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Political Loyalty and Leader Health

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ABSTRACT

Using a new dataset on leader health, we present and test five hypotheses derived from a selectorate theory account of how chronic illness interacts with political institutions, especially winning coalition size, to help shape the probability and timing of regular and irregular leader depositions. The analysis shows that, especially in small coalition — autocratic — political systems, the expectation that an incumbent will die soon, and so not be able to deliver future private rewards to her coalition of supporters, greatly increases the likelihood that the leader will be overthrown. The study also compares selectorate expectations with an alternative view, that sickly leaders are deposed because they can no longer produce effective policy, measured in terms of economic growth. As predicted by selectorate theory, sickly leaders significantly improve growth in an effort to stay in power for their short remaining lifetime. The analysis offers a new view on an important aspect of political instability, namely leader removal.

Keywords: Selectorate theory; political economy; instability; regime change; leader health

Illness and Political Survival

Political survival depends upon a symbiotic relationship between a political leader and her supporters. The leader provides rewards in exchange for which

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the supporters keep the leader in power. Sometimes enough of a leader's supporters are convinced to desert her and back a rival or a mass uprising so that she falls from power. Understanding why backers would abandon the incumbent in favor of someone else is at the heart of understanding political instability. Here we focus on how health shocks alter expectations about the incumbent's ability to deliver future rewards. Health shocks raise questions about whether supporters will stick with the incumbent or actively (e.g., via coup d'etat) or passively (e.g., by not defending the leader against an anti-government mass movement) allow her deposition.

In this paper we present and then test a selectorate theory account of leader survival that focuses on how health shocks influence the prospects that a leader will be deposed (Bueno de Mesquita and Smith, 2017). While we know much about the causes of a leader's death ex post, contemporaneous records are likely to have been incomplete since leaders have strong incentives to keep serious health problems secret. Despite being ex post, such data allow us to draw reasonable conjectures as to how likely the incumbent's coalition of supporters were to have been aware of the leader's impending demise and hence the extent to which their loyalty was diminished. In particular, we want to know if the leader suffered from a chronic health condition such as cancer or severe cardiovascular disease. When leaders suffer from such ongoing conditions it is likely that their supporters and the masses detect signs of ill health and so formulate the anticipation that the leader's near-term death has become more likely. In contrast, if death results from an acute condition, such as an infectious disease, then the illness is less likely to have been detected by the masses or even by essential supporters and so the incumbent's death is less likely to be anticipated. If leaders are killed in an incident, such as a traffic accident, or via assassination or execution following deposition, then we treat these death events as censoring our ability to know when the leader would have died of natural causes.

While certain factors, most notably age, predict likely death, these factors are not particularly strong indicators. We treat chronic illness as if its occurrence is random and use this pseudo-experimental setup to test selectorate theory predictions regarding leader survival. As the theory shows, as leaders approach the date at which they will die of natural causes, they become more likely to be deposed. In those cases where we can identify the cause of death as a result of a chronic condition (and we use a conservative coding scheme), the impact of approaching death is expected to be strongest in reducing political survival.

This paper is structured as follows. We review related literatures, following which, we provide a brief account of the specific theoretical approach to be tested. We then introduce the data and methods. We focus particularly on censoring issues since they are central to our empirical tests. We then present empirical results, looking at all forms of political deposition, then dividing the analyses into regular and irregular removal, after which, focusing on economic growth, we contrast the selectorate approach with an alternative explanation of the relationship between health and political survival. We conclude with a discussion of how the results can help inform assessments of political instability.

Review of Literature

To our knowledge there are few existing systematic studies of the impact of leader health. Jones and Olken (2005) is the most notable exception. However, leaders have become an increasingly important unit of analysis. Starting in the early 1990s scholars examined the impact of war and crisis involvement and other matters on the tenure of leaders across political systems (Bienen and Van de Walle, 1991; Bueno de Mesquita and Siverson, 1995; Bueno de Mesquita *et al.*, 1992; Chiozza and Goemans, 2011). As a result of this research, scholars developed data on national leaders (Horowitz *et al.*, 2015; Jones and Olken, 2005; Mattes *et al.*, 2016). The Archigos data have become a standard source and one that this research builds on (Goemans *et al.*, 2009). These data provide the term, birth and death of national leaders as well as information on how they entered and left office and their post-tenure fate.

