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Rent seeking, revolutionary threat and coups in non-democracies

Michael T. Dorsch, Paul Maarek





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Michael T. Dorsch[†] Paul Maarek[‡]

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Abstract

This paper studies the political turnover process in autocracies due to coup d'états. We present a model in which autocratic rulers are politically constrained both by the elite and by the street. In the model, these political constraints are inter-related such that when leaders extract rent from the economy on behalf of the elite they increase the probability of facing a revolt in the street. We suppose that rulers differ in the efficiency with which they extract rents and citizens make inference about the ruler's type when idiosyncratic shocks occur. Equilibria are characterized in which elite-led coups serve to reset citizens' beliefs about the leader's type and pre-empt revolutions during periods of popular unrest. We then investigate the theory's empirical implications using panel data on popular unrest and coups in sub-Saharan Africa. We pursue a strategy to instrument for the intensity of popular unrest, the results of which support the causal mechanism highlighted in our theory.

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[†]Central European University, School of Public Policy, Nádor u. 9, 1051 Budapest, Hungary; DorschM@ceu.edu

[†]Corresponding author. Université de Cergy-Pontoise, Department of Economics (THEMA), 33 boulevard du Port, 95011 Cergy-Pontoise Cedex, France; paul.maarek@u-cergy.fr.

1 Introduction

Many political leaders do not have their political survival threatened by popular elections since many citizens in the world do not have the right to vote in a transparent electoral process. While there has been an increase in the number of nations that are ruled by democratically-elected leaders, there remain a significant percentage that are ruled autocratically.¹ Political turnover *does exist* in autocracies, however, and autocratic leaders are often replaced before they naturally die or voluntarily give up power. That there exists such irregular turnover suggests that autocratic leaders are subject to some accountability constraints even if they are not required to stand for elections. While romanticism about revolutionary democratic movements captures the public imagination, precious few leadership transitions in autocracies follow mass revolutions. Using the Archigos data on leaders from 1875 to 2004 (Goemans et al., 2009), 75% of irregular leadership transitions in autocracies (excluding foreign interventions) were the result of elite-led coup d'états that replaced one autocrat with another.

Recently, a surge of research in economics has been devoted to modeling the political process in autocracies, with much work focusing on political transition from autocracy to democracy. Mass revolutions are a central component of the political transition literature, either as threats that prompt the elite to voluntarily democratize (see, for instance, Acemoglu and Robinson, 2001 or Aidt and Franck, 2015) or as actual events that lead to regime collapse (see, for instance, Kuran, 1991a,b or Lohmann, 1994). However, very often, the political process is characterized by political turnover and leadership replacement without any change in political institution.² This observation motivates us to consider how a revolutionary threat may have real political consequences in autocratic regimes that fall short of political transition. Specifically, we consider how popular unrest may trigger coup d'états rather than political transitions to democracy.

We propose a theoretical model in which the elite may mount a coup d'état in the presence of a heightened revolutionary threat to pre-empt popular unrest from escalating into a revolution. We think of leadership replacement via coup d'état as a concession that the elite make to avoid democratizing when a revolutionary threat is driven by popular discontent with the sitting leader. The most recent elite-led coup events (at the time of this writing) suggest that quelling the threat of revolutionary movements was an important motivation. Military coups in Egypt (unseating Morsi in 2013) and Burkina Faso (unseating Compaoré in 2014) followed massive anti-government protests

¹In 2015, 31% of countries are defined as autocratic according to a Polity IV criteria, whereas 40% are classified as non-democratic (Marshall and Gurr, 2012).

 $^{^{2}}$ According to Kricheli et al. (2011), 72% of authoritarian breakdowns from 1950-2006 did not lead to an improvement in political institutions.

and calmed popular unrest (at least temporarily).³ Taken together with the historical frequency of coup events relative to democratic transitions, these recent events suggest that our theoretical proposition that revolutionary threats may trigger preemptive coup d'états is justified and complements the literature that relates the threat of revolution to democratic concessions.

In this paper, we consider decision making in an autocracy when the ruler has to deal simultaneously with two political agency constraints: one from the elite group who can stage a coup and the other from citizens who can revolt. In our model, the ruler must extract rent from the economy on behalf of the elite to satisfy the coup constraint and prevent the elite from staging a coup. Rent extraction is distortionary, however, and lowers mean income levels. If the economy becomes too distorted due to rent extraction, the citizens may decide to revolt for a political transition to democracy and elimination of autocratic rent-seeking. Thus, both the threat of a coup and the threat of a revolution constrain the ruler in our framework. Moreover, the constraints are inter-related: in extracting rents to satisfy the coup constraint, the leader increases the probability that the revolution constraint is violated.⁴

Strategic interaction between players in the game that we analyze is driven by an information asymmetry. We suppose that leaders come in "good" and "bad" types and that citizens are uncertain concerning the type of the sitting leader. In the model, leader type describes the efficiency with which the ruler can extract rents from the economy. Quite naturally, for a given level of rent extraction the good leader causes fewer distortions in the economy. Citizens derive utility from the economic outcome, which depends on the level of rent extraction, the ruler's type and an idiosyncratic component (shock). Upon observing the economic outcome, citizens make inferences about the ruler's type, and may choose to revolt if they believe with a sufficiently high probability that the leader is a bad type. Choosing to revolt is costly for the citizens, but a successful revolt eliminates rent extraction in the following period, which improves the mean outcome for the citizens and destroys the elite's source of income.

For their part, the elite can choose to mount a coup and replace the ruler with a randomly chosen member of the elite. We suppose that the elite have full information and play before the citizens, who are more numerous and have a larger collective action problem to overcome. Choosing to mount a coup is costly for the elite, but has two economic benefits in expectation. First, since a coup chooses a new leader from the elite at random, each member has a chance to capture the state prize, which we model

 $^{^3\}mathrm{An}$ attempted coup in Burundi to unseat Nkurunziza in 2015 followed a similar dynamic, though it was unsuccessful.

 $^{^{4}}$ To our knowledge, ours is the first paper to model the threat of coups and revolutions as interrelated political constraints on autocratic leaders (with the notable exception of Acemoglu et al. (2010) who focus on military dictatorship).

as an "ego rent" accruing to the leader. Second, and more interestingly, mounting a coup resets citizens' beliefs about leader type to their priors and may quell a latent revolutionary threat.

We characterize some perfect Bayesian equilibria in which the ruler extracts a sufficient amount of rent from the economy to satisfy the coup constraint during normal times. We then analyze the kinds of shocks that would cause citizens to believe that a sitting leader is a bad type and prompt the elite to mount a preemptive coup. This is one of the novelties of our paper. We link explicitly the decision of the elite to mount a coup to the revolutionary threat of the citizens, providing an original mechanism through which citizens' discontent can get translated into political outcomes in a non-democratic setting. Demonstrating that the elite have an incentive to pre-empt revolutionary movements, our model explains the stylized fact that revolutions are relatively rare events compared to elite-led coups.⁵

The model's predictions are consistent with the empirical finding that coups are more likely during economic downturns (see Alesina et al., 1996, Alesina et al., 1997, Galetovic and Sanhueza, 2000 or Londregan and Poole, 1990, for example).⁶ Furthermore, we provide empirical evidence that revolutionary threats increase the likelihood of an elite-led coup d'état. Using a panel data set from sub-Saharan Africa, we demonstrate that the probability of a coup is increasing in the intensity of popular unrest.⁷ An instrumental variable procedure suggests that the effect can be interpreted causally and allows us to rule out some competing explanations for the relationship.

This paper contributes to several strands of literature in political economics. First, as already mentioned, we complement the literature that addresses democratization and the threat of revolution. In Acemoglu and Robinson (2001), for example, a temporary economic shock increases the threat of revolution by decreasing the cost of revoluting. There, the elite make democratic concessions in order to avoid a destructive revolution.⁸ Our model is complementary in two principle ways. First, we consider a different type of costly concession that the elite may make to avoid a revolution. Replacing a bad leader

⁵Though relatively rare, revolutions do actually occur of course. In an extension that is presented in the appendix we provide a more complex model in which the threat of revolution may lead to effective mass protest movements as equilibrium outcomes.

⁶Note that in our model, we consider the "shock" to be an idiosyncratic component of the observable economic outcome. One could think of shocks more broadly as any stochastic variable that could lead to Bayesian updating about the leader's type.

 $^{^{7}}$ We follow Aidt and Leon (2015) and Aidt and Franck (2015) in using popular unrest as a proxy for the threat of revolution.

⁸Some papers also allow for effective revolutions (Ellis and Fender, 2011). Empirically, Burke and Leigh (2010) and Brückner and Ciccone (2011) show that economic downturns can explain some democratization episodes in autocracies. These papers do not provide evidence, however, that economic downturns are associated with a heightened revolutionary threat. Rather than look at economic proxies, Aidt and Leon (2015) and Aidt and Franck (2015) demonstrate that a heightened revolution threat, proxied by popular unrest, is associated with democratic concessions.

with a random draw from among the elite increases the probability that the leader is a good one. This improves the distribution of economic outcomes in expectation and makes the citizens better off, without actually conceding democracy to them. Second, while we also relate the threat of revolution to an idiosyncratic economic shock, we consider an alternative information mechanism through which the relation can operate (see also Dorsch et al., 2015).

We also contribute to the growing political economic literature on coup d'états. The Accemoglu and Robinson (2001) paper also considers the possibility that the elite may reverse institutional concessions with a coup d'état and retake power when democratic fiscal consolidation proves too costly. By contrast, we model coups as ways for the elite to maintain the initial autocratic political institution rather than reverse a conceded transition to democracy. One strand of the recent literature on coups has focused on the political turnover process in autocracies. For instance, Gallego and Pitchik (2004) focus on leadership turnover but consider an opportunity cost mechanism à la Accemoglu and Robinson (2001) to explain coups in a model that does not have a role for citizens. Egorov and Sonin (2011) model the competency choice of the vizier in a coup model with a single constraint. Some recent papers have considered both constraints from the elites and from the street on the ruler. Accomoglu et al. (2010) provide a model with a ruler whose choices are subject to two political constraints: a powerful army reduces the probability of revolution but increases the probability of having a (military) coup. As in our paper, Gilli and Li (2015) also consider a double agency constraint on the ruler, but do not explicitly model the policy choice of the leader and how the two constraints are inter-related and depend on the leader's policy choices. Kricheli and Livne (2011) examine both theoretically and empirically the economic conditions under which a coup or a revolution is more likely to occur. They do not, however, consider the interaction between the threat of revolution and the decision to stage a coup. De Mesquita and Smith (2015) introduce both the coup constraint and the possibility for revolution into the selectorate theory of De Mesquita and Smith (2005). They analyze various policy responses for dealing with the constraints and temporary shocks and show how the different threats are interconnected. However, they assume that the resources available for the ruler to satisfy the various constraints are exogenously given and that there is no coup reaction of the elite when the regime faces a revolutionary threat. Casper and Tyson (2014) examine the joint occurrence of coups and protest as we do. The mechanism they highlight is very different from ours, however. The leader has an unobserved ability (type) to deal with a coup or a revolution. The citizens and the elite receive private signals concerning the ruler's type. Protests aggregate citizens' information which gives the elite an extra (public) signal which favors coordination in a global game setting. Finally, Galetovic and Sanhueza (2000) is maybe the closest to our paper. In a reduced form model, they assume the cost of mounting a coup is decreasing in popular unrest and that coups are more likely during such episodes as a result.

The rest of the paper is organized as follows: section 2 provides our baseline model. In section 3 we present some empirical evidence in line with our theoretical model, while section 4 concludes. In an appendix, we enrich our baseline model to allow for effective revolutions and the possibility for regime switch and democratization.

2 The model

We present an incomplete information game between three players: a disenfranchised working class, an elite group and a ruler and characterize possible Nash equilibria for this game.

