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Abstract

Threats of mass revolts could effectively constrain a dictator's public policy if it were not for the collective-action problem. Mass revolts nevertheless happen, but they follow a stochastic pattern. We describe this pattern in a threshold model of collective action and integrate it into an agency model which demonstrates how mass revolts can impact on a winning coalition's incentives to keep backing an incumbent dictator. Having observed public policy and found a sufficiently high posterior probability of the dictator to be of a ``bad" character, the winning coalition's members may exploit an incidentally happening mass revolt for escaping a loyalty trap that had otherwise prevented them from switching to disloyalty. While this explains why mass revolts sometimes happen to oust a dictator, the arising policy constraints in dictatorships may nevertheless be weak in practice.

JEL-Codes: D02, H11, D74

Keywords: Autocracy; Revolutions; Threshold Models; Selectorate Theory.

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University of Münster
CIW – Center for Interdisciplinary Economics
Scharnhorststrasse 100
D-48151 Münster

phone: +49-251/83-25329 (Office)
e-Mail: clementine.kessler@uni-muenster.de
Internet: www.wiwi.uni-muenster.de/ciw

1 Introduction

An autocrat's power can effectively be contained to the extent that there is a credible threat of a potential overthrow that becomes effective whenever the autocrat pursues a non-welcomed public policy. Such a mechanism to be broadly beneficial requires some causal relationship between such a threat on the one hand and the wealth of a broad public on the other (Besley and Kudamatsu, 2008). The most direct causality is that from low public wealth to a "public rising", but this causality is plagued by the collective-action problems of revolutions (Tullock, 1971). This notwithstanding, rebellious activities by a broad public have at least been associated with a number of major challenges of political regimes, so that the real world does not always seem to fit into the picture of collective-action theory (see Kurrild-Klitgaard, 2004; Lichbach, 1998). This applies not only to the revolts against the communist regimes at the end of the 1980s but also to those of the so called Arab rebellion, and we have seen further public revolts in Thailand, Iran and the Ukraine, to name but a few. Understanding the potential of public control in autocracies presupposes this gap between theory and reality to be closed, and that is what this paper tries to contribute to.

Different branches of literature have developed ways to deal with the problem of collective action in public revolts, but as of yet, none of them is fully convincing. For example, the general equilibrium approach to insurgencies by Grossman (1991; 1999) can do without bypassing the collective-action problem. However, Grossman's approach is not exactly applicable to the—at leat seemingly—spontaneous outbreak of public revolts but rather to the formation of groups like *Hamas* or *Hizbollah*, that is with company-like organizations with a long-term perspective. Hence, they do not explain revolutionary events like those of 1989 in Middle- and Eastern Europe. By contrast, although the deprivation literature (Gurr, 1970) attracted considerable attention (Acemoglu and Robinson, 2001; Bloch, 1986; Boix, 2003),

it ignores the problem or simply assumes the potentially revolting groups to somehow find ways for solving their collective-action problem (Acemoglu and Robinson, 2006, pp. 126-128).

The more recent literature on selectorates defines a winning coalition by its capability to decide as to whether a government will stay in office or not. It does, however, not delve into the precise mechanisms that may back or oust a government (see Bueno de Mesquita, Smith, et al., 2005; Bueno de Mesquita and Smith, 2010; Besley, 2007; Besley and Kudamatsu, 2008). Should a broader public be capable of contributing to an overthrow of a government, then it is by definition part of a winning coalition. However, that naturally leaves the question unresolved whether there are further members of the winning coalition and, if so, how the different subgroups might interact in ousting a government. With one exception (namely Li and Gilli, 2014), selectorate theory has so far not aimed at considering these questions.

Threshold models of collective behavior (see Granovetter, 1978; Schelling, 1978; Kuran, 1989; Yin, 1998) are able to consistently explain public revolts by assuming the rebels to exhibit expressive behavior in much the same way as in Brennan and Lomasky (1993). However, they remain silent regarding the causality between these protests on the one hand and the enforced resignation of an incumbent dictator on the other. Somewhat roughly speaking one may ask: Why should an incumbent step down "only" because there are public protests or even violent rebellions as long as he is backed by the winning coalition on which his power rests after all? Furthermore, one would ask why a winning coalition should quit backing the incumbent "only" because there are subgroups of the population protesting against the dictator? The winning coalition in a dictatorship typically comprises, *inter alia*, high officials of the police, the army, and the security services. And indeed, these officials have at times loyally executed orders by the political leaders to shoot at the protesters, like in Beijing 1989, but sometimes they either refused to do so or they even openly withdrew their loyalty from the political

leadership. Only months after Beijing's security forces had committed the Tianmen massacre, the GDR's security forces refused to violently suppress the ongoing protests in Leipzig and East-Berlin and thereby set the stage for a spectacular collapse of a regime.

As a result, both deprivation theory as well as the public-goods approach fail to reconcile the public-goods problem with the reality of public revolts by assuming away either the public-goods problem or the public revolts. By contrast, threshold theories convincingly explain collective action of a broader public but fail to link this to the decisions of the winning coalition, while selectorate theory focuses on precisely these decisions in a convincing way but fails to relate them to the influence of the collective action by a broader public.

This paper aims at providing the missing link between collective action of a broader public and the loyalty of a winning coalition to an autocrat. To that end, we start with a simple threshold model of mass revolts (Granovetter, 1978, Kuran, 1989) which implies that grievances against a government provide the necessary but not the sufficient condition for public protests. The latter, then, comes through some stochastic shock that only occurs with a certain probability. We then combine this model with a simple "selectorate-type" agency model in order to demonstrate that a mass revolt gives a winning coalition the chance for escaping a loyalty trap (Bueno de Mesquita, Smith, et al., 2005) that would otherwise bind it to an incumbent dictator even when he has proven to cheat the winning coalition. A dictator who is aware of that will be induced to refrain from depriving the general public and from cheating a winning coalition.

The model can explain to a somewhat deeper extent why mass revolts sometimes do occur and sometimes do not; and why they, if they occur, sometimes do sweep a dictator out of office and sometimes do not. It also shows how a dictator's public policy may be checked to some extent by the threat of such

an event. It will ultimately be discussed, however, that there is not too much reason to trust in the latter mechanism as the strength of the arising checks is likely to be rather weak although this is admittedly an empirical question after all.

The paper is organized as follows. In section 2, we define all groups and subgroups of our model society on which our analysis rests throughout the paper. In section 3, we lay out a very simple threshold model of rebellion. Based on that model, we develop our selectorate model of the incumbent's behavior in section 4. Section 5 discusses central findings as well as empirical implications, and Section 6 concludes.

2 Structure of the Model Society

We lean on selecorate approaches in the definition of the groups and subgroups considered in our model society (see Bueno de Mesquita, Smith, et al., 2005; Bueno de Mesquita and Smith, 2009; Bueno de Mesquita and Smith, 2010; Besley and Kudamatsu, 2008). Most of the selectorate models principally apply to a broad range of political regimes, ranging from full-fledged democracies all the way to strict autocracies. For the sake of our topic, we restrict the range of political regimes to autocracies of some sort.

