How Budgets Shape Autocrats' Survival Strategies*

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This Draft: January 2019
Preliminary; please do not cite.

Abstract

How do budgets affect autocrats' incentives to include rivals in their ruling coalitions? We construct and estimate a dynamic model of autocrats who adjust the composition of their coalitions to maintain power and maximize rents given changing budgets. The model's key feature is that including rivals or purging them from government affect not only the leader's office benefits but also his future survival and fiscal resources. Estimation reveals that even the most unconstrained dictators face large upfront costs from purging their rivals — it reduces their office benefits and, when budgets are tight, their survival chances. Yet purging has substantial dynamic benefits with tight budgets because it removes fiscally infeasible coalitions that also threaten survival. Furthermore, budget upswings comparable in magnitude to those generated by recent commodity booms have lasting effects on the likelihood that autocrats adopt inclusive governing coalitions increasing the probability by 10 percentage points after twenty or even forty years.

* First draft — comments welcome. Thanks to Gabriel Lopez-Moctezuma, Jack Paine, and Miguel Rueda for comments and suggestions.

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1. Introduction

Survival is expensive for autocrats. Patronage and repression, common methods of commanding loyalty, demand resources. Social scientists have thus focused their attention on the budgets that autocrats disburse to hold their grip on power. de Waal (2015, 25), for example, writes, "the health of the political budget is the indicator of whether a political entrepreneur will thrive or fail, whether a political CEO will sustain his empire, or be plunged into crisis." Past research describes how large flows of unearned income from natural resources or foreign aid provide ample political budgets, allowing autocrats to survive longer in office (e.g., Smith 2004; Morrison 2009; Andersen and Ross 2013; Wright et al. 2013).

The relationship between budgets and autocrats' incentives to use different survival strategies is not always clear, however. Ambiguities arise because survival strategies not only affect autocrats' rents from office today, but also their likelihood of survival and thus their ability to consume rents tomorrow. For example, suppose we observe autocrats purging rivals from their coalitions following budget downturns. Is this because purging strengthens autocrats grip on power amid austerity or because autocrats can, after removing their rivals, consume a larger portion of the smaller pie? Suppose instead that autocrats incorporate rivals in their coalitions when budgets increase and financial constraints loosen. Is this because power sharing promotes autocrats' survival or because it generates additional policy benefits? Without additional theory, we cannot infer autocrats' incentives in either instance.

These ambiguities compound when autocrats are far-sighted and consider how today's decisions can constrain future choices. In that case, the survival strategies that autocrats adopt will not only reflect today's budget, but also their expectations about future budgets. Picking up on the second example, suppose the budget increases. If autocrats expect this upswing to endure, then expanding their coteries of ministers is more fiscally sustainable. Yet, if they anticipate short-lived budget increases, autocrats may want to avoid cutting in coalition members that they will struggle to pay off when budget revert. They may decide, instead, to pocket the rents and maximize their current consumption. Different expectations about budget trajectories could lead to divergent survival strategies even with similar budget levels.

To resolve these ambiguities, we adopt the structural approach. That is, we write down and estimate a model of autocratic survival in which an autocrat repeatedly decides whether or not to share power with opposition. The model incorporates three features of autocratic decision making that are essential to the above discussion. First, including rivals or purging them from government not only affects the autocrat's office benefits today but also his likelihood of survival and the evolution of tomorrow's budget. Second, the autocrat makes these decisions to maximize long-term expected utility, endeavoring to retain power and maximize rents in the long run. Third, decisions to include the opposition are persistent; an inclusive government remains the status quo until the autocrat purges, a potentially costly action. These components generate a dynamic tension where the autocrat may want to adopt specific power-sharing arrangements today given the current budget, but worries that fiscal resources may change tomorrow, making the commitments untenable.

We fit the model to data that describes the tenures, budgetary resources, and power-sharing decisions of autocrats in the post-WWII era. Following Rust (1994), we proceed in two steps. First, we estimate the effects of budget levels and power-sharing arrangements on the likelihood of autocratic survival along with autocrats' expectations of budget fluctuations. Second, given the effects isolated in step one, we estimate autocrats' office benefits and their costs associated with sharing power and purging rivals. Thus, our structural approach allows us to identify how autocrats balance the effects of power-sharing arrangements on their office benefits and political survival. In doing so, our results make three primary contributions.

First, although purging allows autocrats to consume more office rents in the future, it entails substantial upfront expense. We estimate that the cost of purging is an order of magnitude larger than the cost of power sharing. Power sharing cannot be cheaply undone and, thus, constitutes a meaningful commitment even in contexts where autocrats exercise unconstrained authority. This result confirms a common but untested assertion that cabinet posts represent a "credible" promise of future patronage (e.g., Arriola 2009; Paine 2018c; Roessler 2016). Furthermore, the cost of purging varies in expected ways. Institutionally unconstrained autocrats or those with a military pedigree pay a smaller price for purging; autocrats with substantial trade connections pay larger costs for purging.

Second, we find that large budgets are necessary for autocrats to share power and maintain inclusive political institutions. By contrast, when fiscal resources are tight, autocrats purge with substantial probability and then maintain exclusive governments. Although the relationship between large budgets and power sharing confirms previous results (e.g., Caselli and Tesei 2016), our dynamic analysis uncovers leaders' inclination to purge when budgets are more meager. We find that autocrats with tight budgets and inclusive coalitions face a dilemma: purging members of the opposition from a weak financial position increases leaders' chances of being immediately ousted by 15–20 percentage points. Yet, maintaining their inclusive cabinets amid austerity also leaves them vulnerable; leaders with tight budgets have larger probabilities of removal with inclusive rules than without, a difference of 10 percentage points. When autocrats expect lean times to persist, they risk purging (and paying the upfront costs). Should they survive the tumult that follows, they will have reduced their patronage obligations, increasing their share of the office spoils and likelihood of weathering subsequent low-budget periods. These predictions do not describe some unrecognizable sovereign; our in-sample predictions match de Waal's (2015) case study of Sudanese politics and help to explain the downfall of Samuel Doe in Liberia.

Third, our structural estimates enable us to analyze the evolution of power-sharing institutions in response to budget shocks. Financial crises and commodity booms constrict and expand budgets: the upswing in commodity prices between 2000 and 2012, for example, increased government consumption by over one log point in over a dozen mineral-producing African countries. We find that expansions on this scale — moving from the average budget to one standard deviation above the mean — generate lasting changes in the likelihood that rulers include opposition groups in their ruling coalitions: after twenty years (and despite intervening budget volatility), the autocrat that starts from the more auspicious fiscal position is ten percentage points more likely to include other groups in their cabinet. This difference shrinks with time — volatility eventually erodes any initial differences — but remains of similar magnitudes even after fifty years.[1] These findings have implications for how we expect autocrats to respond to sanctions or aid conditionality — the economic sticks and carrots of foreign policy. Starving autocrats or denying them aid until they liberalize could be counter-productive: these leaders have little incentive to incorporate rivals without first having a flow of funds to buy their loyalty.

Our theoretical framework is essential for these results. Without a dynamic model, there would be little incentives for autocrats with tight fiscal constraints to purge, as purging under these conditions merely increases the autocrats per-period chances of removal and carries substantial cost. In addition, our counterfactuals contrast with more recent work which, in pursuit of credible causal identification, focuses on short-term responses to as-if random budget fluctuations (e.g., Bazzi and Blattman 2014; Caselli and Tesei 2016). Our analysis, in fact, suggests that random and fleeting blips in the budget may not have a large impact on power sharing if autocrats do not expect these shocks to generate a persistent change in their fiscal resources (see Ross 2015, for a related discussion).

Our unified theoretical and empirical approach and findings distinguishes this paper from other political economy research analyzing the effects of budgets on leaders' decision-making (Robinson et al. 2014; Paine 2018a; Dunning 2005; Bueno de Mesquita and Smith 2017). Our model most closely resembles Caselli and Tesei (2016) who study a dynamic model of an autocrat dividing a budget between private rents and self-preservation spending. We build on this work by incorporating a new dynamic tension: it may be costly to purge opposition members, so autocrats are forward looking when deciding whether or not to include possible rivals, taking into account their future survival and the evolution of revenues. By adding this tension, our empirical analysis reveals that, unlike Caselli and Tesei (2016), negative budget shocks encourage autocrats to expend resources to purge opposition groups from their ruling coalitions.

We also contribute to a literature that describes how (primarily African) leaders dole out patronage and cabinet positions to their ethnic kin and elites from other groups to maintain power (Bratton and van de Walle 1994; Fearon et al. 2007; Arriola 2009; Roessler 2011; Francois et al. 2015; Paine 2018b). Like these papers, we study whether or not a leader accommodates or excludes potential rivals when forming their ruling coalition. Unlike past work, we consider autocrats outside of Africa, and we illustrate how budget projections shape those decisions. Specifically, we conceive of budget levels as a state variable in a dynamic model that follows a probabilistic law of motion; leaders

[1] While a recent literature in political economy documents the long-run effects of endowments or institutions (see Nunn 2009, for a review), these papers sometimes struggle to explain why differences persists or whether we should expect the initial variation to be amplified or erode in the intervening centuries or decades.

anticipate the evolution of the budget when optimally deciding whether or not to accommodate the opposition. As such, our contribution is to study leaders' forward-looking survival strategies — how decisions to payoff or purge elites today reflects the leader's expectations and uncertainty about what revenues they will have at their disposal in the future.

2. Model Rationale

2.1 Goals

"Survival is the primary objective of political leaders" (Bueno de Mesquita and Smith 2010, 936). "Leaders," according to De Mesquita and Smith (2015, 708), "overwhelmingly act as if they want to hold on to power as long as they possibly can."[2] This is true of both democrats and autocrats; yet, the latter face fewer constrains in how they dole out punishment and patronage to maintain their grip on power (Gehlbach et al. 2015).

Autocrats also share an interest in maximizing rents — the economic perks from holding office.[3] This is commonly assumed in models of authoritarian decision-making, even those that acknowledge that autocrats may also have policy preferences (e.g., Gandhi and Przeworski 2006; Bueno de Mesquita et al. 2005). In a succinct but exemplary statement, Magaloni (2008, 717) writes "In my account, all dictators are presumed to be motivated by the same goal — survive in office while maximizing rents."

An autocrat's survival and access to these rents are most immediately challenged by rival elites that also aspire to lead. Svolik (2009) shows that among 303 dictators from 1945 to 2002, over two thirds (205) were removed by government insiders. Although autocrats are also threatened by agitation by the masses (as in Acemoglu and Robinson 2006), only 10% lost power in a popular uprising during the post-WWII era.[4] The most immediate challenge facing far-sighted autocrats is how to manage elite rivals. Roessler (2011, 308) writes, "the imminence, proximity, and the secrecy of the threat, coupled with its incredibly high costs, have forced rulers to be on the defensive at all times and adopt a set of 'coup proofing' techniques."

2.2 Survival Strategies

Past work focuses on two strategies autocrats employ: repression or patronage (Wintrobe 1990, 854). Both strategies affect the leader's office benefits and survival prospects. First, leaders can use coercion to reduce an individual's capacity to oppose the incumbent or to extract a larger share of government revenue. Repression usually takes the form of purging potential rivals from government,

[2] Geddes (2003, 49) argues that military officers may sometimes "return voluntarily to the barracks" to maintain the cohesiveness of the armed forces.

[3] Dixit (2010) argues that "autocrats are less willing to sacrifice rents" — a feature that distinguishes them from their democratic counterparts.

[4] Foreign interventions can also imperil a leader's survival, but these are quite rare, ousting just 16 (roughly 5 percent) of Svolik's (2009) dictators.

e.g., Stalin's gutting of the Communist Party Congress and Soviet Central Committee.[5] Although purges allow the leader to extract larger rents, they can have positive and negative consequences for survival. In seminal work, Skocpol (1979) argues that governments with effective security forces can fend off challenges. Bellin (2004, 143) uses this framework to explain the varied longevity of autocrats in the Middle East and North Africa: "Democratic transitions," she observes, "can be carried out successfully only when the state's coercive apparatus lacks the will or capacity to crush it." However, purging is not without costs or risks. Maintaining a cohesive security apparatus is costly (Wright et al. 2013). Moreover, obvious attempts to exclude rivals could invite countercoups (Sudduth 2017).

Second, leaders can also buy off potential challengers with concessions. Gandhi and Przeworski (2007, 1281-2) note that "the use of force is costly and may not always be effective ... The instruments by which nondemocratic rulers solicit cooperation and thwart rebellion include policy concessions and distribution of spoils." Inclusion in the ruling coalition represents an important type of patronage. Arriola (2009, 1340-1) argues that "leaders use high-level government appointments to make credible their promises to distribute patronage among political elites and the constituencies whom they represent." Likewise, Kramon and Posner (2016, 27) contend that "the implicit understanding is that holders of these cabinet seats will enrich themselves, distribute resources to their clients, and support the incumbent from whom their benefits flow. The common use of elite inclusion indicates its perceived efficacy; more systematically, Arriola (2009, 1355) estimates that "each additional cabinet minister lowers the coup hazard by 23% to 25%."[6] The costs associated with this approach are obvious: resources expended on patronage cannot be consumed by the leader. In addition, larger ruling coalitions increase the number of insiders that might mount a coup (Roessler 2011), and they make it more difficult for leaders to use particularistic transfers to secure power (Bueno de Mesquita and Smith 2010).

2.3 Budget constraints

A number of studies in political science find that leaders more often succeed in retaining power when they control large flows of unearned income, such as royalties from natural resources or foreign aid (Smith 2004; Morrison 2009; Bueno de Mesquita and Smith 2010). Even studies focused on regime type (rather than survival) often argue that states with abundant natural resources (particularly oil) tend to be less democratic, because resource-rich autocrats endure while resource-poor leaders give way to democratic pressures (see Ahmadov (2014) for a meta-analysis; Ross (2015), for a broader review).[7]

[5] While we focus on elite bargaining, many models of authoritarian politics illustrate the tactics leaders use to diffuse revolutionary threats (see Gehlbach et al. 2015, for a review). Selectorate theory, for example, considers how leaders allocate public goods to appease the masses (De Mesquita and Smith 2010). Egorov et al. (2009) argue that dictators deploy censorship to avoid mass mobilization.