A number of scholars have focused on how the personal characteristics of leaders affect their policy choices (Horowitz *et al.*, 2005). For instance, Horowitz *et al.* (2015) examine how age, profession, military experience and family background affect the conflict involvement of leaders. In a departure from traditional Realist approaches, researchers have attributed reputation to individual leaders rather than to nations (Dafoe *et al.*, 2014). They show that when leadership change occurs, then so too do relations between states (Mattes *et al.*, 2015; McGillivray and Stam, 2004).

Early themes in political survival analyses examined cabinet durations in parliamentary systems (King *et al.*, 1990; Laver and Schofield, 1998; Mitra, 1978). Rather than looking at whole governments or individual leaders, a number of recent studies have explored the tenure of cabinet ministers and bureaucrats (Arias and Smith, 2018; Flores, 2016; Francois *et al.*, 2014). The fate of ministers appears to be strongly dependent upon coalitional concerns rather than policy performance.

While to our knowledge there are no systematic cross-national analyses of the impact of leader health, the press frequently follows the health of leaders. Academics have also written extensively about the impact of health in the context of particular countries or leaders. McDermott (2007) examines illness and the foreign policy choices of US Presidents. A highly relevant study is Robins and Post (1995) that examines the medical implications of illness on decision making, succession concerns and implications that follow from the need for secrecy.

The theory on which we are building explores how health shocks influence the risk of coups, revolutions, purges and political liberalization (Bueno de

Mesquita and Smith, 2017). There is a voluminous literature on political transitions, democratization, coups and revolutions. We do not discuss these literatures as our concern is the linkage between leader health and leader deposition.

Jones and Olken (2005, 2009) use sudden death and the survival of assassination as 'as if random' events to provide identification strategies to measure the impact of new leaders on economic growth and war. Jones and Olken (2005) is perhaps the most relevant paper for our study. They argue that leaders differ in their ability and so leader change can result in shifts in growth rates. However, given concerns that deposition rates are endogenous to economic performance, the authors identify the set of leaders who died in office of natural causes or following an incident, such as a transportation accident. Treating such deaths as random events, their analyses find that growth rates differ significantly across leaders. These papers are powerful from a causal identification perspective (Pearl, 2009). Our approach exploits similar advantages. No leader chooses to get sick. Although older leaders are more likely to get sick, many other leaders do as well. Hence, we treat the actual occurrence of a life-threatening illness as a random, exogenous shock. Unfortunately, we cannot perfectly measure when a health shock is perceived either by coalition members or by the masses. However, individuals close to the leader are likely to perceive life-threatening illnesses suffered by the leader earlier than are others. In that sense, their response to a leader's illness is not random. Insiders are more likely to react to protect their own welfare before the masses catch on to the problem. Hence, sickly leaders are probably more likely to suffer the consequences of coups than revolutions but other than differences in responses across interests, the advent of a life-threatening illness per se is likely to be news that follows a random shock.

Selectorate Politics, Leader Health and Political Survival

Selectorate theory classifies political institutions according to the size of the selectorate, S, and the size of the winning coalition, W. The selectorate consists of the set of people who have at least a nominal say in the selection of leaders. In universal adult suffrage electoral systems, adult citizens comprise S. This is true whether the electoral system is rigged or free and fair. In monarchies the selectorate might be made up just of members of the royal family, making it quite small. Selectorate size is highly variable and is important because it defines the pool of people who have a positive expectation that they could become members of a regime's winning coalition.

The winning coalition is composed of a subset of the selectorate whose support is essential to keep the incumbent in power. In rigged-election systems, W typically is small. In systems with free and fair elections, W tends to be large, although how large depends on the details of the system such as whether it is a plurality voting system, a majoritarian system, a provincial- or national-list proportional representation system, or a handicapped indirect electoral system that assigns legislative seats, for instance, to protected minorities or other interest groups.