First of all, we have the group of the entire population GP consisting of P domestic inhabitants. A subgroup $GS \subset GP$ comprising S members is referred to as the selectorate. This group is formally or informally endowed with the right to appoint the government. However, within the selectorate, only a subgroup is indeed decisive with respect to the recruitment of the government. As in Bueno de Mesquita, Smith, et al. (2005, pp. 51 - 55), we refer to this subgroup as the winning coalition $GW \subset GS$ which comprises W members.[1]

[1]In a full-fledged democracy, the winning coalition is some sort of a majority of the members of the selectorate, and in an aristocracy or in a military regime, it consists of

Whenever the winning coalition withdraws its loyalty from the dictator the regime will collapse and there will be an open contest for power. As a result of that contest, a new winning coalition will be established and a new government will be inaugurated (see Besley and Kudamatsu, 2008).

In Bueno de Mesquita, Smith, et al. (2005), groups that have any influence on the incumbent's power position are, by definition, part of the winning coalition. In that respect, though, selectorate theory is too abstract for our purposes. Rather, we need the definition of a group that may collectively impact on the incumbent's power although no member of it has an individual incentive for intentionally doing so. For that matter, we define a further subgroup of the total population. With reference to a famous article by Vaclav Havel (1985), we call this group the *powerless* $GL \in \{GP \backslash GW\}$. Members of group GL may or may not belong to the selectorate, but if they do they have been overruled in the broad sense of the word by the winning coalition.

The incentives of each member of group GL of the powerless are compatible with some sort of expressive behavior at best, for no single member can intentionally exert any influence on the behavior or the position of an incumbent. If the individual members happen to find together for collectively protesting or rebelling against the government, however, the group as a whole may nevertheless collectively impact on the behavior of the winning coalition and thus indirectly on the power position of the incumbent. Hence, while being individually powerless but doing things that may aggregate to a collectively significant hazard to the incumbent, one might arguably speak of some collective power, which is what Vaclav Havel (1985) obviously had in mind. The question as to why and under what conditions an outburst of collective

those members of the nobles or the military officials, who are powerful enough to dominate the rest of the respective selectorate. By contrast, in a rigged democracy like the former communist regimes and their single-party systems in Middle and Eastern Europe, the winning coalition consists of an inner circle within, for example, a party bureaucracy.

protest or rebellion may influence the loyalty of the winning coalition to an incumbent's power is at the heart of our analysis.

Before proceeding, we finally define the government R_k with $k \in \{G, B\}$ which is of either type G (good) or type B (bad). The government is drawn from any subgroup of the population and we assume, for simplicity, that it consists of only a single person.

3 Sparking Public Revolts

Let $g \in [0, 1]$ be the ratio of public-goods expenditures in terms of an exogenous level of tax revenues. We assume all excess tax revenues $1 - g$ to be either spent as transfers paid to the members of the winning coalition or to be retained and used for concealed private consumption by the government officials. Independently of the government's choice g, each member $i \in \{1, 2, ..., L\}$ of group GL has a private opinion $g_i \geq g$ regarding the minimum of a public expenditure ratio that this particular member accepts as appropriate, given his or her evaluation of agency costs and possibly also some tolerated degree of governmental slack. We follow the deprivation literature (Gurr, 1970; Bloch, 1986; Acemoglu and Robinson, 2006) and define $\gamma_i := \frac{g_i}{g} - 1$ as the individual degree of relative deprivation.

We assume each individual member of group GL to exhibit an either obedient or a disobedient habit toward the government. A share $z \in [0, 1]$ of group GL is disobedient, so that the share $1 - z$ is obedient. Disobedience can take a range of different forms: It may be limited to statements or comments among friends or, within a more general public, it may imply the attendance in peaceful demonstrations; but it may as well go as far as to the participation in violent rebellious activities or even terrorism. In any case, however, the character of these individual activities is purely expressive in Brennan and Lomasky's sense (Brennan and Lomasky, 1993) in that they do, from the

point of view of the individual, not aim at increasing the probability of an overturn of the government—although they may effectively contribute to precisely that. The latter is important in the light of the collective-action character of a revolution. Since GL is by definition a latent group in Olson's sense (Olson, 1965), no rational member of that group can be motivated to deliberately participate in rebellious activity aimed at raising the probability of a successful revolution (Tullock, 1971). We can, however, maintain the rationality principle by assuming expressive behavior as the driving force behind rebellious action on the part of the individual members of GL.

The share z of disobedient members of group GL cannot directly be observed. As Kuran (1989) argues, it will usually be difficult to even indirectly evaluate this share, and particularly so in a dictatorship. These difficulties account for the fact that public mass protests, even those that most significantly impacted on the distribution of political power, sometimes came totally unexpected by politicians, external observers and even active participants (see Kuran, 1991). We hence need a variable z^e that measures the expected value of z.

Based on a simple cumulative distribution $z = (1 - a\gamma)/\gamma$ of the relative degrees of deprivation γ_i over all potentially disobedient members of group GL, we can write the degree of deprivation in the following fashion:

$$\gamma(z) = \frac{1}{a+z} \qquad with: \ a > 1. \tag{1}$$

Equation 1 reads as follows: The first persons among those that may eventually switch to disobedience are those who are most demanding with respect to the government's choice of the public-goods supply g. These are hence the members of group GL with the highest degree of relative deprivation γ for any level g as chosen by the government. As the share z of disobedient persons among the members of group GL rises, more and more members with

more moderate demands and hence with lower levels of relative deprivation γ are included, so that the level of γ drops as the number z of disloyal members rises.

Defining a simple linear benefit function of disobedience $B(\gamma) = b\gamma$ and combining this with equation 1 yields:

$$B(\gamma(z)) = \frac{b}{a+z} \qquad with\ b > 0. \tag{2}$$

We next turn to the costs C associated with disobedient behavior. These costs will typically be substantial in a dictatorship but they will only materialize with a certain probability of the disobedient person to be punished. We assume the subjective probability of being punished to critically depend on the expected share z^e of other individuals who also exhibit disobedience. We account for that with the following function of expected costs of disobedience:

$$C(z^e) = \frac{c}{1+z^e} \qquad with:\ c > \frac{b}{a}.^2 \tag{3}$$

Defining the net indirect utility of disobedient behavior $V(z, z^e)$ as the difference between equations 2 and 3 yields:

$$V(z, z^e) = \frac{b}{a+z} - \frac{c}{1+z^e}. \tag{4}$$

Whenever $V(z, z^e) = 0$, the respective individual at the margin is indifferent between obedience and disobedience. Should V rise by a small amount from there on, the marginal individual will switch to disobedient behavior. Hence, setting $V(z, z^e) = 0$ in equation 4 and solving for z yields the following

[2]This establishes that $C > B$ and hence that nobody wants to engage in public protests as long as no others do.