2.1 Model environment

2.1.1 Players and actions

All players live for two periods, are risk neutral, and act to maximize the expected present value of their period payoffs discounted at rate δ . The ruler benefits from an ego rent R^E , which corresponds to all non-transferable monetary and in-kind advantages the ruler can derive from his position. We assume ruler can be of good type or bad type and that type is unknown to workers, but known to elite. Nature determine the ruler type which may be good with probability π or bad with probability $1-\pi$ (i = g or i = b)and ruler chooses a level of rent to extract that depends on his type, R^i with $i \in \{g, b\}$, on behalf of the elite. We interpret R^i as the rent received by each member of the elite. We think of this as all institutional arrangement introduced by the ruler in order to guarantee elite makes abnormal gains in the activity they operate. For instance it can corresponds to barriers to entry in the goods market as suggested by Acemoglu (2010) or other non-competitive policies that generate rents for the elite.⁹ There is a cost to rent extraction. It deteriorates the economic outcome for citizens (see below) and makes them more likely to revolt. The ruler cares only about the length of time he is ruler since he earns the ego rent each period he is in power. The rent extracted affects this length of time by determining the likelihood of coups by the elite and revolts by

⁹Djankov et al. (2002) argue that regulations that limit competition do not seem to correct any market failure, but rather seem to be associated with rent creation, especially in autocracies, which is consistent with public choice theories of regulation. Parente and Prescott (2000) argue that institutional arrangements among elites are very pervasive and that economic liberalization could substantially increase GDP per capita in developing economies. De Haan and Sturm (2003) show that democratization leads to more economic freedom. The Arab spring events have shown that economic institutions may be at the heart of social contest in autocracies.

the workers. More precisely, in our model the autocrat extracts rent in order to please elite and make them indifferent between mounting a coup and the status quo but by doing so the likelihood of a revolt by the workers increases.

The elite consists of N identical members. We will consider the elite as a single player. The period payoff to the elite will include the rent, R^i , extracted by the ruler on behalf of the elite. The elite can also choose to mount a coup, which costs λ , against the ruler. If they do so then one of the elite will be randomly selected to be the new ruler and thus receive the ego rent R^E the next period. Note that we are not modeling any coordination problems involved in mounting a coup nor are we concerned with competition among the elite for power.

The period payoff of the workers depends on the observed outcome of the economy w. This outcome depends on both the level of rent extracted and a random variable, y, which can be interpreted as a macro variable subject to shocks. The workers do not observe either the level of rent extracted or the random shock. Workers also have the possibility to stage a revolution at a cost of ζ . If workers decide to revolt then the revolution is successful and the political regime switches from autocracy to democracy, in which workers maximize their expected outcome in the next period by extracting zero rent. If a coup or a revolution occur, we assume ruler gets a zero payoff for the current and future periods.¹⁰

2.1.2 Information

We assume the function determining the economic outcome that the workers care about depends on the ruler's type. Explicitly, we assume

$$w = w^{i}(R, y) = w^{i}(R) + y = \overline{w} - \phi_{i}R + y$$
 with $\phi_{b} > \phi_{g}$,

where y is distributed according to the cumulative distribution function G(y) with mean zero and \overline{w} is the mean outcome if no rent is extracted. Since $\phi_b > \phi_g$, for a given level of rent R and a given shock y, $w^b(R, y) < w^g(R, y)$. In other words, a good ruler is one who can extract the same amount of rent at a lower cost to the workers for any given shock to the economy. The distribution of the economic outcomes will thus be different for the different types of rulers for a given level of rents.¹¹ Let's define $g(w \mid \phi_i R^i)$

¹⁰Coup and revolution is often violent and may be very costly for the ruler. We could assume ruler only looses future ego rent. This would not affect the nature of our results.

¹¹Jones and Olken (2005) show that shifts in economic performances are related to changes in the national leader especially in non-democracies. In this paper, we exploit the competence of leader in rent extraction. We could also have focused on benevolent versus opportunistic leader or the kind of elite a ruler is connected to: for example elite may operate in modern sector generating growth or elite may operate in archaic, old sector and demand for institutions protecting their rent. It's common in the democratic political economy literature to associate the politican's type with their ability to provide

as the probability that outcome w is realized given a level of rent R^i extracted by a ruler of type *i*. We assume that the shock y is informative in the sense of Milgrom (1981). That is, the ratio $g(w \mid \phi_b R^b)/g(w \mid \phi_g R^g)$ satisfies the monotonic likelihood ratio property (MLRP) and decreases with w if $\phi_b R^b > \phi_g R^g$ (we will show this is the case at equilibrium). Given a pure strategy equilibrium we can compute the citizen's perceived probability the ruler is of good type using Bayes' Rule¹²:

$$p(w, R^{g}, R^{b}) = \frac{\pi g(w \mid \phi_{g} R^{g})}{\pi g(w \mid \phi_{g} R^{g}) + (1 - \pi)g(w \mid \phi_{b} R^{b})}$$
$$p(w, R^{g}, R^{b}) = \frac{\pi}{\pi + (1 - \pi)g(w \mid \phi_{b} R^{b})/g(w \mid \phi_{g} R^{g})}$$
(1)

or

Due to the monotone likelihood ratio properties, $p(w, R^g, R^b)$ increases in w or equivalently the probability the ruler is perceived to be good decreases when outcome w deteriorates. This is represented on figure 1, which shows the distribution of outcomes for a bad and a good type ruler given $\phi_b R^b > \phi_g R^g$ that is, given the mean outcome is higher for the good type ruler.

[insert figure 1 here]

If bad type ruler increases rent extraction R^b everything else equal, the distribution of outcomes for bad types shifts to the left. Given the fact that the distribution of outcomes for good type is unaffected, for every outcome realization w, the perceived probability ruler is of good type should increase. Therefore, $\partial p/\partial R^b > 0$. Similarly $\partial p/\partial R^g < 0$. We can also define the probability p the ruler is of good type in terms of the shock component y. For a given shock y this probability p will be different for the good type and the bad type ruler if $\phi_b R^b \neq \phi_g R^g$ since the outcome corresponds to $w = \overline{w} - \phi_i R + y$ and will be different for both ruler types. We define $p^i(y, R^g, R^b)$ as the probability a ruler of type i is perceived as good given a shock value y. Of course, if $\phi_b R^b > \phi_g R^g$ then $w(R^b, y) < w(R^g, y)$ and we have $p^b(y, R^g, R^b) < p^g(y, R^g, R^b)$ for a given value of the shock y.

Therefore, although workers cannot directly observe the ruler's type or level of rent extracted, they receive information about the ruler's type from the economic outcome. This will be an important determinant of when the workers will decide to revolt. As stated before, note that w can be interpreted more broadly: it can also correspond to the

$$p(w, R^g, R^b) = \frac{\pi \int \sigma(R^g) g(w \mid \phi_g R^g)}{\pi \int \sigma(R^g) g(w \mid \phi_g R^g) + (1 - \pi) \int \sigma(R^b) g(w \mid \phi_b R^b)}$$

where $\sigma(R^i)$ is the probability a ruler of type *i* plays R^i .

public goods and services efficiently (see Persson and Tabellini, 2002, for instance).

 $^{^{12}\}mathrm{More}$ generally, we can write

quality of public goods, the number of corruption scandals that appear in newspapers (observing this number, citizens update their beliefs on ruler's type), the quality of management during crisis events, etc. In all these examples, the outcome is affected by the ruler's type and the amount of rent extracted.

From the point of view of the ruler, we can also define $y^i(p, R^g, R^b)$ which corresponds to the value of the shock y necessary for a ruler of type i to obtain a belief p given the level of rent R^b and R^g . Given R^b and R^g , to obtain a specific outcome w associated with a unique belief p, a ruler of type i needs a shock y^i which is type specific since the mean outcome $\overline{w} - \phi_i R$ is ruler type specific. Of course, given that $\phi_b R^b > \phi_q R^g$ and that $p^b(y, R^g, R^b) < p^g(y, R^g, R^b)$, we have that $y^b(p, R^g, R^b) > y^g(p, R^g, R^b)$. In other words, if $\phi_b R^b > \phi_q R^g$, a good type ruler must experience a more adverse shock than the bad type in order to obtain the same outcome w and the same belief p. At this stage, we can compute several comparative statics. First, $\partial y^b(p, R^g, R^b)/\partial R^b > 0$. An increase in R^b makes $p^b(y, R^g, R^b)$ lower since it shifts outcomes of the bad type to the left and makes the realized outcome $w(R^b, y)$, for a given shock y, lower and more unlikely to occur if the ruler were good. As a result, when \mathbb{R}^{b} increases a bad type ruler must experience a more favorable shock in order to obtain a given belief p. Similarly, we have $\partial y^b(p, R^g, R^b)/\partial R^g < 0$, $\partial y^g(p, R^g, R^b)/\partial R^b < 0$ and $\partial y^g(p, R^g, R^b)/\partial R^g > 0$. Of course, due to the MLRP, we have $\partial y^g(p, R^g, R^b)/\partial p > 0$ and $\partial y^b(p, R^g, R^b)/\partial p > 0$. Increasing the belief p a ruler is of good type, requires that both ruler types have to experience a more favorable outcome (ie, a higher value of y).

2.1.3 Timing of the game

The timing of this incomplete information game is the following within each period t:

- 1. Nature chooses the ruler's type: good (g) with probability π or bad (b) with probability 1π . The actual type is not observed by the workers.
- 2. A ruler of type *i* chooses a level of rent to extract, R^i .
- 3. An economic shock, y_t , occurs and the economic outcome is realized, $w_t = w^i(R^i, y_t)$, which is observed by all players. Workers update their beliefs about the probability that the leader is good, p_t as define in 1.
- 4. The elite choose to mount a coup $(C_t = 1)$ or not $(C_t = 0)$. If the elite mount a coup $C_t = 1$ workers return to their priors beliefs $p_t = \pi$.
- 5. Workers chose to revolt $(Z_t = 1)$ or not $(Z_t = 0)$. Each players receive current period payoff. If no coup or revolution has occurred to this point then the game goes

back to stage 3 for the second period game. If workers revolt then a democracy results with R = 0 in the second period.

We focus on sub-game perfect Bayesian equilibria. Each period strategies are best responses to other players' strategies and beliefs are consistent with Bayes' Rule whenever possible. Equilibrium is characterized by: choice of the ruler of rent extracted $R^i, i \in \{b, g\}$, choice by the elite of $C(p_t, R^b, R^g) \in \{0, 1\}$, choice for the worker of $Z(p_t) \in \{0, 1\}$. Payoffs are functions of the strategies choices $\{R^i_t, C_t, Z_t\}_{t=1}^2$. Obviously, $C_2 = 0$ and $Z_2 = 0$ since there is no benefit of mounting a coup and revolting in the second period.

Here we make an additional simplifying assumption. Ruler faces no political constraints in the second period since revolution or coups does not provide any payoff in the second period. We assume that the ruler commits to the elite to extract the same level of rent in the second period as she would have extracted the first period under the political constraints. In other words, if a ruler of type i is in power at the first period and extracts R_1^i she extracts $R_2^i = R_1^i$ at the second period. If a new ruler is in power at the second period (a coup but no revolution occurs during the first period), she extracts the same amount of rent that her similar type would have extracted the first period under coups and revolution constraints. Saying differently, there is a type specific commitment. This assumption captures what would occur under an infinitely repeated game in which a ruler faces the same constraint in each period. This does not affect the nature of our results.

Since the only relevant period for analysis is the first one, we drop time subscript for the remaining of the analysis. We now turn to the analysis of the game.

2.2 Analysis

2.2.1 Workers

We solve the game recursively and start with the workers' decision of whether or not to revolt. First, consider the value functions for the workers in the first period of the game when the elite are in power, V_w^e . If the workers decide to revolt, their value function is given by the following at any belief p:

$$V_w^e(Z=1|p) = w_t - \zeta + \delta \mathbf{E} V_w^d$$
 with $\mathbf{E} V_w^d = \overline{w}$

where V_w^e is the value function for the workers when elites rule in first period, $\mathbf{E}V_w^d$ is the expected value function for the workers in the democratic state (in the second period since state is assumed to be autocratic in first period) and \overline{w} is expected worker payoff when no rent is extracted.¹³

If the workers do not revolt, their value functions depend on beliefs about the leader type:

$$V_w^e(Z=0|p) = w + \delta C V_w^e(Z=0|p),$$

with $CV_w^e(Z=0|p) = \overline{w} - p\phi_g R^g - (1-p)\phi_b R^b$, which depends on the value of beliefs p. We now define the revolution constraints that characterize the conditions under the workers find it optimal to revolt.