The essential feature of the members of the winning coalition is that they receive private benefits from the incumbent in exchange for their loyalty to her. That loyalty, in turn, is a crucial driver of leader survival. Political institutions vary in how they shape the strength of a loyalty norm that binds coalition members to their leader. That norm is strongest when W is small, S is large and leaders are healthy and well established in power. Since these effects have been formally modeled elsewhere, (Bueno de Mesquita and Smith, 2017; Bueno de Mesquita *et al.*, 2003), our intention here is to provide a heuristic explanation of the logic and examine how leader health affects political loyalty.

The intuition behind selectorate theory has two basic components: first, the size of W determines the types of political rewards leaders use to buy loyalty, and, second, when deciding who to support, selectors take account of the likelihood that they will be rewarded in the future. Leader health is an important consideration in making the latter evaluation as leaders cannot provide rewards from beyond the grave. We consider these factors in turn.

The size of the winning coalition shapes the types of policies that political leaders use. We assume leaders use a combination of g public and x private goods to rewards supporters. Public goods benefit everyone in society whether he/she backs the leader or not. In contrast, private goods are given only to coalition members. As such, W serves as the effective price of private goods. If the price of a unit of public goods is p, then the incumbent's expenditure is $M = pg+Wx$. Let $u(g)$ and $v(x)$ be the utility associated with receiving public and private goods, respectively. To maximize supporters' rewards, leaders allocate resources to g and x such that the ratio of marginal benefits equals the ratio of marginal costs for the two goods.

When W is small private goods are relatively cheap. An incumbent who needs the support of only a handful of supporters can effectively reward her supporters by spending lavishly on them, even if doing so leaves few resources to provide for society as a whole. However, when the coalition is large, the marginal cost of providing private goods (W) is high as many people need to be rewarded. As a consequence, leaders shift their spending towards public goods. Coalition size determines the relative focus of policy provision. There is considerable empirical support for this result (Bueno de Mesquita *et al.*, 2003; Deacon, 2009; Lake and Baum, 2001).

Our objective here is to provide the logic rather than a full characterization. With that in mind, we write $V_W(M) = u(g^*) + v(x^*)$ as the payoff that supporters receive if a leader optimally spends M resources on a coalition of size W by providing g^* public and x^* private goods. Economists would refer to $V_W(M)$ as an indirect utility function as it determines the level of rewards from spending M. Furthermore, let $U_S(M) = u(g^*)$ refer to the value of the public goods alone; the rewards received by those outside of the coalition. Perhaps the most pertinent factor given what is to follow is that the difference between coalition rewards and rewards for those outside the coalition decreases as W rises: $V_W(M,W) - U_S(M,W) = v(x^*)$ and $\frac{\partial x^*}{\partial W} < 0$. Being left out of the coalition is much more costly in an autocracy than in a democracy!

Political loyalty depends both on what leaders offer today and on what supporters expect to receive in the future. If the leader's backers anticipate they will receive more from a potential rival, then they defect and the leader is replaced. Given this, we start by considering what rivals can offer the incumbent's supporters to encourage them to defect. To come to power a rival needs to form a coalition of size W and persuade some of the incumbent's backers to defect. In the immediate period, a rival can offer no more than $V_W(R)$, that is to say, efficiently spend all available resources on his coalition. Once in power, a new leader may replace those who helped him come to power if there are others whom he trusts to remain loyal.[1]

We do not develop a formalization here, but rather recognize that reshuffles are likely and transitional backers are only retained in the long-run coalition probabilistically. In particular, let γ_c be the probability that the challenger, if successful, retains transition backers in the long term. With the complementary probability, $(1-\gamma_c)$ transitional supporters are dropped out of the winning coalition. The likelihood that a transitional supporter is retained in a leader's long-term coalition is increasing in the number of supporters that a leader needs (W) and decreasing in the size of the pool from which he can draw his supporters (S). In mathematical formulations of selectorate theory, $\gamma_c = \frac{W}{S}$. The cost and risk of being excluded from the long-term winning coalition creates political loyalty.