"threshold function":

$$z(z^e) = \frac{-(ac-b)}{c} + \frac{b}{c} z^e. \tag{5}$$

We define a steady-state level of the expected share z^e as the "critical level" $z^e_{cr} := z^e = z$, so that:

$$z^e_{cr} = \frac{ac-b}{b-c.} \tag{6}$$

For the moment, we focus on cases with costs C sufficiently low so as to not discourage public protests right away, which is the case if $z^e_{cr} < 1$.[3] Later on, we will consider cases with higher costs as well. Figure 1 shows the threshold function $V = 0$ and the steady-state line $z = z^e$ for the case $z^e_{cr} < 1$. There exists one interior equilibrium at the critical level z^e_{cr}, and there are two corner solutions in points 0 and B, respectively. We refer to 0 as a *peace equilibrium* and to B as a *rebellion equilibrium*. Note that point A represents a non-stable equilibrium. Any exogenous shock that temporarily shifts the belief z^e to the right or left and hence to a level above or below the critical value z^e_{cr} drives the system all the way into either point 0 or point B.

We now introduce a shock that disturbs the expectation z^e in an established peace equilibrium whenever new information on the tax allocation chosen by the government is conveyed.[4] The extent $u \in [0,1]$ of such a shock follows a truncated probability density function $Tr(u)$ for any given set of new information on the tax allocation. Following the dissemination of the latter, the expected share of disobedient members of group GL is hence $z^e = u$. With $\rho := \int_{z^e_{cr}}^{1} Tr(u)\,\mathrm{d}u$, we define the probability that $u > z^e_{cr}$ and hence that the shock is sufficiently strong for turning a peace equilibrium into a rebellion equilibrium. For our analysis, we assume $Tr(u)$ to be common knowledge.

[3] Formally, that requires $b \in (\frac{1+a}{2}, ac)$.

[4] We abstract from such shocks in a rebellion equilibrium.

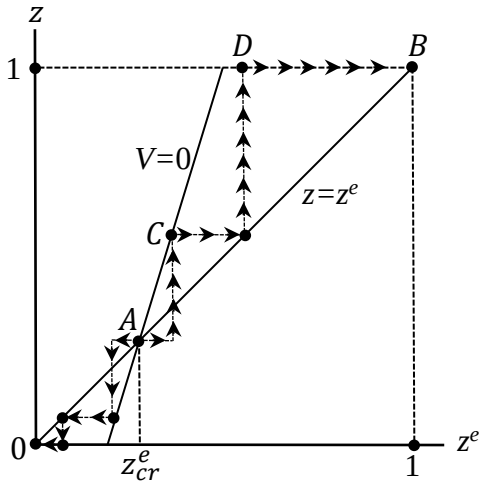

Figure 1: Dynamics of Insurrections

However, this does not naturally fit reality, which will be discussed further below.

Note that rising (dropping) levels of z^e_{cr} lower (raise) the probability ρ. Since z^e_{cr} is determined by the parameters a, b and c, the probability ρ is also a function of these parameters for any given distribution of stochastic shocks $Tr(u)$. In particular, since $z^{e'}_{cr}(a, c) > 0$ and $z^{e'}_{cr}(b) < 0$, a rise in the degree of relative deprivation (that is, a drop in a), a rise in the benefits of exhibiting disobedient behavior (a rise in b), and a drop in the cost parameter c lower the critical value z^e_{cr} and thus raise the probability of a process toward a rebellion equilibrium following the dissemination of new information on the tax allocation, so that:

$$\rho = \rho(a, b, c) \qquad with : \rho'(a, c) < 0; \qquad and : \ \rho'(b) > 0. \tag{7}$$

Recall now that the existence of a rebellion equilibrium requires a critical level $z^e_{cr} < 1$. Since we have $z^{e'}_{cr}(c) > 0$ from equation 6, one can raise the critical

level by raising the cost parameter c until it reaches unity. From there on no rebellion equilibrium is possible anymore. Since, at least in a dictatorship, the police, the military and the secret services are typically part of the winning coalition, this group is, in principle, free to raise the parameter c of the costs of participating in a rebellion as high as is necessary to destabilize any existing rebellion equilibrium or even for rendering a process toward a rebellion equilibrium impossible from the outset, implying $\rho = 0$.

As explosive as the dynamics of the model appear, it nevertheless implies that the public, as represented by group GL, can always be kept under control of the security forces pretty well, at least in principle. Should the latter have been somewhat lenient with respect to the cost parameter c in the past, it may indeed happen that the members of GL find themselves gathered together for protesting or even rioting against an incumbent government. But even then would the winning coalition always be capable of ending the rebellion by raising the costs to whatever level is needed, which is what Tullock (1971, 1987, p. 20) consistently emphasized.

Since the latter is doubtlessly true, at least in formal terms, then why does the winning coalition not always and everywhere proceed that way? Kuran (1989) argued that once the security forces have failed to raise the costs at an early stage, and once a rebellion equilibrium has settled, the security forces may simply shy away from raising the costs to such a tremendous level as is necessary for restoring a peace equilibrium. That would explain why the security forces abstained from shooting at the protesters in Warsaw, East-Berlin, Prague, and elsewhere in 1989. But why didn't their colleagues abstain from shooting in Beijing as well?

We offer an alternative hypothesis, the basic idea of which is this: Whenever a rebellion equilibrium evolves, the members of the winning coalition may figure out what is best for them with respect to their personal future prospects. They may either abstain from raising the protesters' costs and

hence withdraw their loyalty and allow for a regime collapse; or they may remain loyal to the incumbent and raise the costs of participation in a rebellion to a level sufficiently high as to suppress the rebellion. The parameters behind this decision will be different from case to case, and so will be the decision of the winning coalitions' members.

At the heart of the following considerations is the following: Combining a reticent habit toward raising the rebels' costs during an ongoing rebellion with withdrawing their loyalty can provide an opportunity for the winning coalitions' members to escape a loyalty trap in the sense of Bueno de Mesquita, Smith, et al. (2005) which binds them to even such an incumbent who is under the suspicion of cheating the winning coalition's members. In the following section, we lay out the details of our hypothesis.

4 Public Policy, Revolts, and Loyalty

As in the previous section, we assume the government to spend a share g of tax revenues for public goods. These goods are not only purely public in the *Samuelsonian* sense that no member of GP can be excluded from their consumption but also that they are not subject to any rivalry in consumption whatsoever. Apart from g, however, the government distributes a share vW of tax revenues as direct money transfers equally to each member of the winning coalition and the government.

Finally, the government may retain a share $e = 1 - g - vW$ of tax revenues and use it for government purposes alone. Funds e are not directly consumed by the government, nor are they direct transfers. Rather, they are used as inputs for the government sector in a way as to enhance the utility derived from holding a government position. As e is no direct transfer, however, its disposability is low as compared to direct transfers, it is related to high positive externalities with respect to the incumbent's environment and, po-

litically, allocating taxes into e becomes *ceteris paribus* the more delicate, the higher is e. The latter is particularly true when e is compared to direct transfers that are viewed as legitimate at least by the winning coalition. All in all, the utility derived from any unit of e is lower than what can be derived from direct transfers and, most notably, it is subject to substantially decreasing marginal utility. In any case, of course, the way these funds are used is not considered legitimate by members of both group GL of the powerless and the winning coalition GW. What is more, it is not even considered legitimate by a *good government* R_G. Hence, a good government will not be interested in retaining the share e in the first place since this would require the government to allocate the funds into non-legitimate channels. Whether or not a government is *good* or *bad* is not directly observable by either group GL or group GW, but the probability π of a government of being good is common knowledge.

