China. As tensions subsided on the Korean Peninsula, the long redeployment, which took until 1958, began.

In the meantime, although skirmishes continued between UN forces and China, the threat of an all-out war with the US dropped significantly, both objectively and subjectively, for Mao. The US had begun rapprochement with the USSR, and the new US President, Dwight D. Eisenhower, signaled very strongly that he had no intention of reigniting the Korean War without provocation and used the US's nuclear power as an "enticement" to get China to the negotiating table (Keefer, 1986). Also, by 1958, Mao had interpreted emerging civil conflicts in Lebanon and Latin America as important distractions for the American imperialists. As Mao said at the 2nd plenum in 1958, "Instability in the capitalist world is plentiful; in our world, there is little instability; they have deep internal contradiction; we are unified" (Mao 1958). Beyond signaling Mao's ease about America's willingness to invade China in 1958, Mao also did not see the emerging conflict with the USSR as anything to worry about because the socialist world was "unified."

After resolving the potentially catastrophic shock of an all-out war with the US, Peng's position within the Chinese military increasingly consolidated. In September 1954, a national defense committee and the Ministry of Defense were formed. Mao naturally became the head of the committee, but Peng became vice-chair and also, concurrently, Vice-Premier and Minister of Defense, as well as PLA chief of staff. At the same time, the Central Military Commission was formed to take de facto control of the military. Again, Mao chaired the Commission, but Peng Dehuai ran it on a day-to-day basis. Other veteran generals, including Zhu De, Lin Biao, Liu Bocheng, He Long, Chen Yi, Deng Xiaoping, Luo Rongheng, Xu Xiangqian, Nie Rongzhen, and Ye Jianying, were vice-chairmen or members of the CMC who met only occasionally (Li and Shu, 2009: 685).

Unlike in an abstract model, a dictator can often observe ambitious behavior by an underling, which suggests confidence about their level of power. By the late 1950s, Peng clearly sought to strengthen his power base at the expense of potential rivals within the military. For example, in May 1958, Peng launched an attack on Su Yu, then the chief of staff in the PLA, for "bourgeois individualism"(Jiangsu Party History Work Office, 2012: 402). After criticizing him, Peng suggested Huang Kecheng as Su's replacement; Huang Kecheng, of course, was a loyal follower of Peng from the First Field Army (Jiangsu Party History Work Office, 2012: 402). Two months later, Peng instigated criticism of fellow senior generals Liu Bocheng and Xiao Ke for being "dogmatists" in following Soviet military training manuals. Later, Lin Biao and others accused Peng of taking advantage of Mao's critical comments against "dogmatism" to move against his personal enemies (Li and Shu, 2009: 987; Wang, 2013: 187). Although in both cases, Peng based his criticism on Mao's own critical remarks or established party norms, the outcomes of these attacks clearly favored Peng, a fact that Mao surely noticed. As previous analysis shows, Peng's actions against his peers may also have been an attempt to shrink γ^B, the pool of potential talent with skills similar to his. As our model shows, if γ^B is sufficiently low, the type A dictator would have no choice but to allow an ambitious type B lieutenant to continue accumulating power.

The last straw for Mao was the 1959 Lushan Conference, held after a disastrous year of Great Leap policies pursued by Mao and the central leadership. Witnessing mass starvation in his native Hunan Province, Peng Dehuai, along with other high-level officials, called on Mao to retrench Great Leap policies of overly ambitious grain and steel production targets (MacFarquhar, 1983). Peng Dehuai, outraged by the starvation, had several discussions with fellow leaders on how best to

convey to Mao the urgent need to turn things around (Yang et al., 2012). Mao, of course, came to see such conversations as an emerging plot to overthrow him (Yang et al., 2012). When Peng wrote Mao a private letter calling parts of the Great Leap Forward a manifestation of "petty bourgeois fanaticism," Mao jumped at the opportunity to accuse Peng of fomenting an "anti-Party" plot (MacFarquhar, 1983). Threatening to "go back to the mountains to fight guerilla warfare," Mao forced the rest of the Central Committee to condemn Peng and, more disastrously, to continue Great Leap policies for another two years, which resulted in the deaths of millions more (Goldstein, 1991).

Below, we present our model's predictions for a subordinate who has accumulated substantial power after several victories. As long as shock b—the shock that matches the skills of the type B lieutenant—has a high conditional probability of being a strong shock—i.e., low $p(w|b)$—the type A dictator has no incentive to purge the lieutenant for fear of being destroyed by the next strong shock b. However, with the reduction in the conditional probability of strong shock b, so long as her probability of defeating the type B lieutenant during the mutual conflict is not very low—i.e., when R^A is high enough—the type A dictator will attempt to purge the lieutenant. In the analysis presented in Table 7, we set n at 2, γ^B at 0.5, $p(a)=0.5$, $u^L=45$. Realistically, we would set Mao's initial political resources at a slightly higher level than Peng's, $G(R^A)=0.85$ and $G(R^B)=0.75$.