Suppose that in the long run a leader is expected to spend M^* of the available R on rewarding the coalition and that, relative to the short-term rewards, selectors place δ weight on long-run rewards. If a backer of the current incumbent defects and backs a rival who comes to power, then his expected rewards are

$$\underbrace{V_W(R)}_{\text{immediate reward}} + \underbrace{\underbrace{\delta\gamma_c V_W(M^*)}_{\text{coalition inclusion}} + \underbrace{\delta(1-\gamma_c)U_S(M^*)}_{\text{coalition exclusion}}}_{\text{long-term rewards}} \tag{1}$$

Equation (1) sets the minimum rewards level that the incumbent must match to survive in office. Using a parallel approach, if the incumbent spends M resources on coalition rewards in the immediate period, suffers a random

[1] Bueno de Mesquita *et al.* (2002) examine the choice of coalition members and deposition rules in more detail.

performance shock ϵ (related to all other dimensions) and retains supporters with probability γ_I, then the payoff from remaining loyal to the incumbent is

$$\underbrace{V_W(M)+\epsilon}_{\text{immediate reward}} + \underbrace{\underbrace{\delta\gamma_I V_W(M^*)}_{\text{coalition inclusion}} + \underbrace{\delta(1-\gamma_I)U_S(M^*)}_{\text{coalition exclusion}}}_{\text{long-term rewards}} \quad (2)$$

By comparing Equations (1) and (2), the incumbent survives if

$$V_W(M)+\epsilon \geq V_W(R) - \delta \underbrace{\underbrace{(\gamma_I-\gamma_c)}_{\text{Pr. inclusion}} \underbrace{(V_W(M^*)-U_S(M^*))}_{\text{inclusion value}}}_{\text{incumbent advantage}} \quad (3)$$

The incumbent has an incumbency advantage provided that $\gamma_I - \gamma_c > 0$. This advantage allows the incumbent to survive performance shocks (negative ϵ's) and retain resources for her own pet projects ($M < R$). The extent to which she can do so depends upon two factors: the costs of being excluded from the long-term coalition ($V_W(M^*) - U_S(M^*)$), and, the relative risk of exclusion ($\gamma_I - \gamma_c$). As already discussed above, the cost of exclusion is high when the winning coalition is small, as under these arrangements most of the rewards are in the form of private goods. The relative risk of exclusion depends upon institutions and the health and tenure of the incumbent.

Leader survival is governed by a political life cycle which depends upon leader tenure, leader health and political institutions. To explore this cycle we examine a series of cases. Consider first a healthy, well-established incumbent. Since the incumbent has been in office some years she has already had the opportunity to replace those who brought her to power with those selectors that she likes and trusts. Since her reshuffles have mostly already occurred, those supporters who remain in her coalition have a reasonably high expectation of being kept on by the incumbent: γ_I is high. For convenience, let us say $\gamma_I = 1$. In contrast, if a challenger comes to power, then a reshuffle is likely: $\gamma_c = \frac{W}{S}$. Supporters have a greater chance of access to future private goods if they stick with the incumbent rather than defect to the challenger. $\gamma_I - \gamma_c$ is at its largest for heathy, established leaders.

The magnitude of incumbency advantage for healthy established leaders, $\delta(1 - \frac{W}{S})(V_W(M^*) - U_S(M^*))$, depends upon political institutions. When W is large then the risk of being excluded from future coalitions is relatively small since any incoming leader needs a large proportion of the selectors in order to form his coalition. Furthermore, the cost of being excluded from the coalition is small since most of the rewards are public goods. Since the incumbency advantage is small, a democratic incumbent can divert relatively few resources (M is close to R) and is unable to survive performance shocks. In contrast, as W contracts, healthy, established leaders have a large incumbency advantage that enables then to divert funds (kleptocracy or pet projects) and to survive even large performance shocks (recessions and lost wars). The incumbency advantage is large in small W systems because the private goods focus in policy making means the cost of coalition exclusion is high $(V_W(M^*) - U_S(M^*))$, and the need for few supporters creates a high risk of exclusion $(1 - \frac{W}{S})$. Healthy, established, small coalition leaders have a large incumbency advantage.