We catch these aspects by describing indirect utility V^j as derived by groups $j \in \{GL, GW, R_k\}$ in the following functional form:

$$V^j = g^{\alpha}(1+v)^{\phi}e^{\theta} \; with \; \theta = \begin{cases} \beta \; for \; j = R_B \\ 0 \; for \; j = GL, GW, R_G \end{cases}$$

$$\phi = \begin{cases} 0 \;\; for \; group \; GL \\ 1 \;\; otherwise \end{cases} \quad and \;\; 0 < \alpha, \beta < 1. \tag{8}$$

The budget constraint for public expenditures is:

$$1 = g + vW + e. \tag{9}$$

Table 1: Optimal Tax Allocation

group	g	v	e
GL	$g^*_{GL} = 1$	$v^*_{GL} = 0$	$e^*_{GL} = 0$
GW or R_G	$g^*_{GW} = \frac{\alpha(1+W)}{1+\alpha}$	$v^*_{GW} = \frac{1-\alpha W}{(1+\alpha)W}$	$e^*_{GW} = 0$
R_B	$g^*_{R_B} = \frac{\alpha(1+W)}{1+\alpha+\beta}$	$v^*_{R_B} = \frac{1-(\alpha+\beta)W}{(1+\alpha+\beta)W}$	$e^*_{R_B} = \frac{\beta(1+W)}{1+\alpha+\beta}$

The respective group members find the optimal allocation of tax revenues (g^*_j, v^*_j, e^*_j) from their respective point of view by maximizing a group member's indirect utility, subject to the budget restriction 9. Table 1 summarizes the optimal allocations from the respective point of view of each group.[5] Note that $g^{*'}_{R_k}(W) > 0$ and $g^{*'}_{GW}(W) > 0$, indicating that expenditures for public goods become more attractive to both types of the government as well as for the winning coalition as the size of the winning coalition rises.

By the same token, we have $v^{*'}_{GW}(W) < 0$ and $v^{*'}_{R_k}(W) < 0$ since direct transfers to the members of the winning coalition become more expensive as the size of the winning coalition rises, which makes them less attractive relative to public goods. These results reproduce an implication from the selectorate model by Bueno de Mesquita, Smith, et al. (2005, pp. 77 - 106) as well as from Olson's encompassing-interest approach (Olson, 1993; McGuire and Olson, 1996). Both approaches imply that winning coalitions that grow in size will shift fiscal expenditure from redistribution in favor of privileged groups to the funding of public goods that are equally available to everybody.

[5]For the sake of brevity, we have assumed $g^*_{R_B}, v^*_{R_B}, e^*_{R_B} > 0$ as well as $g^*_{GW}, v^*_{GW} > 0$. Corner solutions $e^*_{R_B} = 0, v^*_{R_B} > 0; e^*_{R_B} > 0, v^*_{R_B} = 0; e^*_{R_B} = 0, v^*_{R_B} = 0$, and $g^*_{GW} = 0, v^*_{GW} = 0$ are possible (though not always plausible), but presenting all these cases would require lengthy considerations without adding further insights, nor would it change any of the results. A full set of Kuhn-Tucker conditions is of course available from the author.

Table 2: Levels of utility of group... optimal for group ...

utility of...	GL	GW	R_G, R_B
optimal for...			
GL	$V_{GL}^{GL} = g_{GL}^{*\alpha}$	$V_{GL}^{GW} = g_{GL}^{*\alpha}$	$V_{GL}^{R} = g_{GL}^{*\alpha}$
GW, R_G	$V_{GW}^{GL} = g_{GW}^{*\alpha}$	$V_{GW}^{GW} = g_{GW}^{*\alpha}(1+v_{GW}^{*})$	$V_{GW}^{R} = g_{GW}^{*\alpha}(1+v_{GW}^{*})$
R_B	$V_{R_B}^{GL} = g_{R_B}^{*\alpha}$	$V_{R_B}^{GW} = g_{R_B}^{*\alpha}(1+v_{R_B}^{*})$	$V_{R_B}^{R} = g_{R_B}^{*\alpha}(1+v_{R_B}^{*})(1+e_{R_B}^{*})^{\beta}$

Note further that this logic does not apply to e_{R_B} since the government does not need to share these funds with further members of the winning coalition. Hence, a rise in the size of the winning coalition makes these expenditures more attractive to a bad government, as can be seen by $e_{R_B}^{*'}(W) > 0$, which implies that a bad government tends to reallocate more funds away from bigger as compared to smaller winning coalitions. The rationale behind this is simply the rivalry in consumption of benefits to members of privileged groups. Finally, note that the winning coalition or a good government will always supply a higher level of public goods than a bad government since $g_{GW}^{*} > g_{R_B}^{*}$. Good governments will hence not only abstain from reserving tax revenues for own purposes, but they will also provide more public goods.

Table 2 presents the indirect utilities of groups GL and GW as well as of R_G and R_B as they are optimal from the point of view of the respective groups. As an example, if group R_B were decisive for the allocation of g_j, v_j, and e_j, then the allocation were $g_{R_B}^{*}, v_{R_B}^{*}$, and $e_{R_B}^{*}$, and the resulting indirect utility of group GL were $V_{R_B}^{GL} = g_{R_B}^{*\alpha}$.

Remember that the winning coalition appoints the government and, further

on, that it expects the government to allocate taxes in a way as to maximize the indirect utility of a winning coalition's member. Hence, a winning coalition's member wants the government to set g_j, v_j, and e_j such that its ensuing utility turns out to be V_{GW}^{GW}. However, a bad government may have a different plan. Recall that the winning coalition does not know in advance whether the government is good or bad. The powerless, in turn, would not be happy with a bad government's tax allocation either, since that implies less public goods compared to the level supplied by a good government. On top of that, a change in the attribution of individual members of the population to the respective subgroups GW, GL, and R_k, which may ensue from a broader change in government or even regime, would give each of the members of the powerless a chance for becoming member of a newly constituted winning coalition. In other words: The powerless would always win from a change in the power structure.

However, each member of the powerless is subject to the public-goods problem and does not face a sufficiently strong individual incentive for intentionally contributing to a change in the power structure. This notwithstanding, such a member might nevertheless be inclined to express his or her disapproval with a given tax allocation publicly and possibly even violently; but this inclination to translate into manifest collective action requires the powerless to get uncaged from their peace-equilibrium trap by an exogenous shock strong enough for shifting the initial expected value z^e of disloyal members of group GL above its critical level z_{cr}^e. As described in section 3, this does only happen with probability $\rho(a, b, c)$.[6]

The winning coalition, in turn, would want to continue supporting the gov-

[6] An interesting corollary of $\rho(a)' < 0$ in equation 7 is that processes toward a rebellion equilibrium are less likely in regimes with large winning coalitions and *vice versa*. The reason is again the encompassing-interest effect that induces governments backed by large winning coalitions to supply higher levels of public goods and thereby provide lower degrees of deprivation which, in turn, reduces the propensity of members of group GL to express disobedient behavior. See a proof in appendix 1.

ernment as long as its members expect the latter to choose g^*_{GW}, v^*_{GW}, and e^*_{GW} in the future, and independently of the obedience or disobedience of members of group GL of the powerless. On the other hand, should the winning coalition expect the government to choose an allocation $g^*_{R_B}, v^*_{R_B}$, and $e^*_{R_B}$, then its members need to decide: If they accept this allocation, then their utility falls short of what it otherwise could have been. By contrast, should they decide to drop the government, then a new government will be appointed, but this new government will come along with a new winning coalition of which each individual will become a member only with probability W/S. The latter gives rise to the loyalty trap.