[6] Although their focus is on institutional concessions, Gandhi and Przeworski (2007, 16) find that the average tenure of autocrats is three years long when one or more parties are allowed to influence policy.

[7] Yet, Caselli and Tesei (2016) find that the survival strategies of autocratic rulers are particularly sensitive to budget shocks relative to their democratic counterparts.

Leaders flush with resource revenues survive longer because they can afford to deploy repression and dole out patronage.[8] For purging and repression, coercive capacity is essential, and Cotet and Tsui (2013) and Wright et al. (2013) find that oil discoveries and wealth, respectively, increase military expenditure in autocracies. Reno (1999) traces the downfall of Liberia's Samuel Doe back to his attempts to consolidate power and sideline Americo-Liberian elites during periods of depressed government revenue. In terms of patronage, Jensen and Wantchekon (2004, 820) relay stories about bloated roles of public employees in mineral-rich Botswana and Guinea; Clark (2002) estimates that oil-rich Congo-Brazzaville had the most civil servants per capita in Africa in the early 1990s. On the flip side, resource-starved leaders lack the funds required to buy elites' continued loyalty. "Reform and economic austerity can be imposed on the general population," observes van de Walle (1993, 398) in his study of Cameroon. "It is the state elite that will not tolerate the end of a system of prerogatives and privilege that is the glue that keeps the system together."[9]

3. Model

We construct a model of autocratic survival strategies as a Markov decision process that builds off three features highlighted in prior research. First, a farsighted and potentially long-lived autocrat repeatedly decides whether or not to share power by including the opposition in government. If the opposition is currently included, then the autocrat decides whether or not to purge them from government. In contrast if the opposition is not included, then the autocrat decides whether to accommodate them into the government. The autocrat make these decisions optimally, i.e., to maximize his long-term expected utility. Second, there is uncertainty over the autocrat's future. Not only can the autocrat be removed from office, but he also faces budget fluctuations. Furthermore, both sources of uncertainty are endogenous in the sense that the actions that the leader chooses today (potentially) affect his survival and the future flow of the budget. Third, power sharing is *persistent*. If the autocrat includes the opposition today, then the government remains inclusive until the autocrat purges, a potentially costly action. The key tension in the model arises from this type of persistence and the inherent uncertainty associated with leader survival and future budget levels. Specifically, the autocrat worries that by rearranging his governing coalition today, then he might be faced with a coalition tomorrow that is poorly suited to his financial situation.

Estimation of the model is our end goal. As such we include unobserved action-specific shocks and allow the leader's payoffs and transition probabilities to depend on observed covariates that can vary across leaders. To do this, we consider leaders $\{1, \ldots, L\}$, where l denotes the model parameterized for a specific leader. To illustrate the usefulness of the model, we also consider a simple numerical example.

[8] Some authors (e.g., Gandhi and Przeworski 2007; Bueno de Mesquita and Smith 2010; Besley and Persson 2011) have argued that resource-rich leaders not only have more income at their disposal, but also that this income does not depend on encouraging private investment through investments in public goods.

[9] While we focus here on how leaders manage coerce or co-opt other elites, a large strand of this literature argues that leaders also use resource revenues to assuage the masses by providing social services without demanding tax payments in return (Mahdavy 1970; Shambayati 1994; Anderson 1995; Ross 2001; McGuirk 2011; Paler 2013).

3.1 Primitives

Autocrat l struggles to maintain power in each of a countably infinite number of periods $t \in \{1, 2, \ldots\}$. If l is in power in period t, then he first observes two state variables s_l^t and ε_l^t. The variable $s_l^t = (B_l^t, C_l^t) \in \mathcal{S}$ is two dimensional and is observed by the analyst. The first dimension, $B_l^t \in \mathcal{B}$, denotes the leader's budget in period t, where $\mathcal{B} = \{b_1, \ldots, b_J\}$ is the set of equally spaced budget levels such that $i > j$ if and only if $b_i > b_j$. The second variable, $C_l^t \in \{0, 1\}$, indicates whether the opposition is included in the government ($C_l^t = 1$) or not ($C_l^t = 0$) at the beginning of the period. The remaining state variable, $\varepsilon_l^t \in \mathbb{R}^2$, represents action-specific payoff shocks and is unobserved by the analyst.

After observing s_l^t and ε_l^t, the leader then chooses whether or not to exclude the opposition from the government. If $C_l^t = 0$, then period begins with an excluded opposition, and the leader decides whether or not to include them. If $C_l^t = 1$, then the period begins with an inclusive government, and the leader decides whether or not to purge the opposition. Formally, l chooses an action $a_l^t \in A(C_l^t)$, where

$$A(C_l^t) = \begin{cases} \{\varnothing, i\} & \text{if } C_l^t = 0 \\ \{\varnothing, p\} & \text{if } C_l^t = 1, \end{cases} \tag{1}$$

$a_l^t = i$ denotes including the opposition, $a_l^t = p$ purging, and $a_l^t = \varnothing$ remaining with the status quo.

After the leader chooses action a_l^t in states s_l^t and ε_l^t, he accrues payoffs, which take the form

$$u_l(a_l^t, s_l^t; \theta) + \varepsilon_l^t(a_l^t). \tag{2}$$

The function $u_l(a^t, s^t; \theta)$ captures the deterministic component of the leader's utility and is parameterized by the to-be-estimated vector θ. The value $\varepsilon^t(a^t)$ captures the unobservable, stochastic component.

We endow u_l with the following form:

$$u_l(a_l^t, s_l^t; \theta) = \underbrace{B_l^t}_{\text{Budget benefits}} + \overbrace{x_l \cdot \beta}^{\text{Office benefits/costs}} + \underbrace{\rho \cdot \mathbf{I}(a_l^t, C_l^t)}_{\text{Costs of inclusion}} + \underbrace{\mathbf{P}(a_l^t) x_l \cdot \kappa}_{\text{Cost of purging}} \tag{3}$$

where $\theta = (\beta, \kappa, \rho)$, $\mathbf{P}(a_l^t)$ is an indicator function denoting whether or not the leader purged, and $\mathbf{I}(a_l^t, C_l^t)$ is an indicator function denoting whether or not the opposition is included in the government given (a_l^t, s_l^t).[10] The payoffs in Equation 3 have a reasonable interpretation. First, the leader receives the government revenue B_l^t, and this revenue is offset by an additional cost or benefit $x_l \cdot \beta$. The adjustment $x_l \cdot \beta$ could be positive if governing entails additional benefits outside of observed

[10] Specifically, $\mathbf{I}(a_l^t, C_l^t) = 1$ if and only if $(a_l^t, C_l^t) \in \{(i, 0), (\varnothing, 1)\}$.

revenue, and it could be negative if the leader cannot extract the entire amount of the government budget. These additional office benefits or costs could vary with observables because, for example, leaders with little executive constraints or large amounts of oil may more easily extract spoils than those with substantial constraints or little natural resources.[11] Second, the coefficient ρ captures the degree to which including the opposition diminishes (potentially increases) the autocrat's office benefit. Thus, ρ includes both the monetary resources extracted by the opposition *and* any ideological or policy costs that autocrat may receive by including the opposition. Finally, the value $x_l \cdot \kappa$ represents the cost of purging the opposition from government. These costs of inclusion or purging are separate from the effects that these actions have on the leader's survival probability, which we explicitly model below. If the autocrat can easily eliminate an opposition, then $\kappa \approx 0$, a case which is subsumed by the model.

After the leader accrues payoffs, he may lose power either due to death or forcible removal. This occurs with probability $1 - g_l(a_l^t, s_l^t, \gamma)$, where g_l is a function parameterized by γ that explicitly depends on the current state and endogenous actions chosen by the leader. This framework allows the leader's actions to affect his probability of being overthrown and the current budget level: power sharing affects not only l's payoffs from holding office but also l's likelihood of maintaining a grip on power.[12] For example leaders who purge their governments may face a relatively larger probability of removal than those that maintain power-sharing arrangements. Likewise, if leaders adopt inclusive governments but without sufficient funds to payoff their opposition, then they may expect an increase risk of coups.

If the leader exits office, then his decision process ends, and his payoff in all future periods is 0.[13] If the leader remains in office, then he enters period $t + 1$, in which case, the state variables s_l^t and ε_l^t evolve as follows. First, ε_l^{t+1} is drawn from a type one extreme value distribution and is independent across states, actions, and time periods, which is a standard independence assumption in these types of models. Second, the power-sharing variable is fully endogenous. If the opposition is included in the government at the end of period t, then the next period begins with an inclusion, i.e., $C^{t+1} = \mathbf{I}(a_l^t, C_l^t)$. Third, the budget evolves according to a Markov process conditional on observed actions and states. That is, $f_l(B^{t+1}; a_l^t, s_l^t, \phi)$ is a probability function, parameterized by ϕ, denoting the probability that B^{t+1} is next period's budget given actions a_l^t and the current state s_l^t. Below, we specify g_l and f_l in a manner that matches the empirical analyses common in the literatures on autocratic survival. For housekeeping, let $F_l(s_l^{t+1}; a_l^t, s_l^t, \phi)$ denote the transition probabilities over the state space $\mathcal{S}$ implied by f_l and $C^{t+1} = \mathbf{I}(a_l^t, C_l^t)$.

[11] The covariates x_l are not indexed by t, i.e., they do not vary over time. If they did, then they would need to be incorporated into additional dimensions of the state space, $\mathcal{S}$, and doing so would introduce two complexities: (a) exponentially increasing the size of the state space and the resources needed to solve the autocrat's optimal decision and (b) introducing uncertainty as their law of motion would be need be estimated. Because budget levels and power-sharing rules are our main variables of interest, we adopt the more parsimonious specification and discuss robustness checks below.

[12] Without further assumptions, the model is agnostic to the size and direction of power-sharing's effect on the autocrat's survival probability.

[13] In our data, leaders rarely exit and then return to office, an event that occurs in only 2.4 percent of leaders (7 out of 295). When this occurs, we treat them as separate autocrats.

The leader chooses his decision optimally to maximize the expected sum of his discounted utility. Given a sequence of actions, states, and shocks, $\{(a^t, s^t, \varepsilon^t)\}_{t=1}^{T}$, these payoffs take the form

$$\sum_{t=1}^{T} \delta^{t-1} \left[u_l(a_l^t, s_l^t; \theta) + \varepsilon^t(a_l^t) \right], \tag{4}$$

where $T \in \mathbb{N} \cup \{\infty\}$ and $\delta \in (0, 1)$.[14]

As is standard in dynamic optimization, the leader's optimal choice is Markovian and unique. As such, we characterize the leader's optimal choice as a vector of continuation values, dropping references to time hereafter. Let $V_l(s_l)$ denote the leaders expected continuation value in state s_l, and let $V_l = (V_l(s_l))_{s_l \in \mathcal{S}}$. Following Rust (1994), we can write

$$\begin{aligned} V_l(s_l) &= \int_{\varepsilon_l'} \max_{a_l \in A(C_l)} \left\{ u_l(a_l, s_l; \theta) + \varepsilon_l'(a_l) + g_l(a_l, s_l; \gamma) \delta \sum_{s_l' \in \mathcal{S}} V(s_l') F_l\left(s_l'; a_l, s_l, \phi\right) \right\} d\varepsilon_l' \\ &= \log \left(\sum_{a_l \in A(C_l)} \exp \left\{ u_l(a_l, s_l; \theta) + g_l(a_l, s_l . \gamma) \delta \sum_{s_l' \in \mathcal{S}} V(s_l') F_l\left(s_l'; a_l, s_l, \phi\right) \right\} \right) + C \\ &\equiv \Upsilon_l(s_l, V_l; \theta, \gamma, \phi), \end{aligned} \tag{5}$$

where C is Euler's constant. Above, the first equality follows because ε_l' and s_l' are independent. The second follows from McFadden (1978, Corollary p. 82) because ε_l' is T1EV. Thus, for any parameter values (θ, γ, ϕ), leader l's optimal decision can be described by a vector V_l such that

$$\Upsilon_l(V_l; \theta, \gamma, \phi) - V_l = 0, \tag{6}$$

where $\Upsilon_l(V_l; \theta, \gamma, \phi) = \times_{s_l \in \mathcal{S}} \Upsilon_l(s_l, V_l; \theta, \gamma, \phi)$. Because ε_l is T1EV, if leader l is in state s_l, then he chooses $a_l \in A(C_l)$ with probability:

$$P\left(a_l; s_l, V_l\right) = \frac{\exp\left\{ u_l(a_l, s_l; \theta) + g_l(a_l, s_l, \gamma) \delta \sum_{s_l' \in \mathcal{S}} V(s_l') F_l\left(s_l'; a_l, s_l, \phi\right) \right\}}{\sum_{a_l' \in A(C_l)} \exp\left\{ u_l(a_l', s_l; \theta) + g_l(a_l', s_l, \gamma) \delta \sum_{s_l' \in \mathcal{S}} V(s_l') F_l\left(s_l'; a_l', s_l, \phi\right) \right\}}, \tag{7}$$

where V_l solves Equation 6. Given a vector of parameters (θ, γ, ϕ), Equation 7 defines the likelihood of observing action a_l in state s_l, which we use to fit the model to data via maximum likelihood estimation.