Proposition 1. The revolution constraint at belief p is given by

$$\zeta < p\delta\phi_g R^g + (1-p)\delta\phi_b R^b \tag{2}$$

and if $\phi_b R^b > \phi_g R^g$, then there exists a belief p^* such that workers revolt if $p < p^*$. If $\delta \phi_g R^g < \zeta < \delta \phi_b R^b$ the solution is interior and $p^* \in [0, 1]$.

Proof. Workers find it optimal to revolt at belief p if $V_w^e(Z = 1|p) > V_w^e(Z = 0|p)$. Replace $CV_w^e(Z_t = 0|p) = \overline{w} - p\phi_g R^g - (1-p)\phi_b R^b$ in $V_w^e(Z = 0|p)$ and obtain the condition under which workers find it optimal to revolt: $w - \zeta + \delta \overline{w} > w + \delta(\overline{w} - p\phi_g R^g - (1-p)\phi_b R^b)$. This yields (2). Replace p = 1 in (2) to see workers do not revolt at p = 1 (they know for sure ruler is of good type) if $\delta \phi_g R^g < \zeta$. Replace p = 0 in (2) to see workers revolt at p = 0 (they know for sure ruler is of bad type) if $\zeta < \delta \phi_b R^b$. If $\phi_b R^b > \phi_g R^g$ the right hand side of (2) strictly decreases in p and if $\delta \phi_g R^g < \zeta < \delta \phi_b R^b$ an interior solution exists and is unique.

The intuition is very simple. If $\phi_b R^b > \phi_g R^g$ workers are worse off under a bad type leader than under a good one. Given the cost of revolting, if workers believe with a sufficiently high probability ruler is of bad type $(p < p^*)$ and second period income expected to be low as a result, they find it optimal to revolt and eliminate rents. This will be a dominant strategy.

2.2.2 Elites

Recall that ruler extracts rent on behalf of the elite and that the elite knows the ruler type. As the elite payoff will depend on the worker's choice, value function also depends on beliefs p. When the elite do not mount a coup

$$V_e^e(C = 0 | p, i = \{b, g\}) = R^i + \delta C V_e^e(C = 0 | p, i = \{b, g\})$$

¹³We are not claiming that no rent extraction exist in democracies. Nevertheless, voters should be able to mitigate rent capture behavior from politicians more efficiently than in autocracies.

When the elite mount a coup, we have

$$V_e^e(C = 1 | p, i = \{b, g\}) = R^i - \lambda + \delta C V_e^e(C = 1)$$

If the elite mount a coup at any belief at stage 4, beliefs shift to $p = \pi$ as the ruler is replaced by a random draw from the pool of elite. The continuation value of the elite when mounting a coup is

$$CV_e^e(C=1) = \frac{1}{N}CV_r^e(p=\pi) + [1-\frac{1}{N}][1-\pi]CV_e^e(p=\pi; i=b)$$
(3)
+ $[1-\frac{1}{N}]\pi CV_e^e(p=\pi; i=g).$

n this equation, a member of the elite becomes the new ruler with probability $\frac{1}{N}$ and obtains $CV_r^e(p=\pi)$, the value function of being the ruler in the second period when workers' beliefs at the end of the first period are $p = \pi$. The member of the elite remains part of the elite with probability $[1-\frac{1}{N}]$. In this case, they obtain the continuation value when the new ruler is bad, $CV_e^e(p=\pi; i=b)$ and workers' beliefs at the end of the first period are $p = \pi$, with probability $[1-\pi]$ and the continuation value when the new ruler is good, $CV_e^e(p=\pi; i=g)$, with probability π . If equilibrium rent are such that workers revolt at $p = \pi$ at stage 6, continuation values will be zero. If not, elite continue to receive rents and the new ruler the ego rent.

We now define the coup constraints the ruler faces.

Proposition 2. If current beliefs are such that workers do not revolt at stage 6 $(p > p^*)$ and workers would not revolt at $p = \pi$ (that is $\zeta > \pi \delta \phi_g R^g + (1 - \pi) \delta \phi_b R^b$), we can define the amount of rent, R^{*b} and R^{*g} , respectively, bad type and good type rulers have to extract in order to avoid a coup:

$$R^{*b} = \frac{-\lambda + \delta(1/N)R^E + \delta\left[\left[1 - (1/N)\right]\pi\right]R^g}{\delta\left[(\pi) + (1/N)\left(1 - \pi\right)\right]}$$
(4)

$$R^{*g} = \frac{-\lambda + \delta(1/N)R^E + \delta\left[\left[1 - (1/N)\right](1-\pi)\right]R^b}{\delta\left[\left(1-\pi\right) + (1/N)(\pi)\right]}$$
(5)

Proof. The elite do not find it optimal to stage a coup only if $V_e^e(C = 0|p > p^*, i = \{b, g\}) > V_e^e(C = 1|i = \{b, g\})$. Replace $p = \pi$ in the revolution constraint (2) to obtain that if $\zeta > \pi \delta \phi_g R^g + (1-\pi) \delta \phi_b R^b$, there is no threat of revolution at $p = \pi$. As a result, in $CV_e^e(C = 1)$ we have $CV_e^e(p = \pi; i = \{b, g\}) = R^i$ and $CV_r^e(p = \pi) = R^E$. Since $p > p^*$, there is no threat of revolution and $CV_e^e(C = 0|p > p^*, i = \{b, g\}) = R^i$. Using this and evaluating the coup constraint inequality $V_e^e(C = 0|p > p^*, i = \{b, g\}) > V_e^e(C = 1|i = \{b, g\})$ at i = b gives: $(1 + \delta)R^b > R^b - \lambda + \delta \left[\frac{1}{N}R^E + [1 - \frac{1}{N}][1 - \pi]R^b + [1 - \frac{1}{N}]\pi R^g\right]$. Solving for R^b gives (4). Similarly, evaluating the coup constraint inequality at i = g

and solving for R^g gives (5).

The rent \mathbb{R}^b that the bad type ruler has to extract in order to satisfy the coup constraint increases in \mathbb{R}^g , the equilibrium rent extracted by the good type ruler. Similarly, \mathbb{R}^g is increasing in \mathbb{R}^b . To understand this, let's start with a rent profile \mathbb{R}^b and \mathbb{R}^g such that both coup constraints (4) and (5) are satisfied. Consider an increase in \mathbb{R}^g . From (4), the coup constraint for the bad type ruler is no longer satisfied: staging a coup is more profitable since there is a possibility that the ruler is replaced with a good type who gives higher rents compared to the status quo (no coups). Bad type ruler must increase rent extraction \mathbb{R}^b in order to increase the elite payoff when not staging a coup and equalize it with the expected payoff from staging a coup. When the ego rent \mathbb{R}^E increases, the ruler's position is more attractive for the elite and so the ruler has to provide greater rents in order to avoid a coup. At this stage we make the following assumption:

Asumption 1

$$-\lambda + \delta(1/N)R^E > 0.$$

The condition $-\lambda + \delta(1/N)R^E > 0$ simply says that ruler will always have to give a positive amount of rent in order to satisfy the coup constraint even if the other type ruler gives zero rent. This is satisfied if the ego rent R^E is sufficiently high. We now analyze the incentives of the elite to mount a coup when threat of revolution is high, depending on the equilibrium rent extraction.

Proposition 3. If at current beliefs workers would choose to revolt $(p < p^*)$ and workers would not revolt at $p = \pi$ ($\zeta > \pi \delta \phi_g R^g + (1 - \pi) \delta \phi_b R^b$), then the elite find it optimal to mount a coup. If the workers would revolt at $p = \pi$ ($\zeta < \pi \delta \phi_g R^g + (1 - \pi) \delta \phi_b R^b$) it's never optimal for the elite to mount a coup.

Proof. The elite will mount a coup at $p < p^*$ if $V_e^e(C = 0|p < p^*) < V_e^e(C = 1|i = \{b,g\})$. If $p < p^*$ and the elite do not mount a coup, $CV_e^e(C = 0|p < p^*) = 0$ since workers would revolt at stage 6. As a result, the elite mount a coup if $R^b < R^b - \lambda + \delta CV_e^e(C = 1)$ that is if $CV_e^e(C = 1) > \frac{\lambda}{\delta}$. Under assumption 1 and if $\zeta > \pi \delta \phi_g R^g + (1 - \pi)\delta \phi_b R^b$ (workers do not revolt at $p = \pi$), this is always satisfied even if $R^b = R^g = 0$ (elite receive no rents). To see this, note that since workers do not revolt at $p = \pi$ when $\zeta > \pi \delta \phi_g R^g + (1 - \pi)\delta \phi_b R^b$ we have $CV_r^e(p = \pi) = R^E$ and $CV_e^e(p = \pi; i = \{b, g\}) = R^i$ in (3). Replace $CV_r^e(p = \pi) = R^E$ and $CV_e^e(p = \pi; i = \{b, g\}) = R^i$ in $CV_e^e(C = 1)$ and the result follows. When $\zeta < \pi \delta \phi_g R^g + (1 - \pi)\delta \phi_b R^b$ workers revolt at $p = \pi$ and $CV_e^e(C = 1) = 0$ since state become democratic in the second period. In other words, it will be never optimal for the elite to mount a coup, at any belief p when $\zeta < \pi \delta \phi_g R^g + (1 - \pi)\delta \phi_b R^b$.

If the cost of mounting a coup is not too high and if workers do not revolt at $p = \pi$ (if $\zeta < \pi \delta \phi_g R^g + (1-\pi) \delta \phi_b R^b$) but would revolt if no coup is staged (beliefs at $p < p^*$), then it's optimal for the elite to mount a coup in order to prevent a revolt. We can make the following remark:

Remark 1 At $p > p^*$ (no threat of revolution), the rent profile such that the coup constraints for both leader types bind is $R^{*b} = R^{*g} = R^* = (-\lambda + \delta(1/N)R^E)/\delta(1/N)$.

Proof. At $p > p^*$ the two coup constraints can be expressed as $(1 + \delta)R^g \ge R^g - \lambda + \delta CV_e^e(C = 1)$ for the bad ruler type and $(1+\delta)R^b \ge R^b - \lambda + \delta CV_e^e(C = 1)$ for the good ruler type. Combine both coup constraints when binding to obtain $(1 + \delta)(R^g - R^b) = (R^g - R^b)$. The only solution is $R^g = R^b = R^*$. Replacing $R^g = R^b = R^*$ in (4) or (5) we can obtain $R^* = (-\lambda + \delta(1/N)R^E)/\delta(1/N)$.