Should it happen, though, that new information on the government's choice of g sparks a process toward a rebellion equilibrium on the side of group GL of the powerless, then this may blaze a trail for the winning coalitions' members out of their loyalty trap. In particular, the winning coalition's members can jump on the protesters' bandwagon and support the ongoing rebellious activities by keeping the protesters' costs low. They may, for example, abstain from violence and from seriously prosecuting demonstrators, perhaps initially in a concealed way, and they may even proceed to actively support rebellious groups in various ways. Eventually, the winning coalition may openly turn against the incumbent dictator by formally withdrawing their loyalty.

However, why does such a strategy provide an opportunity for escaping the winning coalition's loyalty trap? The reason is that the support of a rebellion can, under certain circumstances, increase the probability of the winning coalitions' members of becoming members of a newly established winning coalition as well. In particular, a winning coalition that wins a sufficient degree of confidence of the powerless may calm down the protests by presenting a new and more promising candidate for a new government. If this works out, they are most probably members of the new winning coalition as well.

Naturally, this will not always be possible. The more the winning coalitions' members are viewed as having voluntarily been part of the dictator's discredited power system, the less credible will the winning coalition's members be themselves. Should, by contrast, the winning coalition's members have so far been viewed as somewhat apolitical bureaucrats who just did what bureaucrats do without having their personal interests intermingled with those of the dictator in an all too obvious fashion, then things may be different.

We explore the relation between the loyalty trap and mass revolts within a simple game that runs through two periods $t \in \{1, 2\}$. Players are nature (N), the period-one winning coalition (GW), and the period-one government (R_k). All members of both GW and R_k are drawn from the population GP. Without loss in generality, we assume all actors to be risk neutral. The game always starts in a peace equilibrium in period $t = 1$.

The government chooses a level $e_t \in \{0, e^*_{R_B}\}$ in each period t. In period $t = 1$ the information on e_t affects the expected level z^e of disobedient members within group GL of the powerless by an amount u. The level $e_t = 0$ is at least part of an optimal tax allocation not only from the perspective of the winning coalition and a good government but also from the perspective of the powerless, while a level $e_t = e^*_{R_B}$ is only optimal for a bad government. We capture this by assuming $u(e_1 = 0) = 0$ and $u(e_1 = e^*_{R_B}) \in (0, 1)$. As a consequence $\rho(e_t = 0) = 0$ and $\rho(e_t = e^*_{R_B}) \in (0, 1)$. In particular, the timing of the game is as follows:

1. Nature randomly selects a period-one winning coalition GW with probability W/S of each member of GP for being part of GW. Nature then randomly selects a period-one government R_k of type $k \in \{G, B\}$ from group GP, with probability π for $k = G$ and $1 - \pi$ for $k = B$.

2. The period-one government R_k chooses $e_1 \in \{0, e^*_{R_B}\}$ and period-one payoffs are realized.

3. If the government had chosen $e_1 = e^*_{R_B}$ in period 1, then nature decides at the beginning of period 2 with probability ρ that there will be a rebellion equilibrium and with probability $1 - \rho$ that there will be a peace equilibrium. If the government had chosen $e_1 = 0$, $\rho = 0$ and there will always be a peace equilibrium.

4. Group GW chooses among the options "support government" (SG) and "drop government" (DG).

5. The period-two winning coalition and the period-two government are determined depending on the winning coalition's choice between SG and DG in step 4:

   - If the winning coalition had chosen option SG in step 4, then the period-one winning coalition and the period two-winning coalition remain as they were in period one, independently of what the government had chosen in step 2 and independently of whether there is a peace equilibrium or a rebellion equilibrium.

   - If the winning coalition had chosen option DG in step 4 in a peace equilibrium, then nature randomly selects a period-two winning coalition GW with probability W/S for each member of GP for becoming part of period-two GW. Nature then randomly selects a period-two government R_k of type $k \in \{G, B\}$ with probability π for $k = G$ and $1 - \pi$ for $k = B$ from group GP.

   - If the winning coalition had chosen option DG in step 4 in a rebellion equilibrium, then the winning coalition remains as it was in period 1. Nature randomly selects a period-two government R_k of type $k \in \{G, B\}$ with probability π for $k = G$ and $1 - \pi$ for $k = B$ from group GP.

6. The period-two government R_k chooses $e_2 \in \{0, e^*_{R_B}\}$.

7. The period-two payoffs are realized and the game ends.

Two technical remarks are in order. Firstly, as we assume a large number of members of the total population GP we can safely neglect the expected value of additional future incomes of any member of GP for the case of this particular member to be appointed as period-2 government. Secondly, since the winning coalition cannot infer any information on the type of the period-2 government from the period-one government's decision on e_1 in the case of a change in government, it is left to calculate the expected value of e_2 by the prior probability π, so that $e_2 = (1-\pi)e^*_{R_B}$ following a decision DG in step 4. We solve for a Perfect Bayes Equilibrium by using the payoffs and definitions as presented in table 3.[7]

First of all, we determine the best response of the government in period 2. Since the game ends after period 2, the government simply maximizes its payoff from this last choice, which is $V^R_{R_B}$ if $e_2 = e^*_{R_B}$ and V^R_{GW} if $e_2 = 0$. Since, according to table 2, $V^R_{R_B} > V^R_{GW}$ for $k = B$ and $V^R_{R_B} < V^R_{GW}$ for $k = G$, we have:

Proposition 1. *A good government always chooses $e_2 = 0$ and a bad government always chooses $e_2 = e^*_{R_B}$ in period 2.*

Next, we determine the best reaction by the winning coalition to the observation e_1 and the expected e_2. By the relations $V^R_{R_B} > V^R_{GW}$ for $k = B$ and $V^R_{R_B} < V^R_{GW}$ for $k = G$ that lead to proposition 1 we also have that $Pr(R_B|e_1 = e^*_{R_B}) = 1$. SG is nevertheless a best response to an observation $e_1 = e^*_{R_B}$ by group GW if and only if the winning coalition's period-two payoff from DG falls short of the period-two payoff from the sequence $\{SG, e_2 = e_{R^*_B}\}$, that is if:

[7] We also present a game tree in the appendix.