Before proceeding, it is important to acknowledge a modeling choice that deviates from other formal work on autocratic survival: the autocrat is the only strategic actor in our model. While potential challengers play an important role, we black box their machinations using the survival function

[14] Note that that δ is not a parameter to be estimated which is standard in the structural literature as it can be difficult to identify with finite samples. Throughout estimation, we fix $\delta = 0.9$.

g_l. This function describes how the leader's prospects of remaining in office change as a consequence of their budget, survival strategies, and other covariates identified in the empirical literature on authoritarian survival (discussed below). Our forward-looking autocrat, thus, "responds" to would-be challengers by taking decisions that incorporate the empirical associations — estimated here and explored in previous literature — between today's state and actions and tomorrow's survival.

This modeling choice also has a more practical rationale. A key feature of our model is that all leaders are not equal. Their payoffs, survival probabilities, and hence expected utilities of holding office vary systematically by covariates x_l and z_l, which include leader age and military experience, for example. We do not observe these covariates for potential challengers, especially those that do not attempt a coup. As such, it is impossible to specify a challenger's value of office and hence probability of revolt without additional assumptions on the data generating process.[15] Because we think that the autocrat's long-term survival strategies are of a first order concern in the literature, we adopt the more parsimonious specification.

3.2 Numerical Example

We present a simple numerical example and illustrate how model manifests important tradeoffs. We consider two budget levels, large and small, where $\mathcal{B} = \{0, 5\}$. In addition, we parameterize the leader's payoffs using Equation 3, where exogenous office-holding benefits are modest, $x_l = 1$ and $\beta = 1$; and the costs of inclusion and purging are substantial, $\rho = -2$ and $\kappa = -2.5$. Given these parameters, the leader's office benefits vary dramatically in periods with large and small budgets, 6 and 1, respectively. Furthermore, purging members from the government is relatively costly, as it destroys about half of the office benefit in high budget periods. In a similar manner, adopting inclusive governments is also costly, where the opposition siphons off a substantial portion of the leader's office benefits.

For the state transitions, we specify the probability of leader survival as

$$g_l(a_l, s_l) = 0.85 - 0.05\,\mathbf{I}(a_l, C_l) - 0.2\,\mathbf{P}(a_l) - 0.03B_l + \\ 0.06\,\mathbf{I}(a_l, C_l) \times B_l + 0.05\,\mathbf{P}(a_l) \times B_l,$$

which is an equivalent to the representation in Table 1. Notice that the functional form of g_l explicitly models the effects of purging and inclusion as a function of the current budget level. In a similar vein, the effects of larger budgets depends on whether or not the leader adopts power-sharing arrangements. As for fiscal resources, the budget in period t remains the budget in period $t+1$ with probability $\phi \in (0, 1)$, where we set $\phi = 0.75$ as the persistence of the budget in the example.[16]

[15] An additional concern arises because the leader's optimal choices may not be unique if the model incorporates a strategic challenger as multiple equilibria may exist. Following the procedure in Crisman-Cox and Gibilisco (2018), we would need to estimate an additional $4 \cdot L \cdot \#\mathcal{S}$ parameters in order to pin down correct equilibrium choice probabilities if we were to add a strategic challenger.

[16] Note that the budget evolves independent of the leader's actions, an assumption that is consistent with the empirical patterns below.

Table 1: Example of leader's survival transition probabilities.

State (s_l)			
Budget (B_l)	Cabinet (C_l)	Action (a_l)	Survival Prob. (g_l)
Low (0)	Exclusive (0)	Status Quo ($\varnothing$)	0.85
Low (0)	Exclusive (0)	Inclusion (i)	0.80
High (5)	Exclusive (0)	Status Quo ($\varnothing$)	0.70
High (5)	Exclusive (0)	Inclusion (i)	0.95
Low (0)	Inclusive (1)	Status Quo ($\varnothing$)	0.80
Low (0)	Inclusive (1)	Purge (p)	0.65
High (5)	Inclusive (1)	Status Quo ($\varnothing$)	0.95
High (5)	Inclusive (1)	Purge (p)	0.75

We choose this specification because it matches several patterns in the data and easily reveals important tradeoffs. Excluding the opposition in high budget periods imperils the leader's survival: maintaining an exclusive cabinet in a high budget period reduces the survival probability by 25 percentage points. This is consistent with comparative politics research on neopatrimonial regimes, which argues that opposition elites may be inclined to depose the leader if denied some share of the spoils (Kramon and Posner 2016, 27). Yet inclusion is not always recommended, and not just because it is costly to dole out patronage. If the budget falls, then the leader, with an inclusive cabinet, faces a dilemma: if he maintains the status quo, his survival probability is 0.80, and if he purges his survival probability is 0.65. Both of these are smaller than the surivial probability in a low budget state in an exclusive cabinet of 0.85. Thus, even though purging reduces his survival probability by 15 points, the leader may be better off excluding his opponents if he expects the lean times to persist. Our leader's dilemma — not wanting to alienate the opposition during a recession, all the while recognizing that their inclusion is unsustainable amid greater scarcity — is a tradeoff apparent in this example, and also one that our model identifies once taken to the data. Furthermore, these tradeoffs do not arise in models without incorporating meaningful costs of purging cabinet members or expectations over future budget fluctuations.

Table 1 also implies that budget fluctuations affect the relationship between purging and autocratic survival, a pattern we find that is consistent with the data. For example, if the leader purges in a low budget state, then his survival probability drops by 25 percentage points, but if he purges in high states, then it only drops by 20 points. A prospering leader, we rationalize, has the capacity and war-chest needed to dispense with opponents and deter any backlash. They would be best off consolidating power just before a downturn to avoid carrying an inclusive cabinet into a low-budget period. But uncertain budget projections make this a fraught choice, as purging the opposition too early invites challenges if the budget remains high and the leader is seen as hoarding the spoils.

Given these parameter values and tradeoffs, Table 2 reports the quantities describing the leader's optimal choice and associated payoffs. The first column lists the four states in the model, i.e, all pos-

Table 2: Optimal choice quantities.

State $s_l = (B_l, C_l)$	Continuation Value $V_l(s_l)$	Pr(Changing Status Quo) $\Pr(a_l \neq \varnothing; s_l, V_l)$	Long-term Probability $\pi_l(s_l)$
$(0, 0)$	11.45	0.01	0.37
$(0, 1)$	7.12	0.61	0.13
$(5, 0)$	17.24	0.51	0.22
$(5, 1)$	16.72	0.14	0.28

sible (B_l, C_l) pairs, and the second column provides the associated continuation values, where the leader has larger expected utilities in large budget states. The third column reveals how our hypothetical leader's survival strategies change across different states of the world. When budgets are tight, the leader wants to maintain an exclusive cabinet. He almost never adopts inclusive governments when the opposition is currently excluded. If necessary, he's inclined (with probability 0.61) to purge the opposition to consolidate power. Though it initially reduces his survival prospects, he prefers to purge given the persistence of the current, low budget. In high-budget periods, the leader generally maintains inclusive cabinets. He only purges the opposition when the government currently shares power with probability 0.14. In addition, with probability 0.51 he opts to adopt inclusive power sharing structures when the opposition is currently excluded. On the one hand, adopting an inclusive cabinet in this state guarantees the leader a large likelihood of remaining in power tomorrow (with probability 0.95), but on the other hand, it also entails substantial costs ($\rho = -2$).

The fourth column reports the leader's invariant (stationary) distribution. An invariant distribution represents the long-term probability distribution over states given the leader's optimal choice probability (column 3) and the exogenous transition probability ϕ, where $\pi(s_l)$ denotes the probability that state s_l emerges in the long run.[17] Table 2 indicates that, given $\phi = 3/4$, leaders convene inclusive governments in 41% of periods. Furthermore, the majority of periods with power sharing have large budgets, i.e., conditional inclusivity, 69% of periods have the large budget. Thus, large budgets encourage power sharing in this example.

3.3 Transitions

Our model is flexible enough to incorporate a variety of transition probabilities, i.e., g_l and f_l, that capture the effects of the leader's actions on his survival or the evolution of the budget. A benefit of this approach is that we can specify the transition probabilities to match the empirical analyses common in the comparative politics literature,[18] subject to a specification that preserves the

[17] We implicitly assume that, if l is removed from office, then he is replaced by another autocrat with the same preferences and transition probabilities. Appendix A contains a precise characterization of the invariant distribution.

[18] For examples, see Bueno de Mesquita and Smith (2010), Gandhi and Przeworski (2007), and Wright et al. (2013), among others.

Markovian nature of g_l and f_l. Such an exercise allows the model to better illustrate how leaders optimally expand and purge their cabinets given the effects highlighted in the empirical literature.[19]

First, suppose leader l chooses action a_l in state s_l, and consider the probability that he retains power, avoiding death or being deposed. For the latter case, we model this as a probit function with mean $\mu_l^r[a_l, s_l; \gamma^r]$, which takes the form:

$$\mu_l^r[a_l, s_l; \gamma^r] = \gamma_1^r \mathbf{I}(a_l, C_l) + \gamma_2^r \mathbf{P}(a_l) + \gamma_3^r B_l + \gamma_4^r \mathbf{I}(a_l, C_l) \times B_l + \gamma_5^r \mathbf{P}(a_l) \times B_l + \gamma_6^r z_l. \quad (8)$$

Then $\Phi(\mu_l^r[a_l, s_l; \gamma^r])$ is the probability that l is not forcibly removed from office after choosing action a_l in state s_l. This setup has several useful properties due to its flexibility and ease of interpretation. First, the effect of cabinet inclusion and purging depends on the current budget level. For example, it could be the case that, in large budget periods, adopting an inclusive cabinet successfully deters coups, but not in low budget periods. Likewise, a higher budget may enhance the ability of an autocrat to successfully purge members of the ruling coalition. The vector z_l contains pertinent information about the leader such has his start age, military background, whether his administration produces oil, and country-specific dummies. Thus, our model and data alleviates some concerns about omitted variable bias that arise from time-invariant characteristics of states (e.g., geography, colonial origin) by accommodating country fixed effects in the transitions.[20] In a similar manner, we define $\Phi(\mu_l^d[a_l, s_l; \gamma^d])$ as the probability that the leader does not die in office, and $\mu_l^d[a_l, s_l; \gamma^d]$ takes an identical form as μ_l^r in Equation 8. Letting $\gamma = (\gamma^r, \gamma^d)$, we define $g_l(a_l, s_l, \gamma) = \Phi(\mu_l^r[a_l, s_l; \gamma^r])\Phi(\mu_l^d[a_l, s_l; \gamma^d])$, where γ is a vector of to-be-estimated parameters.

For the transition probabilities governing the evolution of the budget, we pursue a similar approach, but we account for multiple discrete budget levels following Tauchen's (1986) model of a discrete AR-1 process. Let $\mu_l^b[a_l, s_l; \phi]$ and σ_l^2 denote the mean and *conditional* variance of tomorrow's budget (what we subsequently refer to as volatility) given the action and state pair (a_l, s_l).[21] We parameterize μ_l^b in a manner identical to Equation 8. For $j = 2, \ldots, J-1$, budget level $b_j \in \mathcal{B}$ arises tomorrow with probability

$$f_l(b_j; a_l, s_l, \phi) = \Phi\left(\frac{b_j + d - \mu_l^b[a_l, s_l; \phi]}{\sigma_l}\right) - \Phi\left(\frac{b_j - d - \mu_l^b[a_l, s_l; \phi]}{\sigma_l}\right) \quad (9)$$

where $2d$ describes the distance between the equally spaced budget levels. Equation 9 is straightforwardly modified to account the smallest and largest budget levels, b_1 and b_J, respectively. Not only does the specification in Equation 9 permit the same flexibility and identification strategy as those

[19] Without data constraints, we could pursue a more general approach. For example, if we observed enough data from autocrat l over time, then we could estimate these transition probabilities nonparametrically using frequency estimators. In the data, however, the median length of autocratic tenure is six years, making the nonparametric approach infeasible.

[20] We evaluate the robustness of the transition probabilities to more flexible model specifications in Appendix E.

[21] In a simple autoregressive model, $y_t = \phi y_{t-1} + \varepsilon_t$, and ε_t is distributed i.i.d. according to normal distribution with mean zero and standard deviation σ. Conditional on y_{t-1}, the variance of y_t is σ^2. The unconditional variance is $\dfrac{\sigma^2}{(1-\phi^2)}$.

above, it can also be estimated consistently from standard autoregressive models, as long as the number of budget levels is not too small. In our results below, we set $J = 50$ and estimate σ_l at the country level. In words, if leaders are from the same country, then they face the same budget volatility, i.e., the same conditional variance of tomorrow's budget. Preliminary Monte Carlo evidence indicates that we can uncover the model's true parameters relatively accurately if $J = 50$.

4. Data

4.1 Sample

We restrict attention to autocratic regimes that impose few or no constraints on leaders — settings where, as in our model, leaders' survival tactics are not limited by other political actors. Our sample constitutes administrations that score five or below on the polity scale; are classified as non-democracies; and have, at most, limited constraints on executive authority, as measured by Polity. As our measurement of leaders' actions relies on the inclusion or exclusion of different ethnic or racial groups, we drop all countries with a single group in the Ethnic Power Relations data. This leaves us an unbalanced panel of 295 administrations from 88 countries over 54 years. In Table A.3, we show how listwise deletion affects our sample of unconstrained autocrats. While we find no evidence that region, oil production, or the number of EPR groups affect sample inclusion, our estimation sample scores slightly lower on the polity scale and is much less likely to include administrations that begin after 2010. As described above, we measure the variables in x_l and z_l at the time the leader assumes power, thereby ensuring that sample selection is not an outcome of leaders' decisions in office.

4.2 Budget

We compile data on government budgets from three different sources: the Penn World Tables (PWT), Cross-National Time-Series Archive (CNTS), and International Centre for Tax and Development (ICTD) (Feenstra et al. 2015; Banks and Wilson 2014; ICTD/UNU-WIDER). While the sources employ different definitions of government revenue,[22] the pairwise correlations across the series (see Table A.2) are very high (above 0.9). Given this high correlation, we use the PWT in our primary analysis, because it provides much better coverage. Among the unconstrained autocracies in our sample, the PWT covers 90 percent of country-years. By contrast, the CNTS covers 65 percent of this sample; the ICTD, less than half.