2.2.3 The ruler

We now turn to the problem facing each type of ruler. He enjoys an ego rent R^E each period he remains in power and extracts rents for the elite. Maximizing his expected utility V_r^e in fact corresponds to minimizing the probability of survival. The ruler faces two inter-related threats. First, the elite can mount a coup in order to capture the state prize (i.e., the ego rent R^E) and the ruler must extract rents on behalf of the elite in order to prevent coups from occurring (see the coup constraints in proposition 2). In raising rents to satisfy the coup constraints, however, the ruler deteriorates the economy, which increases the risk of violating the revolution constraint. Workers revolt if equilibrium rent is too high for some beliefs p. In such a case, under specific conditions concerning both ruler equilibrium rent and the cost of revolution (see proposition 3), the elite can also mount a coup for an additional motive: replacing the leader with a randomly drawn member of the elite which returns workers beliefs to the prior π such that under certain conditions there is no longer threat of revolt. Formally a ruler of type *i* chooses the level of rent extraction R^i , given the other ruler type rent extraction R^{-i} , to maximize her lifetime expected utility

$$V_r^{e,i} = (1+\delta)R^E \vartheta^i(R^i, R^{-i}), \tag{6}$$

where $\vartheta(R^i, R^{-i})$ corresponds to the probability that the ruler remains in power. Recall that the ruler has a payoff of zero in the current (and the second) period if she is removed from power. This probability depends on both equilibrium rent, R^b and R^g , since both affect the decision of the worker to revolt and the decision of the elite to mount a coup. For instance, if ruler satisfies both coup constraints (proposition 2), the rent profile is such that there would be no revolution following a coup ($\zeta > \pi \delta \phi_q R^g + (1 - \pi) \delta \phi_b R^b$) and $p^* \in (0; 1)$, then elite only stage a coup to prevent a revolution when $p < p^*$ (see proposition 3). In this instance the ruler can loose power for sufficiently strong negative shock y such that workers believe with sufficiently high probability that the ruler is of a bad type and it would be rational to revolt at stage 6 for such a belief $(p < p^*)$. Elite mount a preemptive coup to remove the ruler from power when such a shock occurs. Recall there is a ruler type specific value $y^i(p, R^{b*}, R^{g*})$ to obtain a belief p given equilibrium rent R^{b*} and R^{g*} . Therefore the ruler can determine the shock threshold $y^{b*}(p^*, R^{b*}, R^{g*})$ and $y^{g*}(p^*, R^{b*}, R^{g*})$ that is specific to her type such that: when $y < y^{b*}(p^*, R^{b*}, R^{g*})$ for bad type ruler and $y < y^{g*}(p^*, R^{b*}, R^{g*})$ for the good type ruler, beliefs shift to $p < p^*$. Given $\phi_g R^g < \phi_b R^b$ then, due to the monotone likelihood property ratio, $y^{b*} > y^{g*}$. Recall that ruler choice of rent affect the distribution of outcome and in turn affect those thresholds. The payoff function of the ruler is given by the following

$$V_r^{e,i} = (1+\delta)R^E \int_{y^{i*}}^{\infty} g(y)dy = (1+\delta)R^E (1-G(y^{i*})),$$

where $(1 - G(y^{i^*}))$ corresponds to the probability that beliefs shift to $p < p^*$ for a ruler of type *i*. We can derive comparative statics on the thresholds $y^{b^*}(p^*, R^{b^*}, R^{g^*})$ and $y^{g^*}(p^*, R^{b^*}, R^{g^*})$. We have that $dy^{b^*}/dR^b > 0$ and $dy^{g^*}/dR^g > 0$. To see this, first note that p^* increases in R^{b^*} and R^{g^*} according to (2) if $\phi_g R^g < \phi_b R^b$. Citizens are more willing to revolt for a given belief when equilibrium rent of one of the ruler types increases since citizens don't know for sure the type of the ruler. As stated previously, the MLRP implies $\partial y^g(p, R^g, R^b)/\partial p > 0$ and $\partial y^b(p, R^g, R^b)/\partial p > 0$. Secondly, we have that $\partial y^g(p, R^g, R^b)/\partial R^g > 0$ and that $\partial y^b(p, R^g, R^b)/\partial R^b > 0$.

The total derivatives have an intuitive interpretation. By decreasing rent, a type i ruler improve the distribution of economic outcomes compare the other type ruler. For any given y the realized outcome w improves compared to the outcome the other type would have obtained. Due to the MLRP, the probability p the ruler is perceived to be good should increase. As a result, the ruler must experience a more adverse shock for the beliefs to fall under the threshold p^* .

2.3 Equilibrium of the game

This section gives a simple graphical description of the equilibrium of our game. We describe each of the three players' strategies (or at least the relevant features of them) in the strategy space for the good and bad type leader $\{R^b; R^g\}$.

Whether or not workers decide to revolt depends on the parameters and what the workers know. This is shown in the analysis above giving the revolution constraints (2)

evaluated at p = 0, p = 1, and $p = \pi$ (prior) when binding. These are shown in figure 2. Constraint (2) evaluated at p = 0 is represented by the horizontal line $R^b = \zeta/\delta\phi_b$. Constraint (2) evaluated at p = 1 is represented by the vertical line $R^g = \zeta/(\delta\phi_g)$. Constraint (2) for any other value of belief p is represented by the downward sloping line through the intersection of the two previous revolution constraints. Note that revolution constraints are independent from the cost of mounting a coup. Also recall that we assume $\phi_g < \phi_b < 1$ so that $R^g = \zeta/\delta\phi_g > R^b = \zeta/(\delta\phi_b)$.

The line $\phi_b R^b = \phi_g R^g$ is also shown in figure 2. This line has some useful properties. First, as shown, all three of the revolution constraints intersect at the same point on this line. To see this, substitute $R^g = \zeta/(\delta\phi_g)$ and $R^b = \zeta/(\delta\phi_b)$ in $\phi_b R^b = \phi_g R^g$. For equilibrium rents along the line $\phi_b R^b = \phi_g R^g$, the distribution of economic outcomes, w_t , is the same for each type of ruler and the workers will never be able to distinguish between a good and bad ruler. Along this line, the belief p is always at π . For rent profiles $(R^b; R^g)$ above this line, an adverse shock increases the probability p ruler is of bad type.

[insert figure 2 here]

In figure 2, the two coup constraints for the good and bad type intersect on the 45 degree line such that $R^b = R^g = R^*$ at point (e). At point (e) the two coup constraints bind simultaneously (see remark 1). Note that due to our assumption 1 on parameters, they both intersect the axes at positive values. They both end at the intersection with revolution constraint (2) evaluated at $p = \pi$ (see proposition 3). This is due to the fact that for a rent profile (R^g, R^b) located to the right of the revolution constraint (2) evaluated at $p = \pi$ which follows a coup issue workers would revolt at period 6 (for belief $p = \pi$ which follows a coup) resulting in no payoff for the elite at the second period. Therefore, the coup constraints are satisfied. Both coup constraints shift away from the origin when the ego rent R^E increases since ruler has to extract more rent everything else equal in order to please the elite and avoid a coup.

Proposition 4. For a given set of positive parameters $\{\phi_b; \phi_g; \lambda; \zeta\}$, there is a strictly positive interval of R^E such that there exists a unique point (e) at which both coup constraints bind above the revolution constraint when p = 0 and below the revolution constraint when $p = \pi$ and p = 1.

Proof. At $R^E = 0$ a rent profile $R^b = R^g = 0$ satisfies both coups constraint. The rent profiles for which both coup constraints bind $R^b = R^g = R^*$ is strictly increasing in R^E (see remark 1 and coup constraints (4) and (5)). As R^E increases from zero, R^* which satisfies both coup constraints does as well. R^* can pass the revolution constraint at

p = 0 (violating the constraint) but must remain below the revolution constraint at $p = \pi$ (satisfying the constraint).

This means that for a choice of rent at point (e) there is no threat of revolution at $p = \pi$ but there exists a threat of revolution at p = 0. At point (e) there is a belief $p = p^* < \pi$ such that revolution constraint is exactly satisfied (see figure 2).

Note that the coup constraints on good type and bad type rulers meet the revolution constraint at $p = \pi$ uniquely at (g) and at (b) since they are strictly increasing functions of the other ruler type's rent. We now characterize the Nash equilibrium of this game.

Proposition 5. When point (e) on the 45 degree line is located above the revolution constraint evaluated at p = 0 ($R^b = \zeta/(\delta \phi_b)$) and below the revolution constraint evaluated at $p = \pi$ and for which both coup constraints bind, (e) is the unique Nash equilibrium.

Proof. (e) is a Nash equilibrium. First, recall that due to assumption 1, $CV_e^e(C =$ 1) > $\frac{\lambda}{\delta}$. As a result, if rent is such that $\zeta > \pi \delta \phi_q R^g + (1-\pi) \delta \phi_b R^b$ there is no threat of revolution at belief $p = \pi$ and elite mount a coup when $p < p^*$ (see proposition 3). In other words, when the revolution constraint is violated at stage 5, it is a dominant strategy for the workers to revolt and it will be a dominant strategy to mount a preemptive coup for the elite at stage 4. This is the case for point (e) as represented in figure 1. We will demonstrate that neither ruler type has an incentive to deviate from point (e). First consider the incentives of the good type ruler. At point (e) both coup constraints (4) and (5). He has no incentive to increase R^{g} . For a given R^{b} and increase in R^g makes y^{g*} increase (recall $dy^{g*}/dR^g > 0$), which increases the probability that beliefs shift to $p < p^*$, which decreases the probability the ruler remains in power $(1 - G(y^{g*}))$. As a result he has no incentive to increase R^{g} . Given R^{b} at point (e), a decrease in \mathbb{R}^{g} would violate the coup constraint (5) for good type resulting in a zero payoff. The argument for the bad type ruler is analogous. The bad type ruler has no incentive to deviate from point (e) by increasing rent since it would decrease $(1 - G(y^{b*}))$, the probability he remains in power (recall $dy^{b*}/dR^b > 0$). A lower R^b would violate the coup constraint of the bad type ruler resulting in a zero payoff. As a result, point (e) is a Nash equilibrium since both types of ruler' have no incentive to deviate from the point (e) rent profile.

(e) is the unique Nash equilibrium. (i) For all rent profiles located to the right of point (e) and to the left of point (b), a bad type ruler always has incentive to decrease or increase R^b in order to satisfy the coup constraint exactly. By doing so, for given R^g he avoids a coup (if the coup constraint was previously not satisfied) or decreases $G(y^{b*})$, the probability that beliefs shift to $p < p^*$, and increases his survival

probability (if the coup constraint was satisfied). The argument for the good type ruler is analogous. Once the coup constraint of the bad type is reached, the good type ruler always has incentive to decrease R^g until exactly satisfying his coup constraint in order to decrease $G(y^{g*})$, the probability he is perceived as a bad type with a sufficiently high probability to provoke a revolution (and eventually a preemptive coup). (ii) All rent profiles to the right of point (b) can't be equilibria. In the area to the right of the revolution constraint evaluated at $p = \pi$, recall that coup constraints are not relevant since revolution constraint is always violated in period 5 at belief $p = \pi$. In the remaining area to the right of point (b), coup constraint of the good type is always satisfied. Good type ruler always has incentive to decrease R^g in order to decrease the probability that there is a threat of revolution which result in a zero payoff for the ruler. (iii) For rent profiles to the left of point (e), both coup constraints are never satisfied simultaneously. As a result, a ruler of type *i* whose coup constraint is not satisfied increases R^i . Otherwise, he would experience a coup with probability one.

This equilibrium (e) has several interesting properties. For a given equilibrium rent profile (R^{b*}, R^{g*}) , with probability $G(y^{i*})$ there is a sufficiently strong shock that produces an outcome very unlikely to occur under good type ruler that shifts beliefs to $p < p^*$. This corresponds graphically to a counter clockwise shift in the revolution constraint (2) which crosses point (e) at $p = p^*$. In such a case, workers' belief that ruler is of good type is low and this results in an expected outcome in second period if ruler remains in power which is low (since $\phi_b R^b > \phi_g R^g$). This induces workers to revolt at stage 5 if ruler has not been replaced. Due to assumption 1, $CV_e^e(C=1) > \frac{\lambda}{\delta}$, elite have an interest to preemptively mount a coup. Indeed workers would revolt at stage 5 at $p < p^*$ but not at $p = \pi$. In other words, by changing the ruler, the elite modify beliefs of citizens concerning ruler type and decrease the revolution threat in order to prevent revolution and secure future rents.

Another important characteristic of this equilibrium is since mean outcome for the good type ruler is better than mean outcome for the bad type $(\phi_b R^b > \phi_g R^g)$, we have that $y^{b*} > y^{g*}$ which implies $(1 - G(y^{g*})) > (1 - G(y^{b*}))$. In other words, a good type ruler has to experience a much more adverse shock than a bad type ruler in order to be perceived as a bad type with a sufficiently high probability to violate the revolution constraint $(p < p^*)$. Well managed autocracies are thus much more stable than others. This is consistent with Olken's (2005) findings: (i) the performance of autocracies are very heterogeneous and leader specific and (ii) many autocratic leaders die from natural causes and are not threatened neither by coups or revolution.

In our model on average, the coup mechanism of autocrat replacement is welfare improving from the point of view of the workers since bad leaders are more likely to be removed than good leaders. Nevertheless coups do not always improve welfare of workers because in some cases, it can replace a good autocrat that have been perceived as bad due to a strong enough adverse shock.