The numerical analysis shows that when the conditional probability of a strong shock b is high—i.e., when $p(w|b) \leq 0.363877$—the type A dictator has no incentive to purge the high-skilled type B lieutenant—in this case, Peng Dehuai. As $p(w|b)$ increases, the type A dictator gains the incentive to purge the high-skilled type B lieutenant, first, after the lieutenant has dealt with three $(n+1)$ consecutive shocks, and, ultimately, if the chance of a strong shock b is low enough. That is, when $p(w|b) \geq 0.850186$, the type A dictator may feel comfortable purging the high-skilled type B lieutenant even after the latter has dealt with two consecutive shocks. In the meantime, resolving consecutive shocks b allows the high-skilled type B lieutenant to accumulate power, which would enable the lieutenant to launch a successful coup against the dictator after resolving four consecutive shocks.

Our analysis shows that had the conditional probability of a strong shock b, $p(s|b)$,

remained high—i.e., had the threat of an all-out war between the US and China remained high—Peng might have accumulated sufficient power to take over the regime at some point. The overall trend of PLA modernization and professionalization certainly worked to Peng's advantage, and Mao fought this tendency vigorously with the help of Lin Biao after the removal of Peng (Li and Shu, 2009: 772). If Peng had followed CCP norms of not killing ousted leaders—i.e., $u^P > 0$ and u^P is sufficiently large—Mao might have preferred retirement to potential US destruction of the CCP regime.

Although Communist regimes were much more institutionalized than military dictatorships, the communist world was littered with cases of powerful subordinates peacefully ousting incumbents, including the ouster of Khrushchev and Zhang Wentian. Lest one think that military figures could not elbow their way into power in Communist regimes, Mao himself, as well as General Le Luc Anh, who became president of Vietnam after building up a vast empire as the commander of Vietnam forces in Cambodia, provide vivid examples to the contrary (Malesky et al., 2011). Given the potential danger, it is not surprising that the dictator had a strong incentive to purge this lieutenant once the threat of a strong shock b, i.e., the conditional probability of shock b being strong, subsided below even 63.6123%.

Table 7: High Noon at Lushan: Expected Actions of the Dictator and Lieutenant as $p(w|b)$ Rises from 0 to 1

The range of $p(w\|b)$	[0,0.363877]	[0.363877,0.850186]	[0.850186,1]
The dictator's action	Type A dictator will never purge a high-skilled type B lieutenant	Type A dictator purges a high-skilled type B lieutenant after the latter has dealt with 3 consecutive shocks	The type A dictator purges a high-skilled type B lieutenant after the latter has dealt with 2 consecutive shocks
The lieutenant's action	High-skilled type B lieutenant launches a coup when he has dealt with 4 consecutive shocks		
The equilibrium outcomes of the game	Type A dictator will retire when the high-skilled type B lieutenant launches a coup after dealing with 4 consecutive shocks	Type B lieutenant retires when the dictator purges her after he has dealt with 3 consecutive shocks	Type B lieutenant retires when the dictator purges her after he has dealt with 2 consecutive shocks

Other parameters	$\gamma^B = 0.5$; $\gamma^A = 0.8$; $p(a) = 0.5$; $p(w\|a) = 0.5$; $G(R^A) = 0.85$; $G(R^B) = 0.75$; $u^L = 45$, $u^P = 1$.

The extant literature on the removal of Peng has two explanations of why he was removed. First, it is commonly believed that Peng ultimately was removed because Mao had held Peng responsible for the death of his only healthy son, Mao Anying, who died during an American air raid in Korea. To be sure, Mao clearly held a grudge against Peng for not taking better care of his son. But then why wait eight years before moving against Peng? The other conventional explanation for the removal of Peng was that Peng had violated party discipline by daring to criticize Mao in such a blatant manner during the Lushan Conference, which embarrassed Mao at an already sensitive time (Teiwes, 1993; MacFarquhar, 1983; Goldstein, 1991). However, that was not the first time that Peng had been critical of Mao or had ignored Mao's instructions. He did so repeatedly during the war against Japan. In the 1950s, Mao could have treated Peng's power play in the PLA the same way he treated Gao Gang's grab for power in the State Council (Teiwes, 1993). The final redeployment of Chinese troops back to China in mid-1958 might have given Mao further assurances that war in Korea, at least between China and UN forces, was a low-probability event, especially given US preoccupation elsewhere in the world. That and Peng's own signaling of his rising power likely opened the door for Mao's purge of Peng at the 1959 Lushan Conference. This model provides a potential link between the severity of external shocks and China's internal politics.

6. Conclusion

Authoritarian instability and dictators' obsession with potential instability have had profound influence on the rest of the world. If major authoritarian regimes destabilize, neighboring countries, or even countries thousands of miles away, may be impacted by a flood of refugees. The economic might and energy resources in some authoritarian regimes mean that instability in those regimes would bring about recessions or energy shortages on a global scale. A rich literature already explores the mechanisms that give rise to authoritarian instability. We contribute to the literature by introducing a dynamic stochastic game model which directly links the frequency and severity of external threats to domestic instability, and we make predictions about specific manifestation of instability, including purges, coups, and civil wars. Following the existing literature, we also show that the pool of existing talent in the regime and the institutions governing payoffs to both current and

retired officials have a profound influence on stability. Authoritarian stability can be the most long-lasting when elites realize that they need each other to deal with future shocks to the regime.

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