Furthermore, when leaders first enter office they all have a small incumbency advantage because they have not yet reshuffled the coalition from its transition state to its long-term composition. As a result, γ_I is relatively small. The effect of a universally weak incumbency advantage when a leader first comes to power combined with the growing incumbency advantage for small coalition leaders over time implies that the effect of institutions on leader survival varies over time differentially and favors small W leaders in the long run. We turn now to how such advantages are modified by variations in leader health.

Health concerns increase the risk of leader deposition. Let h represent leader health, the probability that a leader lives to the next period. For leaders who are fit and healthy, h is close to 1. However, as a leader becomes sickly, h declines. A reduction in h undermines a leader's political life as well as her mortal life. No leader can credibly promise to provide rewards from beyond the grave. If the leader dies, then a new leader will take office, and, of course, from the perspective of political supporters this means that a reshuffle is likely. The chance of access to future private goods from sticking with a sickly incumbent is $\gamma_I = h + (1 - h)\gamma_c$. The first term corresponds to the leader surviving and keeping the same coalition and the second term corresponds to the incumbent dying and a subsequent reshuffle by the new leader. As a leader's health declines, $\gamma_I \to \gamma_c$ and the incumbency advantage disappears.

Because political loyalty is generated in the selectorate theory by the expectation of future private goods, once a leader is known to be dying the incentive to remain loyal dissipates. Leaders who are old or infirm are at much greater risk of being deposed than their young and healthy peers. It is not an accident that political leaders attempt to appear young, athletic and spritely rather than old, tired and ill. Our exposition of the theory has focused on deposition by rivals under the extant system. However, the logic of the argument also applies to irregular deposition threats such as revolutions. Revolutions succeed when the regime's supporters fail to suppress protestors. Supporters are willing to undertake the bloody and unpleasant work of suppression when they expect a long-run stream of rewards. However, as both the Shah of Iran in 1979 and Ferdinand Marcos of the Philippines in 1986 found out, when a leader is chronically ill, supporters may sit on their hands and allow the masses to succeed. The theory leads to the expectation that health shocks increase the odds of losing power under the extant rules to a domestic rival (which we refer to as a regular turnover). Leaders can also lose power by irregular means such as coup d'etat and revolution when coalition members or ordinary citizens perceive that there is a high probability that the leader is about to die, creating an opportunity to abandon the extant rules by reshaping the polity.

The best way for leaders to deal with health problems is to keep them secret. If supporters do not know that the leader is gravely ill, then the incumbency advantage persists and coalition loyalty is readily sustained. Once supporters suspect their leader is sick, however, they require greater rewards to stay loyal. In terms of the derivation above, this means that leaders must spend more resources in the current period: M increases. This result is important because it helps distinguish between our selectorate account of political loyalty and an alternative approach that contends that sickly leaders are less capable.

It is plausible to argue that sickly, dying leaders become less competent decision makers whose inability to deliver effective policy leads to their deposition. For instance, in a nuanced series of case studies, Robins and Post (1995) illustrate how illness (and attempts to cover it up) highlights the diminishment in effective public policy when leaders are sick. This diminished capacity argument implies, as an alternative to the selectorate perspective, that sick leaders are deposed, at least in part, because of policy failure. In contrast, selectorate theory predicts that a leader with health problems needs to provide more rewards and so provides additional public and private goods. Such additional spending should result in increased economic activity. In contrast, diminished capacity should result in economic decline.

Hypotheses

To summarize briefly, the theory implies the following testable hypotheses:

1. Healthy leaders in small coalition systems, because of their greater dependence on private goods, are less likely to be deposed (i.e., are likely to survive longer) than are healthy leaders in large coalition systems (Bueno de Mesquita and Smith, 2017, proposition 3).