Of course, other parameter configurations may induce other types of equilibria. Strong checks and balances limit the ability of the ruler to derive personal benefits from his position and in our model this translates to a low ego rent R^{E} . As a result, coup constraints are satisfied for much lower amount of rent and point (e) may be located below the revolution constraint evaluated at p = 0. This could also be obtained from very high costs of mounting a coup λ which shifts coup constraints toward the origin (in case of high fidelity of military for instance) or from very high costs of revolting ζ which shifts up the revolution constraint at p = 0. In such a case, a good type or bad type ruler can satisfy the coup constraints without any probability of facing a threat of revolt. Such a point (e) location would be a Nash equilibrium. But it's weak and there exists many others Nash equilibria given a type i ruler can increase rent profile R^{i} without facing any risk of revolutionary threat. In such a equilibrium choice of rent may depend on ruler preferences: does he care more about workers or elites. Those autocracies enjoying strong constraints on the executive power (and thus are not too far from democratic standards) or characterized by institutions which make the cost of mounting a coup or revolting very high are thus very stable.

In our baseline model, the threat of revolution is a latent variable and there is never effective protest nor revolution that can make the regime collapse. Revolution is a rare event in the data compared to coups but it sometimes occurs. We deal with this issue more carefully in an extended model we present in an appendix. This model allows for effective popular unrest and we include the possibility of successful revolutions. We follow the argument of Aidt and Leon (2015) and argue elite does not necessary observe the willingness of the population to revolt that is, the threat of revolution. In our case, the elite do not observe directly the beliefs of citizens. For instance, the way shocks translate into a particular outcome for citizen may be uncertain to the elite, or the elite may be uncertain on how particular rent-extracting institutions have impacted the mean outcome and welfare of citizens.

In this extended model, workers may start a revolt and the elite may mount a coup after observing the workers' decision. When starting a revolt, workers signal to the elite what their beliefs are. After observing the elite's coup decision, workers may decide wether or not to continue the revolt. At this stage, the cost of continuing the revolt is revealed and it may be high or low depending on the regime strength, which is revealed during an ongoing revolt. We characterize equilibria of the game such that workers start a revolt for sufficiently low beliefs ruler is of good type. For such beliefs, workers would continue the revolt and democratize whatever the cost of continuing the revolt is revealed to be. At this equilibrium, elite have an incentive to mount a coup which modifies the beliefs. At such a new beliefs citizens have an incentive to continue the revolt only if the cost is revealed to be low. In other words, by mounting a coup, elite only have a chance of stopping the ongoing revolt which can possibly degenerate into a full revolution. Revolution is thus a possible outcome of the extended model. However the basic mechanism remains the same: Elite mount a coup when the regime faces a threat of revolution which takes the form of effective revolts in the extended model.

3 From theory to empirics

The principle theoretical property of our model that we investigate empirically is that popular discontent increases the threat of a revolution and that the elite may mount a preemptive coup in order to prevent an actual revolution from occurring. Identification of periods of revolutionary threat is not straightforward, however. We argue that political discontent may translate into observable political actions. While actual revolutions are rare events, we frequently observe popular discontent with an autocratic leader expressed by citizens in the form of popular unrest (protests, riots, strikes, etc.). Empirically, we use the intensity of episodes of popular unrest as a proxy for the threat of revolution and investigate the extent to which popular unrest leads to elite-led coups. Aidt and Leon (2015) and Aidt and Franck (2015) follow a similar strategy for identifying a revolutionary threat, though their focus is on how the revolutionary threat may lead to democratic concessions, whereas we focus on how a revolutionary threat may lead to an elite-led preemptive coup.

In our baseline model, the revolutionary threat is latent in the sense that actual revolutions do not occur since the perfectly informed elite preemptively stage a coup whenever a shock arises that is severe enough to trigger a revolutionary threat in the final stage. The extended model that is in the appendix (see last subsection) relaxes the assumption that the elite are perfectly informed and as a result there are actual incidences of popular unrest in equilibrium rather than only a latent threat. The extended model builds on the argument of Aidt and Leon (2015) that popular unrest can be a signal of popular discontent in an autocratic setting where the elite are imperfectly informed about the strength of the revolutionary threat. It provides a rigorous theoretical foundation for the observation that instances of popular unrest are suitable proxies for the threat of revolution. Empirically, the extended model explicitly predicts that coups will be preceded by observable popular unrest.

Finally, our model features a unique mechanism by which shocks form the revolutionary threat that we will investigate empirically. In our model, shocks (which may be economic though not necessarily) may be informative about the leader's type and may result in popular discontent that could form a revolutionary threat. Thus, shocks in our model do *not* lead to a heightened revolutionary threat through the opportunity cost channel that is most commonly found in the theoretical and empirical literature that relates economic shocks to political instability and/or political institutional change.¹⁴ As noted by Aidt and Franck (2015), the empirical research that relates economic shocks to democratic change is indirectly testing the notion that democratic concessions are made in response to a revolutionary threat that has been amplified through the opportunity cost channel, but in fact, the relation could operate through other channels. In the empirical section that we present below, we distinguish between variation in the intensity of popular unrest that could plausibly be caused by the opportunity cost channel from that which could not and investigate the extent to which such variation can explain the likelihood of experiencing elite-led coups.

4 Empirical investigation

In this section we provide some empirical evidence that supports our theoretical hypothesis that elite-led coup d'états occur in response to civil unrest and a latent revolutionary threat.

4.1 Empirical strategy

Using country-level panel data from sub-Saharan Africa over the period 1990 - 2011, we estimate fixed effect models that explain the probability that a country experiences a coup d'état using data on riots. As a robustness check, we also consider a wider panel that includes countries from other regions of the world.

In addition to country and year dummies, our baseline estimations control for several important time-varying variables, such as the democratic quality of political institutions (the Polity IV index), the level of economic development (GDP per capita), and economic growth (GDP per capita growth rates). All three of these variables are correlated with macroeconomic instability that may trigger civil unrest. To the extent that the variables are also correlated with the probability of experiencing a coup d'état, their omission could substantially bias estimates of the effect of civil unrest.

Controlling for the quality of political institutions, for instance, is important because deterioration of democratic institutions may influence both the probability of a coup

¹⁴For an early contribution, see Grossman (1991). Acemoglu and Robinson (2001, 2005) rely heavily on the opportunity cost logic in their their of political transitions to democracy. Chassang and Padro-i Miquel (2009) have a theory of civil war that is based on the opportunity cost logic. Burke and Leigh (2010) and Brückner and Ciccone (2011) provide empirical studies that relate macroeconomic contractions to the probability of democratization, which they claim provides support for the opportunity cost logic of Acemoglu and Robinson (2001, 2005).

and the probability that citizens express their discontent with government through non-electoral means such as street riots. One would certainly expect that instability of political institutional quality would be associated with greater irregular leadership turnovers, such as via coup d'état.

We also find it important to control for the both the level of economic development and the rate of growth. Low levels of economic development may be associated with low state capacity that does not allow the regime in power to provide sufficient patronage revenues to its key supporters, such as the military or business elite. Low levels of economic growth may lead to tighter budget constraints for the ruling government that require it to reduce expenditures in politically sensitive areas. Moreover, both the level of development and the rate of growth may also affect the likelihood of civil unrest.¹⁵ We thus control for both the level of development and the growth rate as their omission could bias our estimates of the effect of riots on the probability of experiencing a coup.

Of course, endogenous determination of riot intensity is a serious concern, since ruler turnover may itself be the source of the popular unrest. As a first attempt to deal with the possible reverse causality, we simply include a lagged dependent variable in our OLS panel estimations. We then deal with the issue more rigorously by implementing an IV strategy in which we follow Aidt and Leon (2015) by instrumenting riot intensity with extreme weather variations (the lagged incidence of droughts, more specifically).

Using data on extreme weather variation seems well-suited to instrument for variation in riot intensity of the kind that we consider in our theoretical section. Recall that we are interested in civil unrest that follows shocks that reveal information about the ruler. Droughts can obviously cause large variations in economic outcomes that can reveal information about the ruler type. But there are other observational outcomes that may reveal information about the ruler's type – how the crisis was managed, the effectiveness in mobilizing international assistance and distributing economic aid to affected regions, etc. Upon observing these economic and noneconomic outcomes that follow droughts, citizens make inferences concerning the ruler type and may riot. What is required for the instrument to be valid is that the weather shock does affect the decision of the elite to stage a coup (except through its impact on the likelihood of civil unrest). As extreme weather variation has observational effects beyond the current period, we consider include first and second lags, which are significantly correlated with current period riots.

Here as well, it is important to control for the economic growth rate for two reasons. First, as droughts affect the growth rate, their occurrence may directly affect the

¹⁵A standard explanation in the literature is that worsening macroeconomic conditions reduce the opportunity cost of engaging in contentious politics (see Grossman, 1991; Chassang and Padro-i Miquel, 2009; Acemoglu and Robinson, 2001; Gallego and Pitchik, 2004, for example).

likelihood of experiencing a coup through the standard opportunity cost mechanism (Acemoglu and Robinson, 2001, for example). Therefore, controlling for growth rates (the most common proxy for opportunity cost in the literature) seems necessary in order to satisfy the exclusion restriction, which requires that the instrument (droughts) affect the dependent variable (coup) only through their impact on the potentially endogenous regressor of interest (civil unrest). Second, and relatedly, controlling for growth rates allows us to investigate the channel through which civil unrest may affect the likelihood of a coup. Since drought can affect our hypothesized information channel as well as the opportunity cost of rebelion, controlling for growth in both stages allows us to isolate the variation in riot intensity that is not related to changes in the opportunity cost. In other words, including the growth rate in both stages means that instrumented variation in the intensity of civil unrest will be orthogonal to variation in the growth rate, which rules out the possibility that the estimated effect of civil unrest on the likelihood of coups is going through the opportunity cost channel.

4.2 Data

Coup d'états in sub-Saharan Africa. We focus our analysis on sub-Saharan Africa, where political instability and extreme weather variations are all too common. Our baseline sample covers 38 countries in sub-Saharan Africa over the years 1991 – 2007. During that time period, there were 46 instances of coup d'états, according to the data provided by Powell and Thyne (2011), who are very careful to avoid "conflating coups with other forms of anti-regime activity." In the definition of Powell and Thyne (2011), coups "may be undertaken by any elite who is part of the state apparatus. These can include non-civilian members of the military and security services, or civilian members of government." Their definition importantly does not include broader instances of civil conflict that include large segments of the general population, such as the riots that we use to proxy for civil unrest. Additionally, their definition does not focus only on military interventions and also includes unsuccessful coup attempts.

Popular unrest. To proxy for popular unrest, we employ the rich data set from Aidt and Leon (2015), which captures not only the incidence of popular unrest, but also its intensity and political salience. Using the original data from the Social Conflict in Africa Database (Salehyan et al., 2012), riot intensity is calculated by totaling duration of all riots that happened in a given year in a given country. The SCA database includes geographic coordinates, which allows for useful weighting schemes to capture the political salience of popular unrest.

Following Aidt and Leon (2015), we consider three weighted riot intensity measures that are weighted using the geographic coordinates by (i) the density of the local population where the riot occurred, (ii) the distance from the country's capital city, and (iii) the "centrality" in the country. Using the GIS map "1km 2010 Africa population distribution" from Afripop, the first weighting scheme weights each riot location with the log of the local population density of the locality. As a result, riots in urban centers carry larger weights. The second weighting scheme uses data for the location of capital cities from the CShapes data set provided by Weidmann et al. (2010). Each riot location is weighted by the inverse of the lot distance between the location and the capital city of the country in which the riot occurs. As a result, riots that happen closer to capital cities have larger weights. Finally, riots are weighted by the "centrality" of their location, which is captured by creating a gravity-based measure of population concentration around the capital city. The centrality weighting scheme is theoretically appealing. Campante and Do (2009) convincingly argue that the concentration of population around the capital city provides informal checks and balances on autocratic leaders, increasing their political accountability to opposing groups. As such, riots that occur in more "central" locations have a greater political salience and are assigned a greater weight.¹⁶

Instruments. We use rainfall data from the Global Precipitation Climatology Project [GPCP] to identify instances of droughts. Following Aidt and Leon (2015), a country experienced a "drought" in a given year if its annual rainfall level was below the sample's 20th percentile.¹⁷ We create a binary variable that takes value one in country-years where rainfall was below this threshold and zero otherwise, which we then interacted with the share the labor force working in the agricultural sector.