In more democratic settings, one might worry that government expenditure includes allocations beyond the leader's control (e.g., debt servicing). Our measure could, thus, overstate the resources at these leaders' disposal. This is less of a concern in our sample, which is limited to autocrats that face few or no constraints on their authority. In unconstrained autocracies, we assume expenditure is discretionary and line items are a reflection of the leaders' priorities, not their constraints. Furthermore, our model reflects the possibility that autocrats cannot control the every penny of the government budget. Both the constant and coefficients included in the office adjustment, $x_l \cdot \beta$, could be negative, indicating that (certain) leaders' utilities are less than what government consumption implies.

[22] Most notably, the PWT reports government consumption based on the system of national accounts data from the IMF, OECD, and UN.

4.3 Leader's Actions

We use the Ethnic Power Relations (EPR) data to code whether leaders include or exclude rival groups (Cederman et al. 2012). The EPR "identifies all politically relevant ethnic groups and their access to state power in every country of the world from 1946 to 2013." Ethnicity here is defined broadly, incorporating groups defined by a common language, race, or religion. The EPR considers a group to be "politically relevant if *either* at least one significant political actor claims to represent the interests of that group in the national political arena *or* if group members are systematically discriminated against in the domain of public policies."

We code an administration as exclusive ($C_l^t = 0$) if it is dominated by a single group. We define inclusion ($a_l^t = i$) as adding an additional group as a junior or senior partner in government. Purging ($a_l^t = p$) then involves reducing the number of groups in government.[23] This operationalization implies that the leader views elites from other politically relevant ethnic, linguistic, or religious groups as potential rivals — an assumption consistent with past research. Roessler (2011, 324), for example, finds that "two-thirds of groups involved in successful coups [in Africa] are different from the ruler's ethnic group." His analysis also suggests that the ruler's co-ethnics are less likely to stage a rebellion. More broadly, the literature on neopatrimonialism views the inclusion of elites from other ethnic, linguistic, or religious groups as an effort to buy their otherwise wavering loyalty (Bratton and van de Walle 1994; Kramon and Posner 2016). Our use of the EPR data and coding scheme capture a common way of identifying autocrats that do and do not permit power sharing (Francois et al. 2015).

As noted below, we lag these measures to focus on leaders' actions prior to any transition, rather than changes in the ruling coalition that result from a new administration assuming power.

4.4 Transition Data and Covariates

We use the Archigos data, which records the tenure of primary rulers for every independent state until 2015 (Goemans et al. 2009). This enables us to code when an administration starts and ends. Archigos also includes information on how each leader lost power. Of particular interest for us is when leaders die or are removed through "irregular means" — "when the leader was removed in contravention of explicit rules and established conventions." The Archigos codebook notes, "Most Irregular removals from office are done by domestic forces. Irregular removal from office is overwhelmingly the result of the threat or use of force as exemplified in coups, (popular) revolts and assassinations" (3). While multiple administrations can pass in a single country-year, our other variables are measured at the country-year level. We collapse Archigos to the country-year level by retaining the leader that serves the most months in a given year.

[23] We deviate slightly from our model by coding instances of inclusion or purging that involve adding or subtracting partners even when these changes do not constitute a shift away from or to monopoly control. Our estimates of the transition probabilities (Table A.4) are robust to alternative codings of inclusion and purging, where these actions require adding to an otherwise exclusive cabinet and removing all other groups, respectively.

We include additional covariates when estimating the transition probabilities (Equation 10). These reduce confounding by conditioning on time-varying features that affect leaders' actions, the budget, and their survival. (Country fixed effects absorb any static differences across countries.)

The Archigos data enable us to code the leader's age at the start of their administration, as well as the first year of their tenure. Older leaders might have reduced survival probabilities. Stationarity in our model excludes measures that vary over time within administrations. Yet, we capture changes over time that affect survival (e.g., in medical technologies) by including each leader's first year in office. Using data from Ellis et al. (2015), we code whether the leader has a military background, as this might enable the leader to more effectively wield coercive power and repress rivals.[24] As our coding of leaders' actions depends on their decisions to include or exclude other ethnic groups from their ruling coalitions, we condition on the number of ethnic groups. Finally, a large literature on the resource curse relates oil wealth to authoritarian survival Ross (see 2015, for a recent review). We use data from Ross and Mahdavi (2015) to determine if a country is an oil producer during a leader's time in office.

4.5 Payoff Covariates

We specify covariates in x_l that are common in studies of autocratic politics, focusing on those that affect leaders' office benefits and costs of purging. Using Polity's executive constraints measure, we code an indicator for whether or not the autocrat has unlimited authority. Leaders who are not accountable to other branches of government will have an easier time exacting office benefits or purging rivals. We also add an indicator for whether or not the leader has a military background (Ellis et al. 2015), as military leaders are thought to generate less rents (Besley et al. 2011; Yu and Jong-A-Pin 2016). Because oil-flushed dictators may find it easier to suppress opposition members without harming economic performance (Wright et al. 2013; Bueno de Mesquita and Smith 2010), we add an indicator for oil producing countries using data from (Ross and Mahdavi 2015). Following Collier et al. (2003), we include the cumulative number of civil wars — defined by the Correlates of War — in the leader's country. Finally, because trade may mitigate the incentives leaders have for using repression (Gandhi and Przeworski 2007), we have exports as a percent of GDP from PWT. As described above, all covariates are measured during the year the leader takes office. In addition, we scale the continuous covariates to have a zero mean and a standard deviation of one.

5. Results

5.1 Estimating Transition Probabilities

Our model implies a functional form for estimating transition probabilities as a function of the budget, the leader's actions, and leader-specific covariates (see Equation 8). Specifically, we estimate:

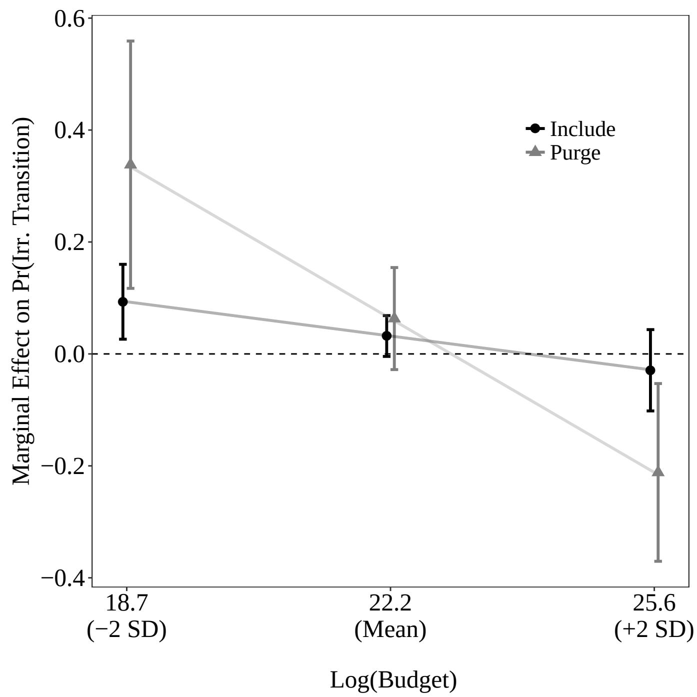
$$Y_{lc,t+1} = \alpha_c + \gamma_1 \mathbf{I}_{lct} + \gamma_2 \mathbf{P}_{lct} + \gamma_3 B_{lct} + \gamma_4 \mathbf{I}_{lct} \times B_{lct} + \gamma_5 \mathbf{P}_{lct} \times B_{lct} + \omega \mathbf{Z}_{lc} + \varepsilon_{lc,t+1} \quad (10)$$

[24] Alternatively, military leaders might be inclined to "return to the barracks," wanting merely to secure order rather than extend their tenure (Geddes 2003).

where l indexes administrations; c, countries; and t, years. Our right-hand side variables lag our outcome measures by one year, and our budget variable B_{lct} is in logs. We include country fixed effects (α_c) and, as implied by our model, only allow $\mathbf{Z}$ to vary at the administration-level.[25] We present the full regression results when the dependent variable is irregular transitions in Table A.4. Our coefficients remain consistent in magnitude across specifications; the inclusion of additional covariates improves precision. In all models, we cluster our standard errors on administration.

To keep our formal model tractable, we restrict the state space to the budget and cabinet composition. As a consequence, Equation 10 does not include other covariates that change over a leader's term. However, as additional robustness checks, we relax this assumption and permit $\mathbf{Z}$ to vary within administrations over time. Our results are qualitatively unchanged (see Table A.7). In these models, we also include year or region-by-year fixed effects to account for global or region-specific trends.

Figure 1: Marginal effect of leader's actions on Pr(irregular transition)



Marginal effects (and confidence intervals for $\alpha = 0.1$) of including an excluded group or purging an included group on the probability of an irregular leadership transition when the budget (logged) is at its mean or ± 2 pooled standard deviations. These predictions use estimates from model 5 in Table A.4.

To aid in interpretation, we present the marginal effects of inclusion or purging when the budget is two (pooled) standard deviations above and below its mean in Figure 1.[26] This plot is based on estimates from model 5 in Table A.4, which includes all of our leader-specific covariates. The figure

[25] For any covariate in $\mathbf{Z}$, we use the first value that it takes in the administration's term to avoid endogeneity issues.

[26] We also compute the marginal effects of the budget on the probability of irregular transitions using Model 5 in Table A.4. The marginal effect is negative when the leader purges, indistinguishable from zero when they include rivals in their administrations, and positive when the coalition remains dominated by a single group.

clearly demonstrates one aspect of the tradeoff leaders face. When budgets are tight, changing the composition of government increases the likelihood of an irregular transition. Yet, when times are good, leaders can increase their survival prospects by purging or, to a lesser extent, including rival groups. What this figure omits (and we estimate below) are the costs associated with opting for repression or dolling out spoils. While Figure 1 suggests that leaders need not worry about reshuffling their cabinet when budgets are large, the cost of purging may be overwhelming, committing even the richest leaders to an inclusive government.

The Appendix contains our other first-stage results. Table A.5 reports models of leader death. Reassuringly, we find that young leaders or those who began their tenure more recently are less likely to die while in office. Table A.6 reports models of the budget transitions. We find evidence of strong budget persistence: the coefficient associated with a lagged budget level is roughly 0.92. In addition, we reject the the null hypothesis that the autoregressive process has a unit root at the $\alpha < 0.001$ level in all specifications. Finally, we find no evidence that inclusion or purging affects tomorrow's budget levels after we control for country fixed effects and today's levels. Overall, the evolution of the budget appears to be a random walk with strong persistence.

5.2 Leader's Payoff Parameters

Table 3 presents our estimates of leaders' payoff parameters — how the benefits of holding office or payoffs from purging vary across leaders with different characteristics. We restrict the coefficient on the budget (B_l^t) to one, lending the other estimates a straightforward interpretation: these marginal effects are relative to a one log point increase in the budget. Notice that we report two coefficient estimates for each variable, one describing how the variable affects the leader's office benefits, β, and one describing how it affects costs of purging, κ. These would be aggregated in a standard reduced-form regressions. Table 3 also includes two sets of standard errors, a conventional estimate based on the outer-product of gradients and a second computed by a jackknife procedure that re-estimates both the transition probabilities and payoff parameters excluding one country at a time. The jackknife generates larger standard errors, as it also incorporates uncertainty in our estimates of the transition probabilities.[27]

Starting with our estimates related to office benefits ($\widehat{\beta}$), we find that unconstrained leaders (those with no constraints as recorded by Polity) in oil-producing states derive more benefits from power. This is consistent with common claims about autocracies. Constraints, if they bite, limit leaders' ability to pursue their self-interest. And a large literature on oil, autocracy, and corruption argues that oil revenues provide valuable rents to leaders (Ross 2015). Autocrats also appear to benefit

[27] In Table A.1, we also (1) use a jackknife procedure that iterates over administrations (rather than countries) and (2) a non-parametric block bootstrap, where we resample administrations. Using the outer-product of gradients or either jackknife procedure, our inferences are unchanged. Our standard errors do increase with the non-parametric block bootstrap although the costliness of repression and cabinet exclusivity are still significant at conventional levels.

Table 3: Estimates of leaders' payoff parameters.

Leader's Utility:	$u_l(a_l^t, s_l^t; \theta) = B_l^t + x_l \cdot \beta + \rho \boldsymbol{I}(a_l^t, C_l^t) + \boldsymbol{P}(a_l^t) x_l \cdot \kappa$			
		Point Estimate	Outer Product	Jackknife Countries
Office Benefits ($\widehat{\beta}$)	Constant	-4.49	(0.05)***	(0.20)***
	Unconstrained	0.44	(0.06)***	(0.16)***
	Military Leader	-1.01	(0.05)***	(0.17)***
	Oil Producer	0.15	(0.07)**	(0.41)
	Cum. Civil Wars	-0.60	(0.02)***	(0.06)***
	Exports	0.59	(0.03)***	(0.08)***
Inclusion Cost ($\widehat{\rho}$)		-1.04	(0.00)***	(0.06)***
Purging Payoff ($\widehat{\kappa}$)	Constant	-10.66	(0.17)***	(0.39)***
	Unconstrained	1.43	(0.18)***	(0.21)***
	Military Leader	1.29	(0.15)***	(0.17)***
	Oil Producer	0.10	(0.14)	(0.32)
	Cum. Civil Wars	0.06	(0.08)	(0.06)
	Exports	-0.50	(0.06)***	(0.08)***
	Log Likelihood	294.53		
	Administrations	295		

Note: *p<0.1; **p<0.05; ***p<0.01

Maximum likelihood estimates of payoff parameters — see Section B. Note that κ is the payoff (not the cost) to purging; positive values imply types of leaders can purge at a lower cost. We report standard errors based on the outer-product of gradients and those computed by a jackknife procedure that re-estimates the transitional probabilities and utility parameters dropping one country at a time. See Table A.1 for other additional standard errors.

from exports beyond oil; we find that larger export volumes — a potential source of trade taxes — increase estimated office benefits (Aidt and Gassebner 2010).