2. Leaders who turn out ex post to have been close to death but who were not suffering a chronic illness are not as likely to be deposed as leaders who were equally close to death based on ex post information, but who were suffering from a discernible chronic illness (Bueno de Mesquita and Smith, 2017, Equations (16) and (17)).

3. The impact of the life cycle on deposition is different for large W and small W leaders. In particular, large W leaders face a fairly constant and high risk of deposition; leaders in small W systems, initially face a high risk of deposition but that risk diminishes over time (Bueno de Mesquita *et al.*, 2003, Chapter 7).

4. When a leader is close to the end of her lifetime and suffers from a chronic illness, especially in small W systems, then loss of power through irregular means (e.g., revolution, coup) becomes more likely. Large W leaders are nearly immune from irregular deposition (Bueno de Mesquita and Smith, 2017, p. 714).

5. When a leader is close to death and is chronically ill, economic growth either remains the same or increases if the selectorate perspective is supported and declines if the diminished capacity perspective is supported (Bueno de Mesquita and Smith, 2017, Figure 3).

Data

Leader Health

We utilize the Archigos data, which has become the standard resource for political leaders in recent years (Goemans *et al.*, 2009). In addition to entry and exit time, Archigos provides dates of birth and death and information on the post-tenure fate of leaders (death, imprisonment, exile) and the method in which they were removed from office. The most recent version of Archigos (Version 4.1, released in March 2016) contains data on leaders through December 31st 2015.

We supplement the Archigos data, updating it through December 31st 2016. Our updating takes two forms. First we updated the tenure information for leaders who left office after 2015 (the date Archigos was coded until). We also added data on successor leaders. Second, we updated data on the deaths of leaders who died after 2015. Our main innovation was to code the cause of death for each leader who died within 10 years of leaving office. The details are described in Smith *et al.* (2017).[2]

As discussed theoretically, we want to distinguish between leaders who had long-term, chronic health conditions and those for whom death was acute and unanticipated. If supporters anticipate that their symbiotic relationship with their leader is coming to an end because the leader is about to die, then loyalty dissipates. Hence, if there is an expectation that a leader will die shortly, then the theory predicts that irregular leader replacement through such events as coups, revolutions and other mass protests, becomes more likely. It is not the date of death per se that matters, but rather the expectation that death is likely to occur soon. Ideally we would like to know how informed citizens and

[2] We received a generous seed grant from the Moore-Sloan Center for Data Science at New York University (http://cds.nyu.edu/nyu-data-science-seed-grant/). The data collection was undertaken in collaboration with Ralph Grishman in NYU's Computer Science department. Carly Abrahams, Sasha Daich, Dongil Lee and Melissa A. Schiff served as superb researchers on the project.

supporters were about a leader's health prospects. In some cases health scares become very public. That was the case, for instance, regarding Fidel Castro in Cuba and Hugo Chavez in Venezuela. These exceptions remind us that precisely because of the impact of such information, leaders attempt to prevent its dissemination. Therefore, we cannot systematically measure who knew what when. However, we know when a leader died and something about the cause of death. Consequently, as a second best alternative, we use information on the timing and cause of a leader's death to make inferences about his/her health while he/she was in office. Our central concern is whether a leader's death was likely to have been anticipated by her/him, his/her backers, and perhaps even the masses, as would be true, for instance, if he/she suffered from a serious chronic illness.

We classify leader deaths into four main categories:

1. **Chronic**: A serious long-term illness whose severity would have been hard to hide from close advisors and supporters. Cancer is one obvious example.
2. **Acute**: A serious illness but whose onset is not foreseeable. Infectious diseases fall in this category.
3. **Incident**: An accident such as falling off a horse or dying in a plane crash.
4. **Killed**: Often leaders are killed during or following a political deposition. Former leaders are also liable to be executed for alleged crimes during their term in office. Assassinations also fall in this category.