Other controls. We also have our standard battery of controls. To control for the level of economic development, we use the natural logarithm of PPP-adjusted per capital GDP from the World Development Indicators. Growth rates in the per capita GDP were also taken from the WDI. Finally, we control for political institutions using the Polity IV index from Marshall and Gurr (2012), which takes a value of -10 for a perfectly autocratic political institution and a value of 10 for a perfectly democratic political institution. Table 1 provides summary statistics from our baseline sample of sub-Saharan African countries over the 1991 – 2007 period. In table 1 we also provide summary statistics for the sub-sample of country-year observations in which there was a coup d'état and the sub-sample in which there was not.

¹⁶We thank Toke Aidt and Gabriel Leon for sharing their data with us.

¹⁷Brückner and Ciccone (2011) and Couttenier and Soubeyran (2014) also employ a physical, rather than economic, definition for drought.

4.3 Estimation results

OLS results. Table 2 presents results from ordinary least squares [OLS] estimations. In all seven of the models estimated with OLS, riot intensity is positive and highly statistically significant. The first column presents the raw bivariate correlation between riot intensity and the likelihood of experiencing a coup. The second column includes country country and year dummies into the estimation. The magnitude of the estimated impact is substantial. A one standard deviation increase in the log of riot intensity is associated with an increase in the probability of experiencing a coup by 4.4 percentage points (0.0258*1.74). Relative to the unconditional probability of having a coup of 0.07, this is indeed an economically significant effect. If we compare the lowest decile of logged riot intensity (0) to the highest decile (4.85), the predicted probability of experiencing a coup increases by 12.5 percentage points – almost two times the unconditional probability of experiencing a coup.

The remainder of the results in the paper are from estimations that include our standard battery of time-varying controls. Estimates of the effect of riot intensity on the likelihood of experiencing a coup d'état remain highly statistically significant and quite stable in their magnitude. Throughout, we find that controls for economic development and political institutions do not explain coup d'états with statistically significant. The negative estimated impact of economic growth rates are highly statistically significant. The negative estimated impact of economic growth rates is as would be expected from our theory and is consistent with other studies that have found economic contractions to be correlated with political instability (Alesina et al., 1996; Jong-A-Pin, 2009) but it is difficult to interpret due to the possibility that GDP growth and the incidence of a coup are endogenously determined.¹⁸ Including a lagged dependent variable (in column 4) does not affect the estimated effect riots, which provides some preliminary evidence that causality runs in the direction that we have hypothesized. The next table of results explores the causal chain more rigorously by employing the IV strategy described in the first sub-section.

Additionally, we estimate the effect of within-country variation in riot intensity weighted by the centrality of their incidence (in column 5), their distance from the country's capital city (in column 6), and the size of the city in which they occurred (in column 7). As expected, the estimated magnitude of the effect of weighted riot intensity is greater than that of un-weighted riot intensity (in column 3) for all three of the weights. In particular, the estimated effect of riot intensity weighted by distance

¹⁸We remind readers that our main focus in this section, however, is coming up with an unbiased estimate of the effect of riot intensity on the likelihood of a coup. To this end, we have included the economic growth rate as an important time-varying control, the omission of which could lead to biased estimation results.

to capital is more than 50 percent greater than the estimated effect of the un-weighted variable.¹⁹

IV results. Table 3 presents results from our IV strategy, where we have used extreme temperature variations (droughts) as an instrument for riot intensity. In the table, we only present the second stage of the 2SLS estimation procedure, though we report the first-stage F- statistic for the excluded instruments. In panel A of table 3 we present results from estimations that did not include time-varying controls, whereas the results in panel B were estimated with our full battery of time-varying controls. The sample for which we have data for the instruments is slightly reduced from the sample used to estimate the OLS results from table 2, so we have included in the first column of table 3 OLS estimates on the sample for which the IV data is available.

Comparing the first and second columns of table 3, we see that the 2SLS estimates are an order of magnitude larger than the OLS estimates (nearly twice as large in panel A and nearly three times as large in panel B), suggesting that the OLS estimates were underestimating the effect of civil unrest on the likelihood of coup d'états. It is also interesting to note that the estimated exogenous effect of riot intensity is greater when we control for the economic growth rate. Economic contractions could affect the likelihood of a coup through a different channel (the opportunity cost channel for instance) than the civil unrest channel that is the focus of our theory.²⁰ Since droughts are associated with economic contractions as well, if we do not control for the economic growth rate in both stages, then the instrumented change in riot intensity may not be isolating the civil unrest channel that is our focus. As in the OLS regressions, the result is not sensitive to the inclusion a lagged dependent variable and the magnitude of the estimated effect of riot intensity is even larger when we use the weighted riot intensity measures.

Our instruments are reasonably strong (according to first stage F- statistics on excluded instruments) and are exogenous (according to p- values on the Hansen J-statistic). It is interesting to note that when we do include time-varying controls (in panel B), the instruments are slightly less strong, but violate the exclusion restriction with a far lower probability. This difference seems to be driven by the inclusion of the economic growth variable in panel B. Similar to the discussion above, when we do not control for economic growth rates, the instrumented variation in riot intensity may include correlated variation in the economic growth rate that also affects the likelihood of experiencing a coup. Thus, we view the second stage estimates that control for the

¹⁹This result is consistent with the work of Campante et al. (2014), who find that regimes seated in isolated capital cities are less likely to be overthrown.

 $^{^{20}}$ See Kim (2014), who finds that exogenous variation in economic growth rates (instrumented using rainfall and temperature variation) can explain the likelihood of coups.

economic growth rate (in panel B) to be more reliable estimates of the effect of riot intensity, as the instrument is more exogenous when the growth rate is included in both stages.

Finally, we note that the magnitude of the estimated effects are substantial. From column 2 of panel B, the estimated impact of a standard deviation increase in riot intensity leads to a 12 percentage point increase in the likelihood of experiencing a coup d'état. An increase in riot intensity from the bottom decile to the top decile leads to a 33.7 percentage point increase in the probability of a coup. When riot intensity is weighted by centrality and distance from the capital, the estimated magnitudes are larger still. Compared to the unconditional probability of 0.07, these impacts are indeed substantial.

Alternative riot data. We have also investigated the correlation between riots and coup d'états using data on riots from Banks (2015), which covers a much larger number of countries and a longer time span. In the first four columns of table 4, we continue to use the coup measure from Powell and Thyne (2011) as the dependent variable, while we use the coup measure from Banks (2015) as the dependent variable in the final column. The estimated coefficient remains statistically significant and of a reasonable magnitude. We have not pursued an IV strategy using the Banks (2015) data since our drought data seems less compelling as an instrument out of the sub-Saharan Africa context.

5 Conclusion

In this paper we have developed a new mechanism in order to explain the frequent occurrence of coups in non-democracies that lead to political turnover without political transitions to democratic institutions. Rulers design institutions in order to extract rent for the elite which deteriorates the mean economic outcome. We highlight two motives for the elite to mount a coup. First, the elite can mount a coup because the ruler is not providing them with enough rent. Second, the elite can mount a coup if the threat of having a successful revolution is high enough. In our model, the threat of revolution is related to dissatisfaction with the ruler given some beliefs concerning ruler type. Workers can make inference concerning ruler type after observing the economic outcome following an economic shock. By mounting a coup and replacing the ruler, the elite can reset the beliefs of citizens concerning ruler type back to prior beliefs, which may lower the threat of revolution and the risk of democratization. We have characterized an equilibrium rent profile such that the elite never have and incentive to mount a coup in tranquil times since both ruler types distribute enough rent. But the elite will mount a coup when workers believe with a sufficiently high probability that the ruler is a bad type, which can occur following a economic shock. We then document some empirical regularities consistent with our model that suggest that a heightened revolutionary threat has a causal impact on the likelihood of an elite-led coup d'état. We have argued that the result is not being driven by the standard opportunity cost mechanism, which leaves the window open for our alternative informational mechanism.

There are many directions for future research. One of them is to find a measure of citizen beliefs concerning satisfaction with status quo policies in non-democracies in order to test more precisely the mechanism highlighted in this paper. Kuran (1989) suggests this may be particularly difficult, however. Another research issue is to model in more detail the sharing rules that may exist between the elite and the ruler. In our model, things remains quite simple along this dimension as all the rent extracted goes to the elite and we assume that the ruler derives welfare from the ego rent (which can include part of the equilibrium rent). In a more sophisticated model, one could make the ruler's welfare depend directly on the rent extracted. We leave those questions for future research.

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6 Appendix

6.1 Coups and revolutions

In the baseline model, the elite observe rent extraction by the ruler and the economic outcome, so there are no revolutions in the natural equilibrium we have considered. In that case, when the economic outcome is such that the workers want to revolt, the elite stage a preemptive coup in order to change the ruler. This leadership turnover returns the beliefs of the workers about the ruler's type to those of the beginning of the game. However, successful revolutions do occur even though the data indicate that the vast majority of non-democratic regime changes are due to coups and that revolutions are often aborted.

In addition, we often observe mass protest movements in autocracies preceding coups or even revolutions. For instance, the military removed former Egyptian President Morsi from power following massive protests in Tahrir Square. Taiwan in 2014 and Burundi in 2015 are other recent examples (in the case of Burundi, the coup was not successful, a possibility we not consider in the model). We now modify our framework in order to make successful revolutions possible and also to allow for protests that need not become a full-blown revolution. The key assumption we relax is that the elite can observe directly the outcomes of citizens and therefore infer their beliefs.²¹ In this new model, workers will have two temporally distinct choices to make: start a revolt and continue the revolt. This will allow the model to have both successful and aborted revolutions.

6.1.1 Environment

The environment is very similar to the basic model. The only difference concerns the welfare of citizens w, which we now suppose is subject to unobservable shocks from the point of view of the elite. This justifies the fact workers will play first, before the elite. The elite have no information on citizen beliefs before observing any citizen action. We assume mounting a preemptive coup just after citizens form their beliefs is too costly (cost of mounting a coup) given there is high probability that there is no threat of

²¹In many cases, beliefs can evolve following an unobservable shock that affects workers' welfare but which does not translate directly into instantaneous observable deterioration in outcomes. Rent capture may be a decentralized process and may not be directly observed by elites. Public agents may be corrupt, but poor management of public funds may be easy to conceal (e.g. public agents do not report inefficient public provision to the leader and elite). Informative news may be released, but the elite do not observe directly the impact on citizen beliefs. For instance, wikileaks cables gave to citizens all over the world precious and credible information concerning many ruling autocrats.

revolution. We do not explicitly model parameter values for which this is true and simply assume that elite observe first move of citizen before acting themselves. The shocks follow the same distribution as in the baseline model. The timing of the game is the following:

- 1. Nature chooses the type of the ruler as in the baseline model.
- 2. The ruler chooses the level of rent to extract as in the baseline model.
- 3. The economic outcome is determined as in the baseline model.
- 4. Workers can start a revolt $(z_s = 1)$ with associated cost ζ_s .
- 5. Elite can mount a coup (C = 1) with associated cost λ .
- 6. If workers started a revolt in stage 4, they can continue $(z_c = 1)$ the revolution with a cost ζ_c , which is randomly drawn each period and is either $\overline{\zeta_c}$ with probability h or $\underline{\zeta_c}$ with probability (1 - h) with $\overline{\zeta_c} > \underline{\zeta_c}$. Continuing the revolt causes democracy to result and the game ends. If the revolt is not continued, then the game goes back to stage 3. If a coup occurred in stage 5 then the game goes back to stage 1.