Conversely, leaders with a military pedigree or ruling states with a history of civil wars gain less from holding executive office. In seminal work on autocracies, Geddes (2003, 49) argues that military leaders often assume power reluctantly, staging a coup only to maintain order or the cohesiveness of the military. In contrast to single-party or personalist dictators, military leaders do not attach the same value to ruling: "If there are circumstances in which they can achieve their ends better while out of power ... then we can expect them to return voluntarily to the barracks." While the variable we use here captures a leader's past employment in the military and not autocratic regime type, our estimate is consistent with Geddes's logic. We also find, unsurprisingly, that a history of repeated civil wars reduces the benefits from holding office. Conflict can destroy the tax base, deter investment, and force leaders to divert revenues to fighting rebellion.

Recall that the parameter ρ captures the payoff a leader receives from including another ethnic group in their government. Our negative estimate suggests this action is costly for rulers. While some ministers may hold noncore portfolios (e.g., over sports or vocational training), rulers pay a cost to increasing the number of groups represented in their cabinets. This finding is consistent with our earlier argument and the literature on power sharing through cabinet appointments. The magnitude indicates that inclusive governments cost the leader roughly one logged unit of government revenue. At the mean level, this is equivalent to reducing the leader's budget by $800 million, a substantively large effect which is significant at conventional levels.[28] If autocrats could be assured of their continued rule, they would prefer an administration composed of their own ruling group. Yet, as we described above, adopting inclusive cabinets allow leaders to extend their expected tenure in office.

Finally, we estimate the payoff to repression among different types of leaders ($\widehat{\kappa}$). In these rows of Table 3, negative values indicate variables that move the leader's payoffs toward $-\infty$, i.e., increase the overall costs of repression. First, we note that the constant is large and negative, implying that purging is costly absent other information. This estimate provides a rationale for Arriola's (2009) claim that cabinet positions represent a credible promise of future spoils: the cost autocrats pay to purge provides their ministers with some assurance that they will not be sacked on a whim. Some leaders take a smaller hit for purging their opposition. The costs are roughly ten percent lower for unconstrained executives or leaders with a military background. While we do not know of past work that estimates leaders' costs of purging, these findings are easy to rationalize using folk theories of autocracy. Leaders who are not accountable to citizens or other branches of government should find it less costly to purge. Those with prior ties to the security forces likely find it easier to threaten or deploy coercive force to remove a rival. Higher exports increase the costs of purging, which comports with Gandhi and Przeworski's (2007) argument that autocrats might discourage economic activity by opting for coercion, rather than concessions.

5.3 Optimal Choice of Power Sharing or Purging

The previous two subsections demonstrate that purging and adopting inclusive governments affect both autocrats' survival prospects and their office benefits. When budgets are small, reshuffling the ruling coalition — either including opponents or attempting to purge them — reduces the leader's likelihood of keeping office. Yet, when resources are ample, both tactics can enhance survival prospects. As for office benefits, we find that both purging and inclusion are costly, but the costs of purging are an order of magnitude larger. Given the tradeoffs implied by our structural estimates, when should leaders purge or share power to maximize the expected value of holding office?

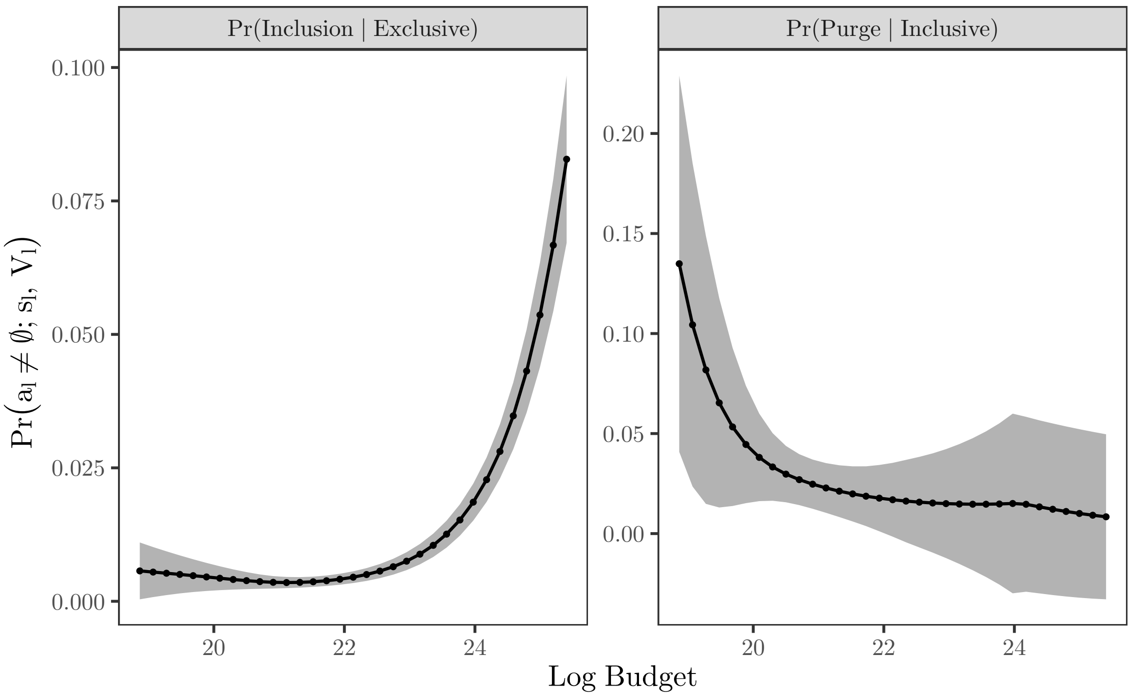
To answer this question we consider a hypothetical autocrat who takes on median values of the observed covariates x_l and z_l. This leader is unconstrained (Polity IV label of "unlimited authority"), has a military background, and entered office in the mid-1970s at the age of 45. In addition, his country does not have oil and has had no civil wars.[29] Fixing the coefficient estimates to those in Table

[28] This is not to imply that $800 million is necessarily being transferred to the opposition, just that the leader receives substantially less office benefits when rivals are in office, equivalent to reducing government revenue by a certain amount.

[29] We include country fixed effects in the transition models of leader survival, death, and budget evolution. We set these values to be the average over all countries in the data for the analysis below. We fix the conditional variance of the budget to $\sigma_l = 0.141$, the mean of the data.

3, we can compute the autocrat's optimal probabilities of purging and including using Equations 6 and 7.

Figure 2: Effect of budget levels of autocratic survival strategies.



Predicted probability that the leader chooses to include an excluded group in their cabinet (**left**) and of choosing to purge an included group (**right**). All variables, z_l and x_l, are held at their sample medians; the conditional volatility of the budget is set at the mean, $\sigma_l = 0.141$. The shaded area denotes confidence intervals ($\alpha = 0.1$). Standard errors computed using jackknifing procedure that drops each country in the sample.

Figure 2 presents the optimal choice probabilities. The left-hand panel graphs the probability that the leader includes an opposition group in the cabinet ($a_l = i$) given that they are currently excluded ($C_l = 0$), and the right-hand graphs the probability that the leader purges ($a_l = p$ given $C = 1$). Two immediate patterns emerge. First, given an exclusive cabinet, the autocrat only broadens his coalition when the budget is large. At the average budget (logged) in the data ($B_l = 22.2$), the autocrat almost never includes other groups, but this probability increases to approximately 9 percent at the upper end of the range ($B_l \approx 25$). This is consistent with Caselli and Tesei (2016), who find that resource booms encourage autocrats to engage in activities that promote their survival. Second, purges are most likely at small budget levels, occurring with over 10 percent probability at the lowest budget levels. At higher budget levels, leaders almost never purge.[30]

[30] This result differs from Caselli and Tesei (2016); we find that leaders do expend resources at low budget levels, but these are to purge the opposition, not create inclusive political institutions.

Figure 1 suggests that, when budgets are high, an inclusive cabinet can bolster an autocrat's survival prospects. Given the relatively high costs of purging, we see autocrats opting for power sharing at high budget levels.

However, Figure 1 also indicates that purging is a risky action when budgets are low. Why then do we see budget-starved autocrats opting to push out the opposition? First, they can expect budgets to remain low: the results of our AR-1 models imply that budget levels are relatively persistent (see Table A.6). And at low budget levels, the autocrats' survival probabilities are greatest when they can simply maintain an exclusive coalition without purging (i.e., $C_l = 0$, and $a_l = \varnothing$). Anticipating future lean periods, autocrats risk purging to reach this preferred state. Should they survive the backlash, they then enjoy the full spoils of office and a higher likelihood of remaining in power in subsequent lean periods. Despite the short-run risks, there are substantial long-term benefits to purging inclusive governments given that autocrats expect budgets to remain low.

To illustrate the size of these dynamic benefits, Figure A.1 graphs the difference in expected utilities between periods with exclusive and inclusive cabinets for a fixed budget, $V_l(B_l, C_l = 0) - V_l(B_l, C_l = 1)$. Because we estimate a relatively large cost to adopting an inclusive coalition, $\widehat{\rho} = -1.04$, this difference is always positive. That is, autocrats always have a material incentive to purge, hoard resources, and not pay spoils to another group. Yet, the long-term benefits of purging depend on the current budget level: when budgets are tighter autocrats have a larger incentive to purge and switch from an inclusive to an exclusive coalition (or simply maintain the latter). As is apparent in Figure A.1, the difference $V_l(B_l, C_l = 0) - V_l(B_l, C_l = 1)$ is greatest when the current budget is low.

Large budget levels encourage leaders to first adopt and subsequently maintain power-sharing arrangements. Small budgets encourage leaders with power-sharing institutions to purge and discourage those leaders with exclusive governments from including rivals. This echoes de Waal's (2015, 70) account of power-sharing decisions in the Horn of Africa. He concludes:

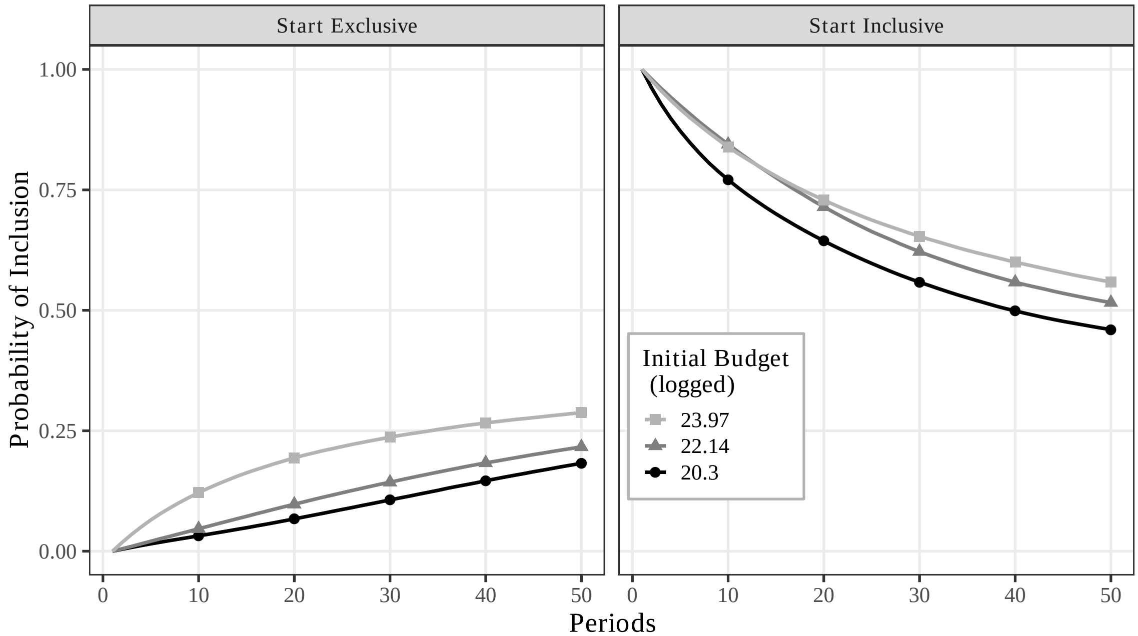
> The essential precondition for a peace agreement is an expanding budget, with most of it under the ruler's discretionary control. The key to a workable peace deal is an allocation of resources to the adversary sufficient for him to join the government.

By contrast, when budgets are tight, any allocation to the opposition cuts into the leader's meager rents. Furthermore, if lean budgets persist, the leader jeopardizes their survival by inviting in opponents and creating unaffordable future obligations.

6. Budget Levels and Power Sharing

Our model enables us to predict the evolution of institutions when an autocrat starts with different budgets. In Figure 3, we endow our hypothetical leader with different initial budgets: 22.14 is

Figure 3: Budgets and the Probability of Inclusion over Time



Predicted probability that a leader has an inclusive coalition (i.e., a cabinet that includes members from outside the leader's ethnic group) after starting in an exclusive (**left**) or inclusive state (**right**). Line colors represent the leader's initial budget level; chosen values correspond to the sample mean and ± 1 pooled standard deviation. All variables, z_l and x_l, are held at their sample medians; the conditional volatility of the budget is set at the mean, $\sigma_l = 0.141$.

the mean; 23.97 and 20.3 are plus and minus one pooled standard deviation, respectively. We then compute the probability that the leader includes the opposition in their coalition as years pass.

Consistent with the logic sketched earlier, larger budgets promote power sharing. Suppose an autocrat starts with an exclusive cabinet (left panel). After ten years, the probability of including the opposition is four times higher when the autocrat begins with the largest versus the smallest of the three budget levels in the figure. This narrows with time — volatility reduces the initial level differences — but remains substantial over the medium-term.[31] Twenty years out, the probability of including the opposition is roughly 20 percent when the autocrat starts with the above average budget, but less than 7 percent when they start with at the budget one standard deviation below the mean.