Table 3: Overview of Payoffs

$e_1 = e^*_{R_B}$	RDG	$SG/e_2 = 0$	$SG/e_2 = e^*_{R_B}$	PDG
	$U1$	$U2$	$U3$	$U4$
GW	$V^{GW}_{R_B} + V_{RDG}$	$V^{GW}_{R_B} + V^{GW}_{GW}$	$2V^{GW}_{R_B}$	$V^{GW}_{R_B} + V_{PDG}$
R_k	$V^{R}_{R_B} + \delta V_{LP}$	$V^{R}_{R_B} + \delta V^{R}_{GW}$	$(1+\delta)V^{R}_{R_B}$	$V^{R}_{R_B} + \delta V_{LP}$
$e_1 = 0$	RDG	$SG/e_2 = 0$	$SG/e_2 = e^*_{R_B}$	PDG
	$L1$	$L2$	$L3$	$L4$
GW	$V^{GW}_{GW} + V_{PDG}$	$2V^{GW}_{GW}$	$V^{GW}_{GW} + V^{GW}_{R_B}$	$V^{GW}_{GW} + V_{PDG}$
R_k	$V^{R}_{GW} + \delta V_{LP}$	$(1+\delta)V^{R}_{GW}$	$V^{R}_{GW} + \delta V^{R}_{R_B}$	$V^{R}_{GW} + \delta V_{LP}$

$V_{LP} := \pi V^{GL}_{GW} + (1-\pi)V^{GL}_{R_B}$ $\qquad$ $V_{RDG} := \pi V^{GW}_{GW} + (1-\pi)V^{GW}_{R_B}$

$V_{PDG} := \frac{W}{S}\left[\pi V^{GW}_{GW} + (1-\pi)V^{GW}_{R_B}\right] + (1-\frac{W}{S})\left[\pi V^{GL}_{GW} + (1-\pi)V^{GL}_{R_B}\right]$

RDG: Option DG within a rebellion equilibrium.
PDG: Option DG within a peace equilibrium.

$$V^{GW}_{R_B} > \begin{cases} V_{RDG} \text{ in a rebellion equilibrium; or} \\ V_{PDG} \text{ in a peace equilibrium.} \end{cases} \tag{10}$$

Condition 10 defines a loyalty trap, since dropping the government is never rewarding to the winning coalition whenever condition 10 holds, not even in the case that the winning coalition has observed $e_1 = e^*_{R_B}$ and hence knows with certainty that the government is bad and will choose $e^*_{R_B}$ in period 2 as well.

By contrast, an observation $e_1 = 0$ constitutes no clear indication of the type of the government. In order to determine the probability of a good government, conditional on the observation $e_1 = 0$, the winning coalition needs to apply Bayes' rule.[8] A bad government chooses $e_1 = 0$ if it expects the winning coalition to respond by SG instead of DG and if it assumes the winning coalition to not be in a loyalty trap. As shown below, SG can in fact be proven to be the best response to $e_1 = 0$ by the winning coalition; but the government never knows whether the winning coalition is in fact stuck in a loyalty trap. The latter is due to the fact that only the probability ρ is known as to whether a choice $e_1 = e^*_{R_B}$ gives rise to a mass revolt that would, in turn, change the conditions for a loyalty trap. As a result, we have $Pr(e_1 = 0|R_B) \in (0, 1)$ and, upon applying Bayes' rule:

$$Pr(R_G|e_1 = 0) = \frac{\pi}{\pi + Pr(e_1 = 0|R_B)(1 - \pi)} \in (\pi, 1). \tag{11}$$

Remember that the probability of a peace equilibrium in the case of $e_1 = 0$ is one. Hence, the option SG is a best response to the observation $e_1 = 0$ if and only if:

$$V_{PDG} < Pr(R_G|e_1 = 0)V^{GW}_{GW} + (1 - Pr(R_G|e_1 = 0))V^{GW}_{R_B}. \tag{12}$$

It can easily be demonstrated that condition 12 is satisfied under all defined conditions, so that SG is a best response to $e_1 = 0$. Taken together, we have:

Proposition 2. *DG is a best response to $e_1 = e^*_{R_B}$ if condition 10 does not hold. SG is a best response to $e_1 = e^*_{R_B}$ if condition 10 does hold. SG is always a best response to $e_1 = 0$.*

[8] In general terms, it is: $Pr(R_G|e_1 = 0) = \frac{Pr(e_1=0|R_G)\pi}{Pr(e_1=0|R_G)\pi + Pr(e_1=0|R_B)(1-\pi).}$

Finally, we determine the best response of the government to nature's choice as well as to the expectations as derived above in period 1. Since $V^R_{GW} > V^R_{R_B}$ for $k = G$, the choice $e_1 = e^*_{R_B}$ is dominated by $e_1 = 0$ in the case of a good government. For $k = B$, the government's best response in period 1 depends on the expected reaction of the winning coalition. Since $2V^R_{GW} > V^R_{R_B} + V_{LP}$, the choice $e_1 = 0$ is the best response of a bad government to an expected reaction DG to $e_1 = e^*_{R_B}$ and SG to $e_1 = 0$ by the winning coalition. Since, by contrast, $2V^R_{R_B} > V^R_{GW} + V^R_{R_B}$, the choice $e_1 = e^*_{R_B}$ is the best reaction of the bad government to an expected reaction SG on $e_1 = e^*_{R_B}$ by the winning coalition.

The winning coalition's best response to $e_1 = e^*_{R_B}$ solely depends on whether or not it is stuck in a loyalty trap. This, in turn, depends on whether there is a peace equilibrium or a rebellion equilibrium. Since the probability of a rebellion equilibrium is ρ, the government expects a response SG by the winning coalition if:

$$V^{GW}_{R_B} > \rho V_{RDG} + (1 - \rho)V_{PDG}. \tag{13}$$

Note that, since $V_{RDG} > V_{PDG}$, the government finds a loyalty trap to be the less likely the higher is the probability ρ of a rebellion equilibrium. If condition 13 does not hold, a government expects the winning coalition to respond with DG to the observation $e_1 = e^*_{R_B}$. For determining the best response to that expectation on the side of a bad government, the latter needs to compare the payoffs from a sequence $\{e_1 = e^*_{R_B}, DG\}$, which is $V^R_{R_B} + V_{LP}$, with a sequence $\{e_1 = 0, SG, e_2 = e^*_{R_B}\}$, which is $V^R_{GW} + V^R_{R_B}$. It can easily be proven that $V^R_{R_B} + V_{LP} < V^R_{GW} + V^R_{R_B}$, so that we have:

Proposition 3. *A good government always chooses* $e_1 = 0$. *A bad government chooses* $e_1 = e^*_{R_B}$ *if condition* 13 *does hold. Otherwise the latter chooses* $e_1 = 0$.