6.1.2 Strategies, payoff and equilibria

Workers: continuing the revolt. As in the previous analysis, the game is solved recursively. We first start with stage 6. The workers decide whether to continue an ongoing revolt (which workers started in stage 4). If the workers did not start a revolt in stage 4 ($z_s = 1$), there is no decision to take in stage 6. We have, given a belief p, the value of continuing an ongoing revolt:

$$V_w^e(z_s=1, z_c=1|p) = w - \zeta_s - \zeta_c + \delta C V_w^D,$$

with, as before, $CV_w^D = \overline{w}$

If workers do not continue an ongoing revolt then,

$$V_w^e(z_s = 1, z_c = 0|p) = w - \zeta_s + \delta C V_w^e(z_c = 0|p),$$

with continuation values $CV_w^e(z_c = 0|p) = \overline{w} - p\phi_g R^g - (1-p)\phi_b R^b$ as defined in the baseline model. We can obtain the ongoing revolution constraint at period 6 by comparing both value functions for a belief p:

$$\zeta_c = p\delta\phi^g R^g + (1-p)\delta\phi^b R^b.$$

At p = 0 and p = 1, ongoing revolution constraints are respectively $\delta \phi^b R^b = \zeta_c$ and $\delta \phi^g R^g = \zeta_c$. As previously, if $\delta \phi^g R^g < \delta \phi^b R^b$ and $\delta \phi^b R^b > \overline{\zeta_c} > \underline{\zeta_c}$ and $\delta \phi^g R^g < \underline{\zeta_c} < \overline{\zeta_c}$ there exists a $p_{c,l}^* \in (0,1)$ such that workers continue a revolt if $p < p_{c,l}^*$ when $\zeta_c = \underline{\zeta_c}$. There also exists a $p_{c,h}^* \in (0,1)$ such that workers continue a revolt if $p < p_{c,h}^*$ when $\zeta_c = \overline{\zeta_c}$. Considering the contrast of the two there exists a $p_{c,h}^* \in (0,1)$ such that workers continue a revolt if $p < p_{c,h}^*$ when $\zeta_c = \overline{\zeta_c}$. Of course, if $\underline{\zeta_c} < \overline{\zeta_c}$, then $p_{c,h}^* < p_{c,l}^*$. For the rest of the analysis, we will characterize equilibrium rent extraction such that $\overline{\zeta_c} > \pi \delta \phi^g R^g + (1-\pi) \delta \phi^b R^b > \zeta_c$. That is, if elite

mount a coup and beliefs shift to $p = \pi$, there will still exist a revolutionary threat if the cost of continuing a revolution is low.

Elite. We now turn to the elite's decision of whether to mount a coup or not. Here we have to distinguish two situations in stage 5. After the workers have started a revolt, even if the elite mount a coup, there is still a possibility that the revolt continues and the elite lose everything. The two value functions for the elite when deciding to mount a coup depend on the decision of workers in 4 to start a revolt.

$$V_e^e(z_s, C = 0 | p, i = \{b, g\}) = R^i + \delta C V_e^e(z_s, C = 0 | p, i = \{b, g\}).$$

When the elite mount a coup, we have

$$V_e^e(z_s, C = 1 | p, i = \{b, g\}) = R^i - \lambda + \delta C V_e^e(z_s = \{0, 1\}, C = 1),$$

with the continuation value $CV_e^e(z_s, C = 1)$ when staging a coup, which depends on the decision the workers took at stage 4 of starting a revolt or not (z_s) . That is,

$$CV_e^e(z_s, C=1) = \frac{1}{N}V_r^e + [1 - \frac{1}{N}][1 - \pi]CV_e^e(p=\pi; i=b) + [1 - \frac{1}{N}]\pi CV_e^e(p=\pi; i=g),$$

As previously, $CV_e^e(p=\pi; i=b) = cR^b$, $CV_e^e(p=\pi; i=g) = cR^g$, and $V_r^e = cR^E$. If $z_s = 0$, then c = 1 since there is no threat of revolution and both coup constraints are exactly the same as the previous model when there is no threat of revolution. Elites are certain to obtain equilibrium rent R^i or the ego rent R^E in the second period. They simultaneously bind at $R^* = R^b = R^g$.

If $z_s = 1$ (workers start a revolt in stage 4), then c = h if $\overline{\zeta_c} > \pi \delta \phi^g R^g + (1 - \pi)\delta \phi^b R^b > \underline{\zeta_c}$ (workers continue the revolt at $p = \pi$ only if the cost is low and elite have a zero payoff with probability 1 - h). We have c = 0 if $z_s = 1$ (workers start a revolt in stage 4) and $\pi \delta \phi^g R^g + (1 - \pi)\delta \phi^b R^b > \overline{\zeta_c}$ (workers continue the revolt at $p = \pi$ at any cost of continuing a revolution and elites get a zero payoff with probability one). Of course, we have c = 1 if $z_s = 1$ and $\underline{\zeta_c} > \pi \delta \phi^g R^g + (1 - \pi)\delta \phi^b R^b$ (workers never continue a revolt at $p = \pi$). We will focus on equilibrium such that $\overline{\zeta_c} > \pi \delta \phi^g R^g + (1 - \pi)\delta \phi^b R^b > \underline{\zeta_c}$. In other words, there is room for the elite to quell a revolt by staging a coup, but this does not stop the revolt with certainty.

We can also compute the continuation value when no coup is attempted. In order to save space, we only focus on the case in which there exists the possibility of successful revolt, i.e., where $\overline{\zeta_c} > \pi \delta \phi^g R^g + (1 - \pi) \delta \phi^b R^b > \underline{\zeta_c}$ and $\delta \phi^b R^b > \overline{\zeta_c} > \underline{\zeta_c}$ and $\delta \phi^g R^g < \underline{\zeta_c} < \overline{\zeta_c}$. In such a case, when no revolution is started, we have that $CV_e^e(z_s = 0, C = 0, i = \{g; b\}) = R^i$. If a revolution started and the elite do not mount a coup, continuation values depend on beliefs which are not directly observed by the elite contrary to the baseline model. Let's define p_s^* such that workers start a revolution at period 4 for beliefs such that $p < p_s^*$ (see below for the computation of p_s^*). For ease of exposition, we focus on parameter values such that equilibrium rent is characterized by $p_s^* \delta \phi^g R^g + (1 - p_s^*) \delta \phi^b R^b > \overline{\zeta_c} > \zeta_c$ (see below to see that such parameter values

exist).²² In other words, at p_s^* citizens will continue a revolution they started whatever is the cost of continuing the revolution. In such a case, $CV_e^e(z_s = 1, C = 0 | p < p_s^*) = 0$ since workers continue an ongoing revolt.

As in the baseline model, comparing $V_e^e(z_s = 1, C = 1)$ and $V_e^e(z_s = 1, C = 0)$, we can derive that the elite will mount a coup at $z_s = 1$ only if $CV_e^e(z_s = 1, C = 1) > \lambda/(h\delta)$ which is always true under a slightly modified assumption 1: $-\lambda + \delta h(1/N)R^E > 0$. As in the baseline model, we will characterize equilibria for which this assumption is satisfied.

Workers: starting a revolt. We now analyze the decision to start a revolt for workers, given the coup constraints are satisfied at $z_s = 0$ (equilibrium rent is such that the elite do not mount a coup if there is no threat of revolution). As in the baseline model:

$$V_w^e(z_s = 0|p) = w + \delta C V_w^e(z_s = 0|p),$$

with $CV_w^e(z_s = 0|p) = \overline{w} - p\phi^g R^g - (1-p)\phi^b R^b$. Here again we restrict the exposition to the case where successful revolts are possible, that is where $\overline{\zeta_c} > \pi \delta \phi^g R^g + (1 - \pi)\delta \phi^b R^b > \underline{\zeta_c}$ and $\delta \phi^b R^b > \overline{\zeta_c} > \underline{\zeta_c}$ and $\delta \phi^g R^g < \underline{\zeta_c} < \overline{\zeta_c}$ (which correspond to the continuing revolution constraint evaluated respectively at $p = \pi$, p = 0 and p = 1). We also assume that the cost of mounting a coup is low enough to ensure that $CV_e^e(z_s = 1; C = 1) > \lambda/(\delta h)$ (note $CV_e^e(z_s = 1; C = 1)$ does not depend on the cost of mounting

a coup λ). That is, the cost is low enough to make it rational for the elite to mount a coup when a threat of an ongoing revolution exists. We show those conditions are satisfied at equilibrium. Thus, if workers start a revolt, we have

$$V_w^e(z_s = 1|p) = w - \zeta_s - (1-h)\zeta_c + \delta CV(z_s = 1|p = \pi),$$

with

$$CV(z_s = 1|p = \pi) = (1 - h)CV_w^D + hCV_w^e(p = \pi),$$

and with $CV_w^e(p = \pi) = \overline{w} - \pi \phi^g R^g - (1 - \pi) \phi^b R^b$ as defined previously. Indeed, if $\overline{\zeta_c} > \pi \delta \phi^g R^g + (1 - \pi) \delta \phi^b R^b > \underline{\zeta_c}$ workers will continue the revolt only if the cost of revolution is low which occurs with probability (1 - h). We will present parameter restrictions such that this is the case at equilibrium (see below). We can now compute the starting revolution constraints by equalizing value functions of workers evaluated at $z_s = 1$ and $z_s = 0$.

Proposition 6. There exists, under parameter restrictions for cost of starting and continuing a revolt $\zeta_s \in \{\underline{\zeta_c}, \overline{\zeta_c}\}$, a belief $p_s^* \in [0, 1]$ such that workers start a revolt if $p < p_s^*$.

Proof. The starting revolution constraint corresponds to $V_w^e(z_s = 0|p) = V_w^e(z_s = 1|p)$. The left hand side is increasing in p if $\phi^g R^g < \phi^b R^b$ (which is the case at equilibrium). The right hand side does not depend on p and is decreasing in ζ_s and ζ_c . Thus,

²²If for instance $\overline{\zeta_c} > p_s^* \delta \phi^g R^g + (1 - p_s^*) \delta \phi^b R^b > \underline{\zeta_c}$, elite would never have incentive to mount a coup in order to prevent an ongoing revolution.

 p_s^* is such that $V_w^e(z_s = 0 | p_s^*) = V_w^e(z_s = 1 | p_s^*)$ and we can parameterize ζ_s to make $p_s^* \in [0, 1]$.

We will focus on equilibria such that $\underline{\zeta_c} < \overline{\zeta_c} < p_s^* \phi^g R^g + (1 - p_s^*) \phi^b R^b$. In other words, when beliefs are such that workers start a revolution $(p < p_s^*)$, they will continue the revolution if beliefs do not change. As we will focus on equilibria such that $\overline{\zeta_c} > \pi \delta \phi^g R^g + (1 - \pi) \delta \phi^b R^b > \underline{\zeta_c}$, this implies $p_s^* < \pi$. It can be useful for the graphical analysis to compute the starting revolution constraint when p = 0 as

$$\frac{\zeta_s + (1-h)\zeta_c + \delta h \phi^g R^g}{\delta(1-h(1-\pi))\phi^b} = R^b,\tag{7}$$

which is an increasing function in the $\{R^b; R^g\}$ plane. When $p = \pi$ the starting revolution constraint is

$$\frac{\zeta_s + (1-h)\zeta_c - \delta(1-h)\pi\phi^g R^g}{\delta(1-\pi - h(1-\pi))\phi^b} = R^b,$$
(8)

which is a decreasing function in the $\{R^b; R^g\}$ plane.

The ruler. As in the previous model, the ruler enjoys an ego rent R^E and extracts rent from the economy in order to maximize the probability he remains in power subject to the coup constraints and the revolution constraints. The only difference with the previous model is that the ruler has to deal with two separate revolution constraints: starting a revolt and continuing the revolt. When $z_s = 0$, the coup constraints are the same as in our baseline model and the ruler only have to give the elite enough rent so that they have no incentive to mount a coup in order to capture the state prize. If not satisfied, a coup occurs with probability one when workers do not start a revolt. At the same time, while satisfying the coup constraints, the ruler has to deal with the revolution constraints. Rent extraction at the equilibrium we will characterize is such that $\overline{\zeta_c} > \pi \delta \phi^g R^g + (1-\pi) \delta \phi^b R^b > \underline{\zeta_c}$ and $\underline{\zeta_c} < \overline{\zeta_c} < p_s^* \phi^g R^g + (1-p_s^*) \phi^b R^b$. As previously, the elite will mount a coup for an additional motive: if workers have started a revolt at $p < p_s^*$, a coup shifts beliefs from $p < p_s^*$ to $p = \pi$ and at such a beliefs, workers may find it optimal to abort the revolt. Note, as stated previously, that as before the two coup constraints at $z_s = 0$ bind simultaneously at $R^* = R^{b*} = R^{g*}$. Note also that under our slightly modified assumption 1 and if $\overline{\zeta_c} > \pi \delta \phi^g R^g + (1-\pi) \delta \phi^b R^b > \zeta_c$ and $\zeta_c < \overline{\zeta_c} < p_s^* \phi^g R^g + (1 - p_s^*) \phi^b R^b$, we have that $CV_e^e(z_s = 1, C = 1) > \lambda/(\delta h)$. In other words, as in the baseline model, the elite have an incentive to mount a coup and replace the ruler under the threat of an ongoing revolution.