If instead the autocrat starts with an inclusive coalition (right panel), he is most likely maintain the power-sharing arrangement when he starts at the large budget level, rather than the moderate or small one. After ten years, the probability of an inclusive cabinet is seven percentage points greater when the autocrat starts with a budget one standard deviation above rather than below the mean. This difference remains fairly large and grows in the medium and long-term. For example, after forty years, the autocrat who started with the largest budget in the figure is 10 percentage points more likely to have an inclusive government than if he had started with the lowest budget.

[31] The long-term probability of an inclusive cabinet is roughly 0.4, whatever their initial budget level (see Figure A.3).

6.1 Illustrative Cases

These counterfactuals illuminate the political consequences of large historical shocks to government budgets. To take a recent example, a dramatic increase in world commodity prices between 2000 and 2012 (fueled by rising demand from India and China) expanded government budgets across a number of mineral-rich countries in Africa (Humphreys 2015). Between 2000 and 2012, fourteen mineral producing African countries saw budget increases of more than one log point; eight experienced increases of more than 1.8 log points, roughly a standard deviation in our data (see Figure A.2). These positive fiscal shocks ought, by our model, to have promoted power sharing. And over this same period, the probability of an inclusive cabinet in this sample of African mineral producers increased by 12 percentage points, from 0.75 to 0.87.[32] While we do not regard this as a test of our model, it suggests that real leaders facing budget shocks respond in ways that resemble the hypothetical autocrat whose behavior is dictated by our structural estimates.

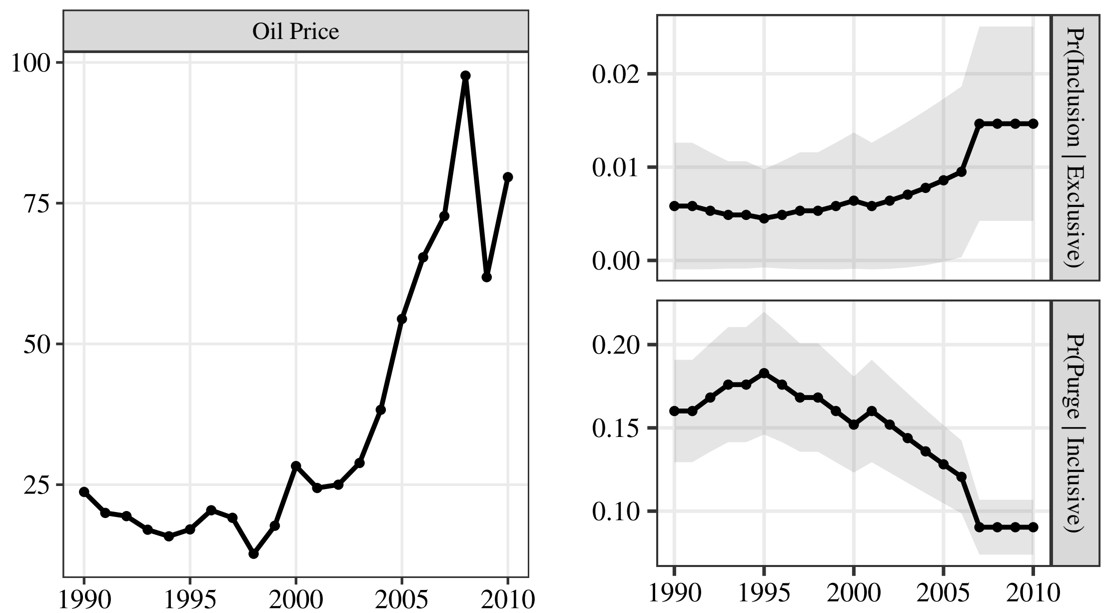
Sudan was among the states that saw a major windfall during this period due to rising oil prices (see left panel of Figure 4). As production and prices rose, government spending increased by an order of magnitude between 1999 and 2008. de Waal (2015, 82-4) argues that this budgetary expansion facilitated power-sharing agreements — a "rentier peace." The timing of peace agreements between the northern government in Khartoum and the South coincide with a major upswing in government revenue: the 2005 Comprehensive Peace Agreement (CPA) was primarily a rent allocation formula meant to buy the loyalty of elites from both regions. "The arithmetic," de Waal (2015, 84) argues, "was possible because the fast-expanding budget meant that Khartoum's ruling cartel could offer a generous incentive without hardship to itself." To use the terminology of our model, as the budget increased, the leader could afford to cut in rivals without sacrificing his own survival or stream of rents. Figure 4 presents our in-sample predictions for Sudan. Consistent with de Waal's (2015) narrative, as oil prices rise the likelihood of inclusion increases (top right panel) — heightened oil prices permit a "rentier peace" — and the probability of purging falls (bottom right panel).

This was not just true during the commodity boom of the 2000s. Between 1970 and 1978, government spending tripled, and "it is no accident that two nationwide peace agreements were reached in this period of expanding state and political budgets" (de Waal 2015, 70).

Oil revenues not only enabled power sharing between the North and South, but provided the glue that held together the ruling coalition in what would become South Sudan. Salva Kiir, who assumed the Presidency of the Government of Southern Sudan in 2005, "adopted a political-business plan of massive purchase of loyalty using oil money" (de Waal 2015, 91). "The viability of this system," de Waal (2015, 101) notes, "depends entirely on the inflow of resources. For South Sudan, this means oil." During the commodity boom, Salva oversaw an expanding budget, and "it was elementary for those in government to bring others into a rent-sharing deal without losing out." Yet, the good times

[32] Note this is for the sample of 47 African states that produce minerals.

Figure 4: In-sample predictions for Sudan.



Left: Global price of Brent Crude in USD/barrel from the St. Louis Federal Reserve. **Right**: Predicted probability that a leader chooses to include an excluded group (top) or purge an included group (bottom). All variables, x_l and z_l, are set using values from Sudan from 1990 to 2010. The shaded area denotes the confidence intervals ($\alpha = 0.1$).

did not last. South Sudan halted oil production in 2012, generating a massive contraction in government spending. "Salva's response was, naturally enough, to dismiss challengers from the government" (de Waal 2015, 104). He consolidated power, trusting only his closest allies and recruiting a militia of co-ethnics from his home region. This, again, is what our results imply: facing a budget decline, the leader purges his rivals. Salva did not invent this survival strategy. de Waal (2015, 78) argues that the Sudanese government (in Khartoum) survived a halving of its budget in the late 1980s, because it had purged the opposition from government and, thus, limited its financial obligations during a period of austerity.

Budget shortfalls have proven fatal for other autocrats.[33] Liberia's Samuel Doe, who came to power in a 1980 coup, faced the dilemma formalized earlier: "How was Doe to manage the urgent task of asserting his political authority over strongmen (not to mention satisfying his expensive person tastes)?" (Reno 1999, 87).

Doe's survival strategies during his tenure illustrate our findings. Upon assuming power and prior to the country's economic collapse, Doe opted for inclusion. While he publicly executed top officials from the overthrown Tolbert government, he also appointed many as ministers: "Doe's first cabinet included four ministers from Tolbert's era, and others from that era were promoted into the top ranks of the civil service. Of twenty-two cabinet ministers listed in 1985, at least half had held

[33] de Waal (2015, 74-5) argues that Colonel Jaafar Nimeiri's dictatorship in Sudan collapsed amid austerity.

bureaucratic positions in pre-Doe governments" (Reno 1999, 82). Charles Taylor, who would later mount a rebellion against Doe's government, returned to Liberia in 1980 to serve in Doe's cabinet. According to Reno (1999, 85), Doe "found that any long-term strategy for consolidating power included buying off his opposition."

Yet, this strategy proved untenable amid austerity. After years of economic decline and the loss of US and international aid in the late 1980s, Doe was left "manag[ing] a burdensome patron-client network on an empty treasury." A declassified assessment from the US Central Intelligence Agency concludes that "Doe has no better than an even chance of coping with Liberia's problems for the next several years" (Directorate of Intelligence 1983, iii). "Doe's vulnerability lay in his incapacity to wield resources to counterbalance those controlled by Liberian strongmen or to finance patronage obligations to Liberia's state bureaucrats" (Reno 1999, 88). Per our model, he looked to consolidate power amid contraction but feared he could not weather the backlash that would follow a purge. Doe lost power and was executed in 1990 as Liberia descended into civil war.

7. Discussion

This paper studies the relationship between budgets and power sharing in autocracies. We develop a dynamic model in which power sharing is persistent and can have divergent effects on leaders' survival depending on the size of the budget. Because of these features, a potentially long-lived autocrat worries that their governing coalition today may be poorly suited to their finances and, thus, survival tomorrow. When fitting the model to data, we find that unwinding power-sharing agreements is indeed costly for autocrats in terms of both expected payoffs and survival rates. Furthermore, large budgets are necessary for them to first create and then sustain power sharing, and budget shocks have long-term effects on the likelihood of power-sharing rules.

In addition to illuminating the consequences of natural resource booms and busts, our findings help to reconcile claims about the effects of economic sanctions on authoritarian breakdowns and consolidation. International relations scholars have found that sanctions often fail to improve governance and may even be counterproductive. Wood (2008) finds that US economic sanctions are associated with greater state-sponsored repression, arguing "repression results from incumbent efforts to prevent the defection of core supporters and to stifle dissent in the face of declining economic conditions" (509). Peksen (2010) similarly finds that economic sanctions are associated with reductions in press freedom. This research contributes to a prevailing view that sanctions do not encourage political liberalization. Krasner and Weinstein (2014, 129) summarize that "the conventional wisdom on sanctions . . . was that sections are ineffective."

Marinov (2005, 564), however, questions this pessimism, showing "economic sanctions work in at least one respect: they destabilize the leaders they target." Folch and Wright (2010) also find that sanctions imperil the survival of personalist dictators and monarchs. "If sanctions are to be effective at destabilizing dictators," the authors conclude, "they should strike at revenue sources the dictator needs to stay in power" (355).

While some view these results as at odds, both consequences of sanctions — increased repression and instability — are implied by our results. If sanctions reduce an autocrat's budget, this pushes them to purge, excluding the opposition from government, which often takes the form of repressing elite rivals. Yet, this is a risky gambit: reconfiguring their coalition amid financial distress, the autocrat increases their risk of an irregular transition (see Figure 1).[34] These empirical results are not contradictory but rather fully consistent with an autocrat attempting to concentrate power from a weak financial position.[35]

For policymakers inclined to use carrots rather than sticks, our results speak to the use of positive democratic conditionality when disbursing foreign aid — rewarding autocrats, for example, with assistance if they permit greater voice to the opposition. We are not the first to question the effectiveness of such conditionality; others have noted that conditions are inadequate or unequally enforced (see Carnegie and Marinov 2017, for a more optimistic take). Our point is that the sequencing is backwards: asking autocrats to invite in their rivals without first having the funds to purchase their loyalty runs contra to autocrats' strong instincts for self-preservation.

These policy implications also raise additional questions and extensions of our work. First, future work could extend our model to incorporate additional survival strategies. For example, scholars and policy practitioners are not only concerned about power sharing among elites but also about treatment of the masses in terms of repression, free press, or human rights abuses. Currently, these types of survival strategies are absent from our model, as we only consider elite inclusion and purges. Second, future work could also examine more nuanced counterfactuals that better mimic conditions on international aid or sanctions. Our counterfactuals examine how leader's immediate and long-term policies change according to different budget levels or shocks. While aid and sanctions affect an autocrat's fiscal resources in this manner, their conditions are complicated, potentially affecting the autocrat's expectations about future budgets in more nuanced ways.

[34] Even if the autocrat does not purge, he still faces diminished survival prospects, as it is difficult to maintain an inclusive and obedient cabinet on a tighter budget.

[35] Folch and Wright (2010, 336) write, "although personalist rulers can and do increase repression in response to sanctions, this is a risky and potentially counterproductive strategy that can further destabilize the regime."

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Supporting Information

Autocrats' Survival Strategies

Following text to be published online.

Contents

A. Invariant Distribution for Numerical Example

More specifically, we construct the transition matrix Q_l, where $Q_l[s_l, s_l']$ denotes the probability of transitioning from s_l to state s_l' given the optimal choice probabilities in the second column of Table 2. In this example, Q_l takes the following form:

$$Q_l[s_l, s_l'] = \begin{cases} \phi \Pr(a_l = \varnothing; s_l, V_l) & \text{if } s_l = s_l' \\ \phi \Pr(a_l \neq \varnothing; s_l, V_l) & \text{if } B_l = B_l' \text{ and } C_l \neq C_l' \\ (1-\phi) \Pr(a_l = \varnothing; s_l, V_l) & \text{if } B_l \neq B_l' \text{ and } C_l = C_l' \\ (1-\phi) \Pr(a_l \neq \varnothing; s_l, V_l) & \text{if } B_l \neq B_l' \text{ and } C_l \neq C_l'. \end{cases}$$

Then the invariant distribution $\pi_l = (\pi_l(s_l))_{s_l \in \mathcal{S}}$ solves the equation $\pi Q_l - \pi = 0$.

B. Estimation

B.1 Point Estimates

We consider L leaders, where $l \in \{1, \ldots, L\}$ indexes an arbitrary leader. Our data consists of a list comprising three arrays: $\{Y, X, Z\}$. Here, $Y = \{Y_l\}_{l=1}^{L}$ is an array of time series matrices, where $Y_l = \{(a_l^t, s_l^t)\}_{t=1}^{T_l}$ records the observed action-state pairs for each leader, and we observe T_l observations for each leader. The matrix $X = (x_l)_{l=1}^{L}$ collects the leader-specific covariates that affect the per-period payoffs of leaders, i.e., the covariates entering Equation 3. Finally, the matrix Z collects the leader-specific covariates that affect the transition probability, i.e., those entering the function $\mu_l^e[a_l, s_l; \gamma]$, for $e = r, d, b$, which is explicitly defined in Equation 8. The goal is to estimate parameters (θ, γ, ϕ). Recall, θ is a vector of coefficients associated with the leaders' per-period payoff and variables x_l, and γ and ϕ are vectors of coefficients associated with the leaders' transition probabilities and variables z_l. We estimate these parameters in following steps.