In order to sum up the possible equilibria, we indicate a peace equilibrium by pe and a situation in which the government assumes the winning coalition to be stuck in a loyalty trap by lt. By contrast, nlt indicates the government to assume the winning coalition to be not stuck in a loyalty trap. Using these definitions as well as propositions 1 to 3, we can write down the following possible pairs of sequentially rational strategies of players GW and R_k:

$$
\begin{aligned}
s^*_{R_k} &= \begin{cases} e_1 = 0; e_2 = 0 \;\; if \;\; k = G \\ e_1 = 0; e_2 = e^*_{R_B} \;\; if \;\; k = B \wedge nlt \\ e_1 = e^*_{R_B}; e_2 = e^*_{R_B} \;\; if \;\; k = B \wedge lt \end{cases} \\
s^*_{GW} &= \begin{cases} SG \;\; if \;\; e_1 = e^*_{R_B} \wedge pe \wedge V^{GW}_{R_B} > V_{PDG} \\ SG \;\; if \;\; e_1 = e^*_{R_B} \wedge V^{GW}_{R_B} > V_{RDG} \\ SG \;\; if \;\; e_1 = 0 \\ DG \;\; otherwise. \end{cases}
\end{aligned} \tag{14}
$$

From these strategies, we can infer four possible Perfect Bayes Equilibria, depending on the respective parameter values. These equilibria are summarized in table 4. The properties of the equilibria 1 and 2 are as follows:

- Equilibrium 1 applies in the case of a good government. Whether or not there is a loyalty trap is of no relevance although both is possible.
- In equilibrium 2, the government does expect the winning coalition to not be in a loyalty trap. It hence chooses $e_1 = 0$ in order to prevent a rebellion that would further on give the winning coalition a chance for dropping the government at low costs. Thus a bad government is kept in check in equilibrium 2.

In equilibria 3 and 4, the government does assume the winning coalition to

be in a loyalty trap, although that does not need to be the case. The only difference between the two equilibria is the peace equilibrium which underlies equilibrium 3 and the rebellion equilibrium which underlies equilibrium 4. As a result:

- In equilibrium 3, a loyalty trap is expected and it materializes. There is hence no check against a bad government in equilibrium 3.
- In equilibrium 4, a loyalty trap is expected, but because of the rebellion equilibrium, the winning coalition escapes form the loyalty trap by jumping on the bandwagon of the rebellion and inaugurating a new government. A bad government will hence be ousted in equilibrium 4.

Table 4: Possible Equilibria

	equilibrium	conditions winning coalition	conditions government
1	$e_1 = 0$ $e_2 = 0$ SG; pe		$k = G$ lt or nlt
2	$e_1 = 0$ $e_2 = e^*_{R_B}$ SG; pe	 loyalty trap or no loyalty trap	$V^{GW}_{R_B} \leq \rho V_{RDG} + (1-\rho)V_{PDG}$ $k = B$ nlt
3	$e_1 = e^*_{R_B}$ $e_2 = e^*_{R_B}$ SG; pe	$V^{GW}_{R_B} \in [V_{PDG}, V_{RDG}]$ loyalty trap	$V^{GW}_{R_B} > \rho V_{RDG} + (1-\rho)V_{PDG}$ $k = B$ lt
4	$e_1 = e^*_{R_B}$ DG; re	$V^{GW}_{R_B} \in [V_{PDG}, V_{RDG}]$ no loyalty trap	$V^{GW}_{R_B} > \rho V_{RDG} + (1-\rho)V_{PDG}$ $k = B$ lt

A rebellion or the expectation thereof affects public policy or the fate of a

government in two out of the four equilibria. In equilibrium 2, the government proactively reduces its claim on a share of the tax revenues in order to prevent being overthrown, and in equilibrium 4, the government will be ousted as it had falsely assumed a loyalty trap. The question as to whether these two channels for checking an autocrat's power by help of (the threat) of a mass revolt are practically relevant is of course an empirical question. There does not seem to be reason for too much optimism, though, as will now be briefly discussed.

5 Discussion

Our theory combines a threshold model with a selectorate approach in order to improve our understanding of the interplay between potential or manifest mass revolts, the behavior of winning coalitions and the power and behavior of an incumbent dictator. We distinguish between the unintended powerful side effect of expressive behavior of members of the general public and the deliberately exerted power of a winning coalition. This presupposes to distinguish the general public from the winning coalition although the interplay of the behavior of both can be decisive for both the power and the behavior of an incumbent dictator.

The winning coalition remains the single group that is capable of either keeping an incumbent in office or ousting him. By contrast, a mass revolt alone cannot overthrow a government but it may unintentionally prepare the ground for it by reducing the winning coalition's costs of doing so. The latter, in turn, may or may not take its chance, depending on whether its members expect a net increase in utility from a change in government or not.

Our approach rests on two filters between the degree of deprivation and the power of the incumbent: The first is the stochastic occurrence of mass revolts and the second is the interest of the winning coalition in overthrowing the

incumbent, which may or may not exist. Only a particular combination of these two elements can effectively endanger the incumbent's power and only the expectation of that particular combination can have a disciplining effect on an autocrat's public policy. The latter of the two filters explains why security forces sometimes do shoot at protesters and sometimes do not.

There are numerous historical examples of the interplay of the two filters, of which the difference between the security forces' reaction to the protests in Beijing and Berlin in 1989 is only one. Another prominent example is the difference in the reaction of the Russian soldiers to the uprisings in 1905 and February 1917. By the time of the 1905 revolution, the soldiers where still in a comparatively comfortable position within the Tsarist Regime. They hence decided to violently fight the rebels. Somewhat more than a decade later, they did not see a future for themselves in the perishing Russian Empire, particularly not after having been abused for a war that was both devastating and senseless in any respect from the outset. Consequently, when the masses gathered for the protests in February 1917, the Russian soldiers not only hesitated to shoot. Rather, one after the other eventually defected to the revolutionaries, and only that gave reason for Tsar Nicolas II to finally step down.

The revolts against the Assad regime in Syria that grew to a most violent and still ongoing civil war constitutes another example. This happened since the core of Assad's security forces remained loyal even in the light of increasingly violent fights and a growing degree of organization and armament of the different rebelling groups. For Assad's winning coalition, there was no way out of the loyalty trap.

In the light of our approach, empirical investigations of the role of the public in both the control of public policy and enforced changes of governments in autocracies need to take the two filters into account. They imply that there is no clear revolution constraint that an incumbent must not violate in order

to preserve his power position. While it is true that a dictator may be aware of the positive probability ρ of a mass revolt to occur and to give a winning coalition a chance for escaping their loyalty trap. It is also plausible that a dictator might take that into account and therefore abstain from cheating the winning coalition and depriving the public too much.

However, the mechanism presupposes a significant and foreseeable increase in the probability ρ of a mass revolt as a result of a defective strategy of an incumbent. But the significance of the increase in ρ and the knowledge of its level requires a stable distribution function of the shock that a defective strategy sends on the expected share of disobedient members of the general public, and this is a rather critical assumption. While presenting empirical evidence is beyond the scope of this paper, it seems plausible to assume that shock to be rather erratic. Given that it is, an asymmetry arises: We may, even quite frequently, be able to trace historical regime collapses back to preceding mass revolt and further on to a particularly high degree of deprivation. On the other hand, though, we will most probably fail in inferring from an increasing degree of deprivation to a mass revolt and further on to a winning coalition that takes the chance for ousting a dictator.