6.1.3 Equilibrium

Graphical characterization of the game's equilibrium is very similar to the baseline model. As before, under the same assumption we made on parameters, the two coup constraints when $z_s = 0$ (workers did not start a revolt) are increasing and bind simultaneously on the 45 degree line for $R^* = R^{b*} = R^{g*}$ (see figure 3).

[insert figure 3 here]

The continuing revolution constraints (period 6) are vertical and horizontal for p = 0or p = 1 and decreasing for $p = \pi$ (or for any p different from 0 and 1). They intersect uniquely when $\zeta_c = \underline{\zeta}_c$ or $\zeta_c = \overline{\zeta}_c$ (see figure 4). When p decreases, the continuing revolution constraints rotate counter-clockwise.

[insert figure 4 here]

The starting revolution constraint is increasing when p = 0 and decreasing when $p = \pi$ (see figure 5). The starting revolution constraint intersects the R^b axis at a higher value when $p = \pi$ than when p = 0 since $[(\zeta_s + (1 - h)\underline{\zeta}_c)/\delta(1 - h(1 - \pi))\phi^b] < [(\zeta_s + (1 - h)\underline{\zeta}_c)/\delta(1 - \pi - h(1 - \pi))\phi^b]$ (see (7) and (8)).

[insert figure 5 here]

Using previous arguments, we can see that there exists a $R^E > 0$ such that both coup constraints bind at point (e) with $R^{b*} = R^{g*} = R^*$, such that $\overline{\zeta_c} > \pi \delta \phi^g R^{g*} + (1 - \pi) \delta \phi^b R^{b*} > \underline{\zeta_c}$ and $\delta \phi^b R^{b*} > \overline{\zeta_c} > \underline{\zeta_c}$ and $\delta \phi^g R^{g*} < \underline{\zeta_c} < \overline{\zeta_c}$ (see figure 2). We can then parameterize ζ_s such that $[(\zeta_s + (1 - h)\underline{\zeta_c})/\delta(1 - h(1 - \pi))\phi^b] < R^* < [(\zeta_s + (1 - h)\underline{\zeta_c})/\delta(1 - \pi - h(1 - \pi))\phi^b]$, which are the intersections of the two starting revolution constraints with R^b axis. Note that ζ_s does not affect the slopes of the two starting revolution constraints nor that of the continuing revolution constraints. We can then parameterize h and π (which do not affect the continuing revolution constraints) in order to ensure that the point (e) is located above the starting revolution constraints when p = 0 and below the starting revolution when $p = \pi$. Thus $p_s^* < \pi$ and we parameterize ζ_s (which affects p_s^*), $\underline{\zeta_c}$ and $\overline{\zeta_c}$ such that $\underline{\zeta_c} < \overline{\zeta_c} < p_s^* \phi^g R^g + (1 - p_s^*) \phi^b R^b$). That is, workers will continue an ongoing revol whatever it costs at $p = p_s^*$. We can then parameterize λ low enough to make $CV_e^e(z_s = 1; C = 1, p = \pi) > \frac{\lambda}{\delta h}$ (see our modified assumption 1). That is, elite will always have an incentive to mount a preemptive coup when there exists a threat of revolution. Note that the cost of mounting a coup does not affect the starting revolution constraint nor the continuing revolution constraint.

Using the previous argument, it's obvious to show we have a point (e) which is a Nash equilibrium such that both coup constraints are satisfied and workers would start a revolt only at $p < p_s^*$. The elite will mount a coup as $\overline{\zeta_c} > \pi \delta \phi^g R^g + (1-\pi) \delta \phi^b R^b > \zeta_c$ and $\underline{\zeta_c} < \overline{\zeta_c} < p_s^* \phi^g R^g + (1 - p_s^*) \phi^b R^b$ and $CV_e^e(z_s = 1; C = 1) > \frac{\lambda}{\delta h}$ (the cost of mounting a coup is not too high). By doing so, the elite have a chance to stop an ongoing revolt. Then the workers continue the revolt only if $\zeta_c = \zeta_c$ which occurs with probability (1-h). As stated previously, under such a parameter configuration, the point (e) equilibrium is unique. We do not describe all of the other possible Nash equilibria we could obtain under different parameter configurations. The important feature of the equilibrium at point (e) is that when a shock occurs and reveals that the ruler is a bad type with a sufficiently high probability $(p < p_s^*)$, the workers will find it optimal to start a revolt having in mind this will lead to a coup and a leadership replacement. This is the first benefit of revolting which we highlight in the baseline model. Nevertheless, at (e), workers will find it optimal to continue the revolt at $p = \pi$ (since a coup occurs and new leader type is unknown) only if $\zeta_c = \underline{\zeta}_c$ which occurs with probability (1 - h). In our model a coup will stop the revolt only if the cost of continuing the revolt is sufficiently high (regime strong) and there is always a risk that a revolt degenerates. Starting a revolution gives citizens information on regime strength, which could be revealed to be weak (see for instance the Arab Spring in Tunisia). In this extended model successful revolution is a possible outcome of the game.

6.2 Figures



Figure 1: An example of outcome distributions under good and bad type rulers. Note that the distribution of outcomes under the good type ruler first-order stochastically dominates the distribution of outcomes under the bad type ruler.



Figure 2: A graphical analysis of the equilibrium of the game.



Figure 3: The continuing revolution constraints.



Figure 4: The coup constraints when there is no threat of revolution.



Figure 5: The starting revolution constraints.

6.3 Tables

	Full sample		Country-year obs. experiencing a coup		Country-year obs. not experiencing a coup	
	Mean	(SD)	Mean	(SD)	Mean	(SD)
Attempted coup d'état (binary)	0.07	(0.25)	N=46		N=622	
Days of riots	48.49	(110.19)	72.37	(119.30)	46.73	(109.38)
GDP per capita growth rate	0.006	(0.06)	-0.05	(0.12)	0.01	(0.05)
GDP per capita	666.30	(959.79)	261.71	(141.57)	696.22	(987.40)
Polity2	0.04	(5.46)	-0.94	(4.82)	0.11	(5.50)
Drought	0.18	(0.38)	0.20	(0.40)	0.18	(0.38)

Table 1: Summary for full estimation period with sub-Saharan data

	Unweighted riots variable				Weighted riots variables		
	(1)	(0)	(2)	(4)	centrality	distance from capital	local population
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
In(riots)	0.0184**	0.0258***	0.0221***	0.0216***	0.0284**	0.0337**	0.0227***
	(0.007)	(0.008)	(0.008)	(0.008)	(0.011)	(0.015)	(0.007)
GDP per capita growth rate			-0.9614***	-0.9725***	-0.9564***	-0.9553***	-0.9614***
			(0.271)	(0.281)	(0.270)	(0.268)	(0.272)
In(GDP per capita)			-0.0295	-0.0223	-0.0272	-0.0274	-0.0311
			(0.114)	(0.111)	(0.113)	(0.114)	(0.114)
Polity2			-0.0048	-0.0048	-0.0048	-0.0047	-0.0047
			(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Lagged dependent variable				0.0444			
				(0.095)			
Constant	0.0227	0.0132	0.1529	0.1080	0.1482	0.1550	0.1571
	(0.017)	(0.049)	(0.682)	(0.667)	(0.680)	(0.684)	(0.683)
Country & year fixed effects	no	ves	ves	ves	ves	ves	ves
Within R ²	0.0160	0.0498	0.0994	0.1012	0.0977	0.0951	0.1051
Observations	668	668	668	668	668	668	668
Number of events	46	46	46	46	46	46	46
Countries	38	38	38	38	38	38	38
Years: 1991 – 2007							

Table 2: Fixed Effects OLS Results for Attempted Coup d'États

Notes: Attempted coup d'état events are coded by Powell and Tyne (2011). Data on riot intensity are taken from Aidt and Leon (2015). Robust standard errors clustered by country are in parentheses. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

	OLS Two-Staged Least Squares IV						
	Unweighted riots variable			Weighted riots variables			
	(1)	(2)	(3)	centrality (4)	distance from capital (5)	local population (6)	
Panel A: No time-varving cou	ntrv controls	(-)	(0)	(')	(0)	(0)	
In(riots)	0.0301*** (0.009)	0.0521** (0.025)	0.0516** (0.025) 0.0219	0.0557** (0.028)	0.0650* (0.034)	0.0536** (0.025)	
Country & year fixed effects F-stat on excluded instruments Hanson J-stat p-value	yes _ _	yes 8.965 0.4550	(0.095) yes 8.914 0.4604	yes 11.616 0.3519	yes 12.910 0.3551	yes 6.582 0.5565	
N Number of events Countries Years: 1991 – 2006	652 44 38	652 44 38	652 44 38	652 44 38	652 44 38	652 44 38	
Panel B: With time-varying cou	untry controls						
In(riots)	0.0265*** (0.009)	0.0695** (0.032)	0.0685** (0.032)	0.0938* (0.048)	0.1168* (0.065)	0.0644** (0.030)	
GDP per capita growth rate	-1.0457*** (0.280)	-0.9466*** (0.257)	-0.9574*** (0.272)	-0.9200*** (0.256)	-0.9068*** (0.255)	-0.9639*** (0.263)	
In(GDP per capita)	0.0024 (0.134)	0.0209 (0.138)	0.0237 (0.136)	0.0209 (0.138)	0.0182 (0.139)	0.0159 (0.137)	
Polity2	-0.0049 (0.004)	-0.0049 (0.004)	-0.0048 (0.004)	-0.0047 (0.004)	-0.0046 (0.004)	-0.0045 (0.004)	
Lagged dependent variable			0.0258 (0.099)				
country & year fixed effects F-stat on excluded instruments Hanson J-stat p-value	yes _ _	yes 6.668 0.9730	yes 6.665 0.9448	yes 8.088 0.7255	yes 7.507 0.6274	yes 5.628 0.8684	
N Number of events Countries Years: 1991 – 2006	630 44 37	630 44 37	630 44 37	630 44 37	630 44 37	630 44 37	

Table 3: Instrumental Variable Results for Attempted Coup d'États

Notes: Attempted coup d'état events are coded by Powell and Tyne (2011). Data on riot intensity and droughts are taken from Aidt and Leon (2015). Robust standard errors clustered by country are in parentheses. We also report the K-P rk Wald F statistic on excluded instruments. We also report the p-value of the Hansen J-statistic, whose null hypothesis is that the excluded instruments are jointly exogenous.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

		Banks coup			
	(1)	(2)	(3)	(4)	(5)
In(riots)	0.0355*	0.0432***	0.0375***	0.0385***	0.0320**
	(0.018)	(0.014)	(0.013)	(0.013)	(0.013)
GDP per capita growth	, , , , , , , , , , , , , , , , , , ,	, , ,	-0.3903***	-0.4001***	-0.4673***
			(0.093)	(0.095)	(0.101)
In(GDP per capita)			-0.0638***	-0.0562***	-0.0504***
			(0.021)	(0.018)	(0.019)
Polity2			-0.0051**	-0.0049***	-0.0065***
2			(0.002)	(0.002)	(0.002)
Lagged dependent variable				0.1291***	()
				(0.035)	
Constant	0.0686***	0.1232**	0.5315***	0.4339***	0.3919***
	(0.008)	(0.062)	(0.146)	(0.120)	(0.140)
Country and year fixed effects	no	yes	yes	yes	yes
Within R ²	0.0043	0.0363	0.0539	0.0699	0.0626
Ν	3474	3474	3474	3470	3160
Number of events	264	264	264	264	171
Countries	105	105	105	105	103
Years	1962 – 2002	1962 – 2002	1962 – 2002	1962 – 2002	1961-1999

Table 4: Fixed Effects LPM Results for Attempted Coup d'États – Banks data

Notes: Attempted coup d'état events are coded by Powell and Tyne (2011). Data on riots are taken from Banks (2015). Robust standard errors clustered by country are in parentheses.
*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.