(A) Estimate $\gamma = (\gamma^r, \gamma^d)$, i.e., $\mu_l^r[a_l, s_l; \gamma^r]$ and $\mu_l^d[a_l, s_l; \gamma^d]$, using linear probability models with country fixed effects. Here the dependent variables are indicators for leader death and leader removal and the independent variables follow the left-hand-side of Equation 8.

(B) Estimate ϕ, i.e., $\mu_l^b[a_l, s_l; \phi]$, using an autoregressive model with country fixed effects, where the dependent variable is the log of the government revenue and the independent variables follow the left-hand-side of Equation 8. In this version, government revenue is a continuous variable and has not been discretized.

(C) Estimate σ_l using the residuals from the regression in step (B). Here we pool information across leaders from the same country. That is, if leaders l and l' are from the same country, then $\sigma_l = \sigma_{l'}$.

(D) Create the transition probabilities of leader survival, g_l, using the predicted values from (A). Discretize the log budget variable using the $J = 50$ equally spaced levels $\mathcal{B}$ and use Equation 9—along with the estimates of ϕ and σ_l from (B) and (C), respectively—to create the budget transition probabilities, f_l.

(E) Fixing the transition probabilities, g_l and f_l, estimate θ via MLE following the fixed point algorithm in Rust (1994). Specifically, for every guess of θ and for every leader l, we compute V_l by solving Equation 6. Then using Equation 7, we can evaluate l's contribution to the likelihood as

$$\mathcal{L}_l(\theta \mid Y_l, x_l, z_l) = \Pi_{t=1}^{T_L} P(a_l^t; s_l^t, V_l),$$

where the overall likelihood is $\mathcal{L}(\theta|Y, X, Z) = \Pi_{l=1}^{L} \mathcal{L}_l(\theta \mid Y_l, x_l, z_l)$. We maximize this likelihood to estimate θ.

B.2 Identification

Besides the standard identification assumptions arising from the known and i.i.d. distribution of payoff shocks, three moments in the data allow us to pin down the autocrats' payoff parameters, $\theta = (\beta, \kappa, \rho)$. Recall that $x_l \cdot \beta$ denotes l's per-period office benefit. Here, we can pin down the parameters β because we have normalized l's payoff of losing power to zero. Thus, all else equal, leaders who more likely to take actions with high probabilities of removal have smaller office benefits than those who more likely choose actions with low probabilities of removal. Thus, we need states or actions that entail differing survival strategies, i.e., the function g_l cannot be constant in (a_l, s_l). Second, recall that $x_l \cdot \kappa$ denotes l's per-period cost of purging, and we can isolate these payoffs from l's frequency of purging given an inclusive cabinet. Third, the parameter ρ denotes the per-period (dis)utility l receives from adopting or maintaining inclusive cabinets. We isolate ρ from the frequency with which l adopts inclusive cabinets given that the opposition is currently excluded.

B.3 Standard Errors

We compute standard errors using three approaches. First, we use the outer-product of gradients estimator, and these standard errors are reported in the main text. Second, we use two jackknife procedures. Here, for each leader l (for each country $c = 1, \ldots, C$), we drop l (c) from the data set and re-estimate the model following the steps in Section B.1 producing point estimates $\hat{\theta}^l$ ($\hat{\theta}^c$) for leader l (country c). We then compute the standard errors using the L (C) estimates. Third, we use a standard non-parametric bootstrap with 500 bootstraps. All standard errors are reported in Table A.1 for comparison.

Table A.1: Comparison of standard errors.

		Point Estimates	Outer Product	Jackknife leaders	Jackknife countries	Non-parametric bootstrap
Office benefits, β	Constant	-4.49	0.05	0.12	0.20	1.39
	Exec. Constraints	0.44	0.06	0.11	0.16	1.54
	Military Leader	-1.01	0.06	0.12	0.17	1.22
	Oil Producer	0.15	0.05	0.31	0.41	1.90
	Cum. Civil Wars	-0.60	0.07	0.05	0.06	0.58
	Exports	0.59	0.02	0.06	0.08	0.71
Repression cost, κ	Constant	-10.66	0.17	0.27	0.39	2.42
	Exec. Constraints	1.43	0.18	0.11	0.21	1.54
	Military Leader	1.29	0.15	0.09	0.17	1.30
	Oil Producer	0.10	0.14	0.16	0.32	1.74
	Cum. Civil Wars	0.08	0.08	0.03	0.06	0.49
	Exports	-0.50	0.06	0.05	0.08	0.70
ρ	Constant	-1.04	0.00	0.04	0.06	0.30

C. Correlation across Budget Series

Table A.2: Correlation across Budget Series (logged)

	PWT	CNTS	ICTD
PWT	1	0.913	0.949
CNTS	0.913	1	0.949
ICTD	0.949	0.949	1

PWT: Penn World Tables, Govt. Consumption
CNTS: Cross-National Time-Series, Govt. Revenue
ICTD: Intl. Centre for Tax and Dev., Tax Revenue

D. Sample

Table A.3: Non-random Missingness due to Listwise Deletion

	Dependent variable:
	$\mathbb{1}$(Sample Inclusion)
Polity	-0.016^{**}
	(0.008)
Oil Producer	0.047
	(0.058)
EPR Groups	-0.002
	(0.004)
Year	-0.004^{**}
	(0.002)
Americas	-0.125
	(0.122)
Asia	-0.073
	(0.065)
Europe	0.046
	(0.064)
Constant	7.827^{**}
	(3.472)
Administrations	402
Observations	3,091
Note:	*p<0.1; **p<0.05; ***p<0.01
	Standard errors clustered on administration.

E. Transition Probabilities

Table A.4: Irregular Leader Transitions

	Dependent variable:				
	$\mathbb{1}$(Irregular Transition)				
	(1)	(2)	(3)	(4)	(5)
$B \equiv$ Log(Budget)	0.021^{*}	0.025^{*}	0.024^{**}	0.024^{**}	0.027^{**}
	(0.012)	(0.014)	(0.011)	(0.011)	(0.011)
$\mathbf{I}$	0.345	0.344	0.371^{*}	0.416^{*}	0.426^{*}
	(0.219)	(0.214)	(0.219)	(0.229)	(0.232)
$\mathbf{P}$	1.850^{***}	1.857^{***}	1.892^{***}	1.908^{***}	1.835^{***}
	(0.694)	(0.718)	(0.698)	(0.700)	(0.687)
$\mathbf{I} \times B$	−0.015	−0.015	−0.016	-0.018^{*}	-0.018^{*}
	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)
$\mathbf{P} \times B$	-0.081^{***}	-0.081^{***}	-0.083^{***}	-0.083^{***}	-0.080^{***}
	(0.030)	(0.031)	(0.030)	(0.030)	(0.030)
First Year in Office	-0.002^{***}	-0.001^{*}	-0.002^{***}	-0.002^{***}	-0.003^{***}
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Military Leader			-0.044^{***}	-0.044^{***}	-0.033^{**}
			(0.015)	(0.015)	(0.015)
EPR Groups				−0.014	−0.009
				(0.009)	(0.011)
Start Age					0.004^{***}
					(0.001)
Oil Producer					0.001
					(0.035)
Country FEs	87	87	87	87	87
Year FEs	0	53	0	0	0
Administrations	295	295	295	295	295
Observations	2,580	2,580	2,580	2,580	2,580
Note:					*p<0.1; **p<0.05; ***p<0.01
					Standard errors clustered on administration.

Table A.5: Leader Death

	Dependent variable:				
	$\mathbb{1}$(Leader Death)				
	(1)	(2)	(3)	(4)	(5)
B ≡Log(Budget)	−0.0002	−0.018***	0.0003	0.0003	0.001
	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)
$\mathbf{I}$	−0.080	−0.148	−0.075	−0.079	−0.081
	(0.133)	(0.133)	(0.135)	(0.137)	(0.135)
$\mathbf{P}$	−0.018	−0.142	−0.011	−0.012	−0.030
	(0.129)	(0.138)	(0.130)	(0.131)	(0.136)
$\mathbf{I} \times B$	0.003	0.006	0.003	0.003	0.004
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
$\mathbf{P} \times B$	0.0002	0.006	−0.0002	−0.0001	0.001
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
First Year in Office	−0.001***	−0.003***	−0.001***	−0.001***	−0.001***
	(0.0002)	(0.0004)	(0.0002)	(0.0003)	(0.0003)
Military Leader			−0.008	−0.008	−0.005
			(0.006)	(0.006)	(0.006)
EPR Groups				0.001	0.003
				(0.007)	(0.007)
Start Age					0.001**
					(0.0004)
Oil Producer					−0.008
					(0.019)
Country FEs	87	87	87	87	87
Year FEs	0	53	0	0	0
Administrations	295	295	295	295	295
Observations	2,580	2,580	2,580	2,580	2,580

Note: *p<0.1; **p<0.05; ***p<0.01
Standard errors clustered on administration.

Table A.6: Budget

	Dependent variable:				
	Budget$_{t+1}$				
	(1)	(2)	(3)	(4)	(5)
$B \equiv$ Log(Budget)	0.939***	0.925***	0.939***	0.939***	0.938***
	(0.015)	(0.020)	(0.015)	(0.015)	(0.015)
$\mathbf{I}$	−0.485	−0.445	−0.485	−0.430	−0.441
	(0.331)	(0.319)	(0.332)	(0.329)	(0.329)
$\mathbf{P}$	−0.672	−0.717	−0.672	−0.654	−0.642
	(0.645)	(0.614)	(0.647)	(0.648)	(0.651)
$\mathbf{I} \times B$	0.024	0.022	0.024	0.022	0.022
	(0.016)	(0.015)	(0.016)	(0.016)	(0.016)
$\mathbf{P} \times B$	0.032	0.035	0.032	0.032	0.031
	(0.031)	(0.029)	(0.031)	(0.031)	(0.031)
First Year in Office	0.001*	−0.0004	0.001*	0.001**	0.001***
	(0.0005)	(0.001)	(0.0005)	(0.001)	(0.001)
Military Leader			−0.00002	−0.0002	−0.002
			(0.010)	(0.010)	(0.010)
EPR Groups				−0.016	−0.016
				(0.012)	(0.012)
Start Age					−0.001
					(0.001)
Oil Producer					−0.021
					(0.020)
Country FEs	87	87	87	87	87
Year FEs	0	53	0	0	0
Administrations	295	295	295	295	295
p-value for $H_0 : \beta^{\text{lag}} = 1$	0.0001	0.0002	0.0001	0.0001	0.0001
Observations	2,580	2,580	2,580	2,580	2,580

Note: *p<0.1; **p<0.05; ***p<0.01
Standard errors clustered on administration.

E.1 Robustness: Time-Varying Covariates

Table A.7: Irregular Leader Transitions

	Dependent variable:					
	$\mathbb{1}$(Irregular Transition)					
	(1)	(2)	(3)	(4)	(5)	(6)
$B \equiv$ Log(Budget)	0.027^{**}	0.029^{**}	0.022	0.019	0.026	0.022
	(0.011)	(0.012)	(0.014)	(0.016)	(0.018)	(0.020)
$\mathbf{I}$	0.426^{*}	0.384	0.381^{*}	0.314	0.367	0.260
	(0.232)	(0.254)	(0.230)	(0.257)	(0.297)	(0.314)
$\mathbf{P}$	1.835^{***}	1.844^{**}	1.787^{**}	1.774^{**}	2.028^{**}	2.025^{**}
	(0.687)	(0.721)	(0.713)	(0.749)	(0.812)	(0.852)
$\mathbf{I} \times B$	-0.018^{*}	-0.016	-0.016	-0.012	-0.015	-0.010
	(0.011)	(0.012)	(0.010)	(0.012)	(0.014)	(0.015)
$\mathbf{P} \times B$	-0.080^{***}	-0.080^{**}	-0.078^{**}	-0.077^{**}	-0.089^{**}	-0.089^{**}
	(0.030)	(0.032)	(0.031)	(0.033)	(0.036)	(0.038)
First Year in Office	-0.003^{***}	-0.003^{***}	-0.003^{***}	-0.003^{***}	-0.003^{***}	-0.003^{***}
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Military Leader	-0.033^{**}	-0.035^{**}	-0.037^{**}	-0.040^{**}	-0.049^{***}	-0.054^{***}
	(0.015)	(0.016)	(0.015)	(0.017)	(0.017)	(0.018)
EPR Groups	-0.009	-0.006	-0.008	-0.008	0.0002	0.001
	(0.011)	(0.010)	(0.011)	(0.010)	(0.015)	(0.013)
Start Age	0.004^{***}	0.004^{***}	0.004^{***}	0.004^{***}	0.004^{***}	0.004^{***}
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Oil Producer	0.001	-0.008	-0.002	-0.017	0.006	-0.020
	(0.035)	(0.022)	(0.035)	(0.023)	(0.037)	(0.028)
Country FEs	87	87	87	87	87	87
Year FEs	0	0	53	44	0	0
Region-Year FEs	0	0	0	0	568	494
Administrations	295	295	295	295	295	295
Time-varying Covariates		✓		✓		✓
Observations	2,580	2,366	2,580	2,366	2,580	2,366

Note: *p<0.1; **p<0.05; ***p<0.01
Standard errors clustered on administration.