This asymmetry may also be responsible for a certain selection bias in the observation of historical cases. While we might find a correlation between historically observed revolutions with some indicators for the degree of deprivation, this correlation would be very likely to disappear upon taking revolutions into account that simply did not happen despite of high degrees of deprivation.

Our approach has some further empirical implications. It is true that the threat of a mass revolt can, in principle, help the winning coalition to check a dictator's behavior by inducing him to choose the winning coalition's instead of the bad government's optimal tax allocation. It may also help the winning coalition to get rid of a dictator who fails to do so. But the group of the

powerless will, if any, only be protected against the worst tax allocation there is in favor of an allocation that is best for the winning coalition but not best for the powerless. In the case of small winning coalitions, there will be not too big a difference between the latter two allocations, but there will be a big difference between the optimal tax allocation from the respective points of view of the winning coalition and the powerless. As a rule, the larger is the winning coalition, the smaller will be the difference between the winning coalition's and the powerless' optimal tax allocation, but note that large winning coalitions are a characteristic of democracies, not dictatorships. Hence the protective effect of a potential rebellion by the powerless is least effective in a dictatorship, but sadly this is the system in which such a protective effect would appear most desirable.

As shown in the appendix 6, the probability of a mass revolt is larger in regimes that are based on narrow winning coalitions. However, the effect they have for the powerless are lower there as compared to a regime with a broader winning coalition. What is more, the winning coalition takes, if any, the chance of a rebellion for ousting an incumbent while safeguarding each member's position in the winning coalition. That, in turn, explains why rebellions face severe difficulties when it comes to changing the deeper roots of power in a country. More often than not, the same old elite appears behind the face of a seemingly revolutionized political power structure. There is at least much anecdotal evidence for this and our model implies a causal explanation for that.

6 Conclusions

Our theory provides an explanation as to why public revolts sometimes happen and why they, if they happen, sometimes prepare the ground for the winning coalition to oust the incumbent. It also gives the conditions for the

threat of a public revolt to exert a disciplining effect on an autocrats public policy. It turns out, however, that these conditions are rather dubious at least if it is true that the shocks that bad news on the autocrat's public policy send on the expected share of disobedient members of the public appear to be erratic. In the latter case, the disciplining effect will hardly be binding. As a result, there does not seem to be a strong indication of any "power of the powerless" (Havel, 1985) in autocracies, even though public revolts have been happening to disrupt autocratic structures from time to time. Rather, the rule in autocracies is that it is the small elites that count, not the general public. That is why they are autocracies.

Appendix 1

In this appendix, we demonstrate that the probability ρ of a process toward a rebellion equilibrium drops as the size of the winning coalition rises. We start by solving equation 1 in the text for a:

$$a = \frac{1 - z\gamma}{\gamma}. \tag{A.1}$$

We take the definition $\gamma := \frac{g_i}{g} - 1$ of the degree of deprivation, use the average value $\bar{g}$ for the individual value g_i and substitute the result $\gamma = \frac{\bar{g}}{g} - 1$ into A.1. We then use the average value $\bar{z}$ instead of z and get, upon rearrangement:

$$a = \frac{(1 + \bar{z})g - \bar{z}\bar{g}}{\bar{g} - g}. \tag{A.2}$$

We now substitute the optimal levels g_{R_G} and g_{R_B} of the public-goods supply g chosen by the government. Remember that g_{R_G} and g_{R_B} are the optimal levels for a good and a bad government, respectively, as given in table 1. This yields:

$$a = \frac{(1 + \bar{z})\alpha(1 + w) - (1 + \alpha)\bar{z}\bar{g}}{(1 + \alpha)\bar{g} - \alpha(1 + w)}. \tag{A.3}$$

for the good government and

$$a = \frac{(1 + \bar{z})\alpha(1 + w) - (1 + \alpha + \beta)\bar{z}\bar{g}}{(1 + \alpha + \beta)\bar{g} - \alpha(1 + w)}. \tag{A.4}$$

for the bad government. In both cases, we obviously have $a'(W) > 0$. Combining this with equation 7 leads to:

$$\rho'(a)a'(W) < 0. \tag{A.5}$$

The larger (smaller) the winning coalition, the lower (higher) is the probability of a process toward a rebellion equilibrium to be launched ■

Appendix 2

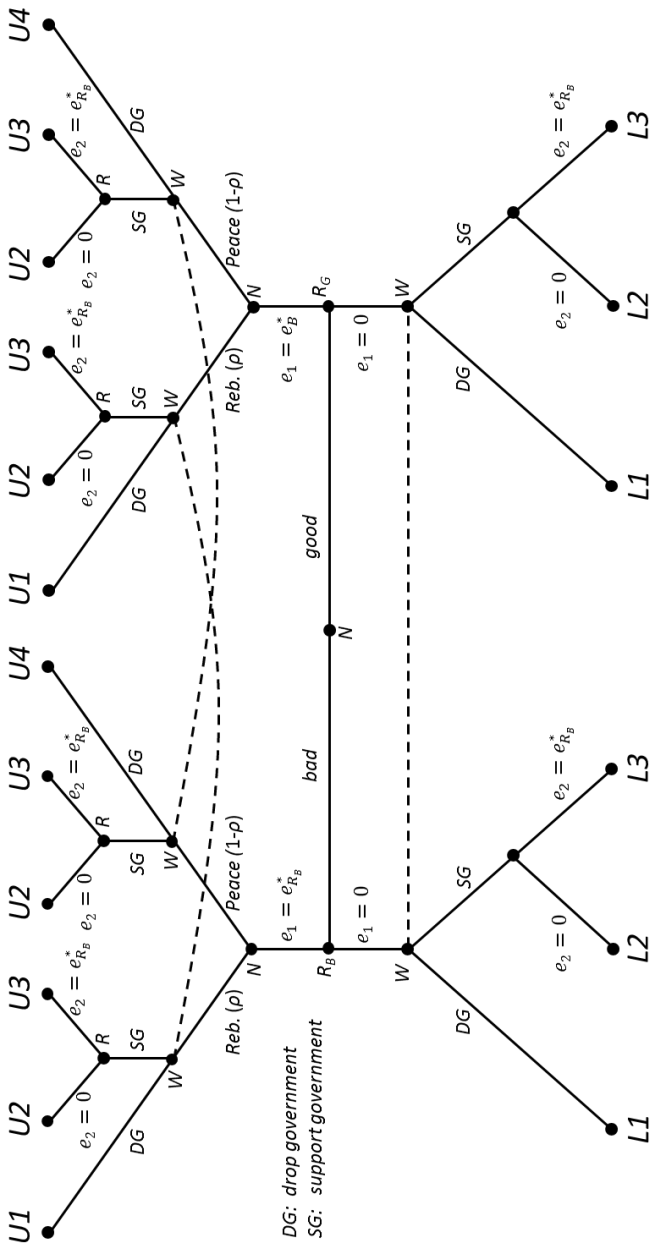

Figure A.1: Game Tree

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University of Münster
CIW – Center for Interdisciplinary Economics
Scharnhorststrasse 100
D-48151 Münster

phone: +49-251/83-25329
fax: +49-251/83-28429

www.wiwi.uni-muenster.de/ciw