F. Robustness: Payoff Estimates

Table A.8: Estimates of Leaders' Payoff Parameters with Monopoly Coding

Leader's Utility:	$u_l(a_l^t, s_l^t; \theta) = B_l^t + x_l \cdot \beta + \rho \boldsymbol{I}(a_l^t, C_l^t) + \boldsymbol{P}(a_l^t) x_l \cdot \kappa$			
		Point Estimate	Outer Product	Jackknife Countries
Office Benefits ($\widehat{\beta}$)	Constant	-2.93	(0.03)***	(0.11)***
	Unconstrained	-1.37	(0.03)***	(0.26)***
	Military Leader	0.03	(0.03)	(0.20)
	Oil Producer	0.78	(0.03)***	(0.21)**
	Cum. Civil Wars	-0.54	(0.01)***	(0.14)***
	Exports	0.60	(0.02)***	(0.10)***
Inclusion Cost ($\widehat{\rho}$)		-1.01	(0.00)***	(0.04)***
Purging Payoff ($\widehat{\kappa}$)	Constant	-10.94	(0.17)***	(0.24)***
	Unconstrained	1.87	(0.18)***	(0.34)***
	Military Leader	0.00	(0.13)	(0.16)
	Oil Producer	-0.59	(0.16)	(0.34)
	Cum. Civil Wars	0.25	(0.07)***	(0.09)**
	Exports	-0.31	(0.05)***	(0.05)***
	Log Likelihood	190.58		
	Administrations	295		

Note: *p<0.1; **p<0.05; ***p<0.01

Table A.9: Estimates of Leaders' Payoff Parameters without logging Budget

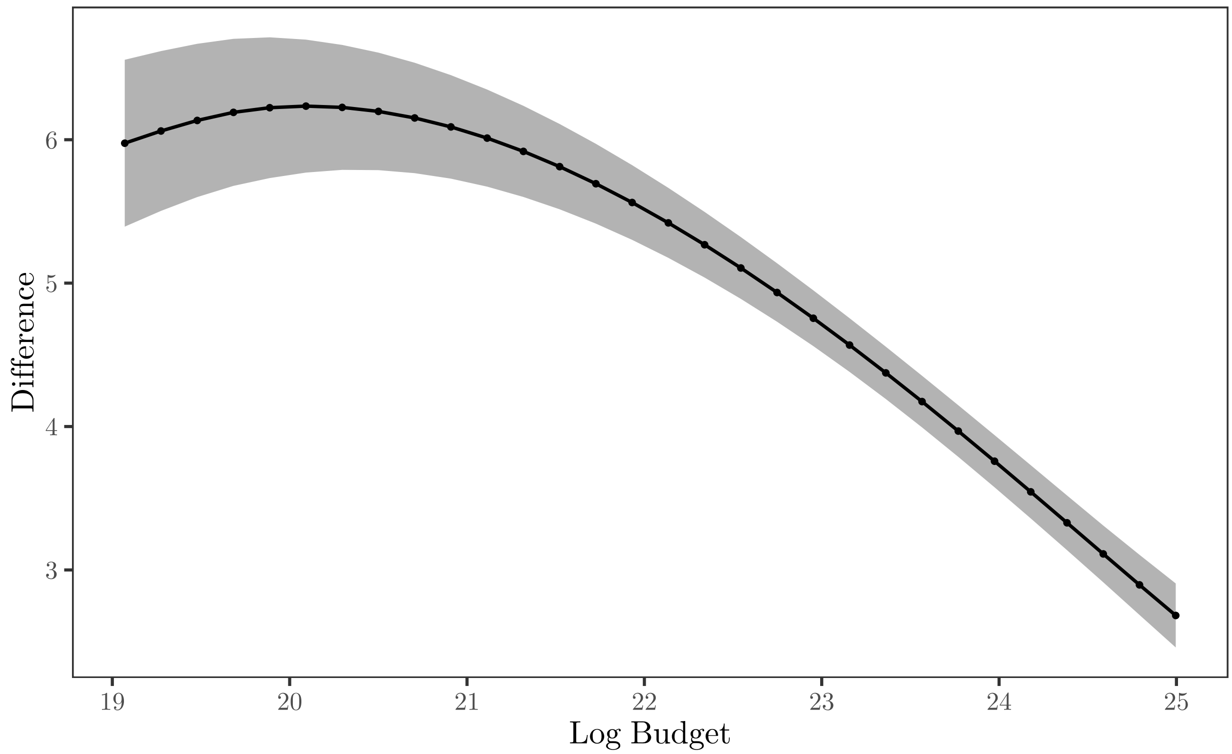
Leader's Utility: $u_l(a_l^t, s_l^t; \theta) = B_l^t + x_l \cdot \beta + \rho \boldsymbol{I}(a_l^t, C_l^t) + \boldsymbol{P}(a_l^t) x_l \cdot \kappa$

		Point Estimate	Outer Product	Jackknife Countries
Office Benefits ($\widehat{\beta}$)	Constant	-6.74	(0.04)***	(0.79)***
	Unconstrained	2.81	(0.04)***	(1.02)***
	Military Leader	-8.43	(0.03)***	(1.44)***
	Oil Producer	3.70	(0.06)***	(3.74)
	Cum. Civil Wars	-2.51	(0.01)***	(0.34)***
	Exports	0.56	(0.02)***	(0.56)
Inclusion Cost ($\widehat{\rho}$)		-5.21	(0.00)***	(0.35)***
Purging Payoff ($\widehat{\kappa}$)	Constant	-49.15	(0.17)***	(4.35)***
	Unconstrained	14.32	(0.18)***	(1.20)***
	Military Leader	10.39	(0.13)***	(1.30)***
	Oil Producer	-0.97	(0.16)***	(1.49)
	Cum. Civil Wars	0.72	(0.07)***	(0.34)**
	Exports	-0.71	(0.05)***	(0.44)*
	Log Likelihood	1631.96		
	Administrations	295		

Note: *p<0.1; **p<0.05; ***p<0.01

G. Substantive Effects

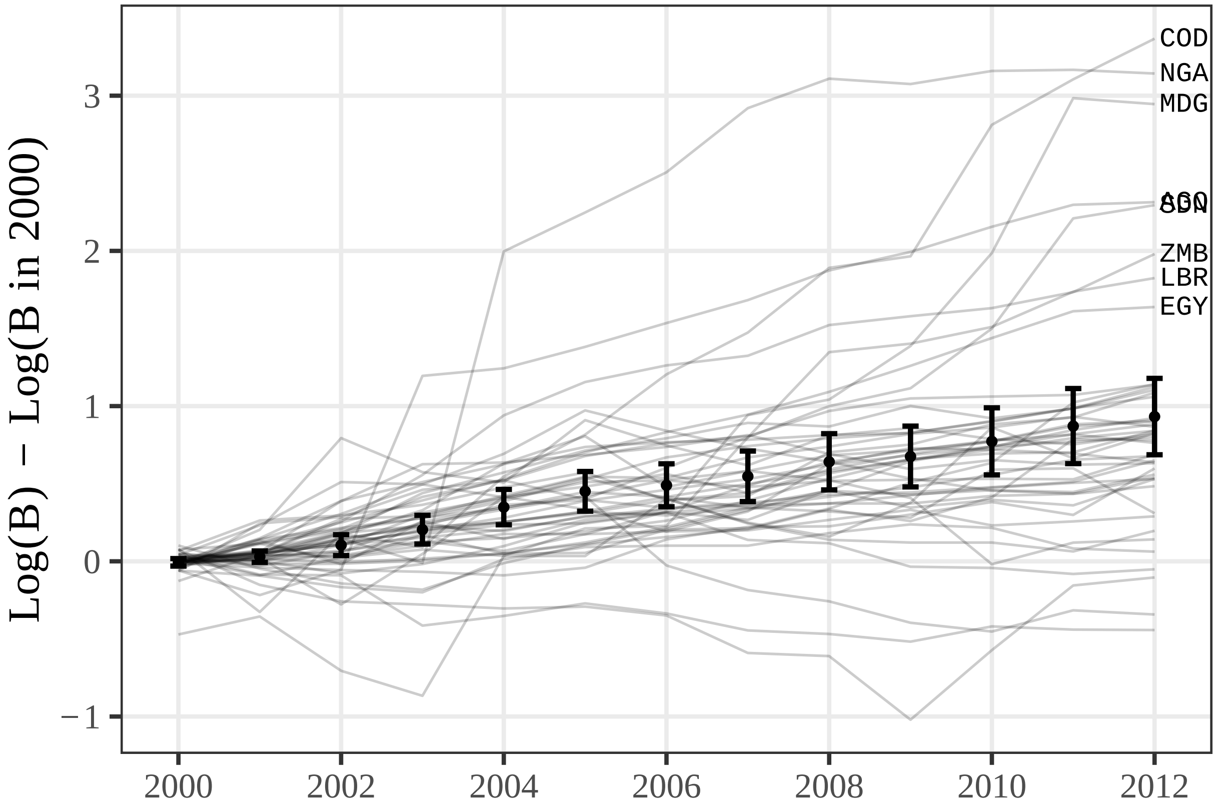
Figure A.1: Difference between $V_l(B_l, C_l = 0) - V_l(B_l, C_l = 1)$



Caption: All variables, z_l and x_l are held at their sample medians, and the shaded area denotes the 90% confidence intervals from a country-level jackknife.

G.1 Historical Budget Shocks

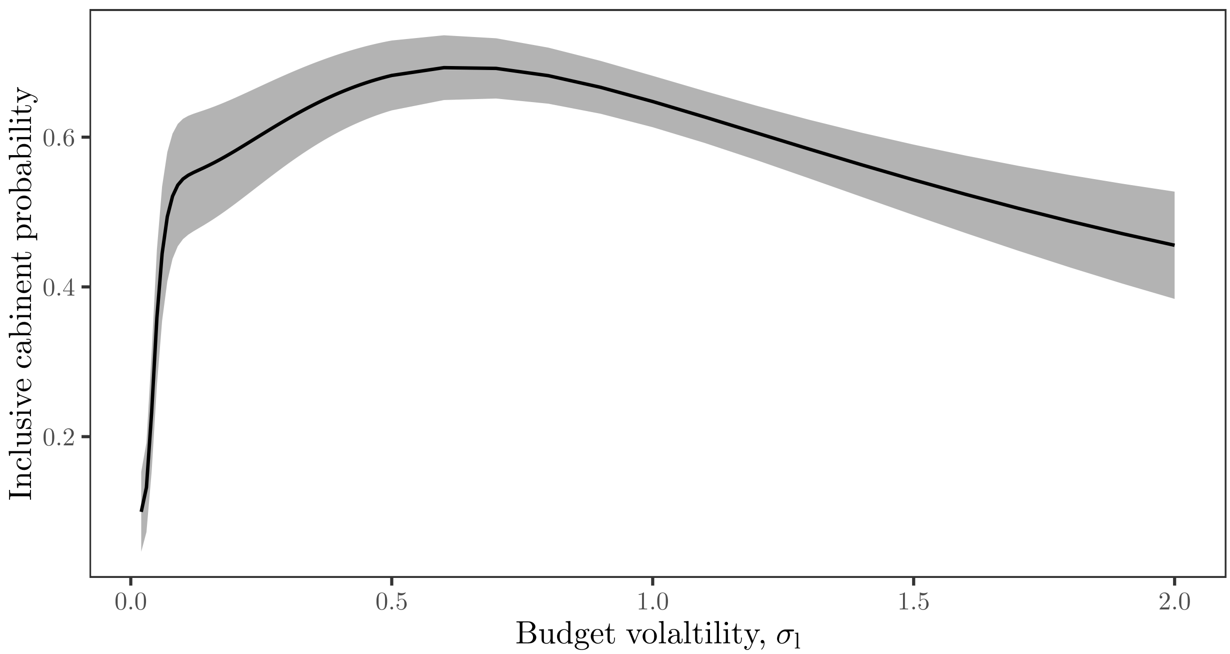
Figure A.2: Budget Implications of Commodity Boom in Africa



G.2 Budget Volatility

How does budget volatility effect the long-term probability of adopting an inclusive cabinet? Given the dynamics discussed in the previous section, there are two countervailing effects. On the one hand, smaller budgets encourage leaders to purge. Yet, the long-term benefit of purging diminishes if the leader expects budgets to increase rapidly in the future. Thus, volatility could decrease the probability of purging generating more inclusive cabinets in the long run. On the other hand, leaders controlling larger budgets are more likely to include other groups, but they would be less inclined to do so if they expect the budget to drop tomorrow, because small budgets and inclusive cabinets result in precarious circumstances for the autocrat. Our earlier analysis reveals the competing effects that determine the relationship between budget volatility and the incentives leaders have to incorporate other groups in the long run.

Figure A.3: Budget volatility and long-term probability of an inclusive cabinet



For each value of σ_l, i.e., the standard error of the budget shock, we compute the invariant distribution associated with the leader's optimal choice probabilities and the long-term probability of an inclusive cabinet. All variables, z_l and x_l are held at their sample medians, and the shaded area denotes the 90% confidence intervals from a country-level jackknife.

What effect dominates in the data? To answer this question, we return to our hypothetical autocrat and compute his optimal choice probabilities as we vary the volatility of the budget, σ_l. At each fixed volatility value, we solve the leader's decision problem and for the associated invariant distribution. Figure A.3 graphs the long-term probability that the autocrats includes the opposition, that is, $\sum_{B_l \in \mathcal{B}} \pi_l(B_l, 1)$ for a fixed volatility level σ_l. The analysis reveals an inverse U-shaped relationship between budget volatility and inclusive cabinets in the long run.[36] This pattern emerges because at relatively low levels of volatility, the

[36] In our data, budget volatility levels fall between 0.01 and 0.5, that is, on the left-hand-side of the maximum in Figure A.3.

first countervailing effect dominates. As volatility increases, leaders are less likely to purge and more likely to maintain the status-quo of power-sharing. However, at relatively high levels of volatility, the second effect starts to dominates. As volatility creeps above 0.6, leaders become less inclined to include rivals in the cabinet, leading to fewer inclusive cabinets in the long run.