There are a few other categories, such as suicide and preemptive suicide. We categorize the cause of death by coding the obituaries of leaders who died within 10 years of leaving office. We assume those leaders who lived at least 10 years after office were unlikely to have had serious health events that would have created the expectation that they were likely to die while they were in office. We classify such leaders as "Long Retirement". We used a combination of web scraping, machine text analysis and hand coding to classify the cause of death. In many cases it is easy to classify the cause of death. Unfortunately, in some cases it was difficult. It is worthwhile to pause to discuss some of these difficulties.

As coders we learned to dread the terms, "natural causes" and "heart attack". Death by heart attack occurs in several contexts. In some instances, a leader can have a chronic health condition and eventually succumbs to a heart attack. In other cases, an apparently healthy individual can suddenly drop dead from a heart attack. The former is an example of a chronic health condition and the latter is an example of an acute condition. When possible we sought background information such as, for instance, had the leader repeatedly

Table 1: Causes of death for political leaders (retirement < 10 years).

	Freq.	pct
Acute	122	11.64
Ambiguous	42	4.01
Chronic	446	42.56
Heart attack	87	8.30
Incident	26	2.48
Killed	191	18.23
Natural causes	111	10.59
Preemptive suicide	11	1.05
Stroke	3	0.29
Suicide	6	0.57
Unknown	3	0.29
Total	1,048	100.00

been hospitalized. In several cases the cause of death was highly debatable. To minimize miscategorization, when we were uncertain about whether a heart attack or death by natural causes was in the context of a chronic or an acute condition, we created a separate category. Table 1 shows the frequency of each cause of death. Of the 1,048 leaders who died less than 10 years after retirement, we code 446 as dying of chronic conditions. For 45 leaders we either failed to find any information on the cause of death or there was sufficient argument or ambiguity that we could not classify them. Many of these unknown cases correspond to leaders who held office for a very short period. We have 87 cases of heart attack, 3 cases of stroke and 111 cases of natural causes in which we have insufficient information to code the cause of death as chronic or acute. We collapse these cases into the category "Other" in subsequent tables. We also merge suicide and preemptive suicide and ambiguous and unknown into aggregate categories.

Political Institutions and Other Variables

In recent years there have been significant efforts to measure institutions so as to be able to make comparisons both within as well as between democracy and autocracy (Geddes *et al.*, 2014; Wintrobe, 1998). Bueno de Mesquita *et al.* (2003) create a five-point scale for winning coalition size, $W \in \{0, \frac{1}{4}, \frac{1}{2}, \frac{3}{4}, 1\}$. They also create a three-point measure for selectorate size, $S \in \{0, \frac{1}{2}, 1\}$. Scholars, such as Gallagher and Hanson (2015) and Clarke and Stone (2008), have criticized these indicators. However, systematic improvements have not been offered and these indicators have previously been successfully used to test many nuanced predictions from the selectorate theory. Still, as a robustness check, in the Appendix we replicated the core analysis conducted here using Polity's democracy minus autocracy score as an alternative measure of coalition size (Marshall, 2016). We rescale Polity's 20-point measure to take values between 0 and 1 and refer to the variable as Polity: Dem-aut. Following the response by Morrow *et al.* (2008) to Clarke and Stone (2008), we also examine models with W and Polity's executive constraints measure (XCONST); the executive constraints measure is the component of Polity not present in W.

Table 2 shows the frequency of different causes of death across different sizes of W. Leaders die from different causes under different political institutions.[3] The category Alive indicates the leader was still alive as of 1/1/2017. Long

Table 2: Cause of death across political institutions.

	Winning coalition size, W					
Cause of death	0	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	1	Total
Acute	14	20	22	38	23	117
%	4.5	3.2	5.0	3.6	3.1	3.7
Alive	46	103	38	362	200	749
%	14.8	16.4	8.6	34.6	27.0	23.7
Chronic	36	94	56	153	96	435
%	11.6	14.9	12.7	14.6	13.0	13.7
Incident	3	8	4	9	2	26
%	1.0	1.3	0.9	0.9	0.3	0.8
Killed	47	53	35	37	13	185
%	15.2	8.4	7.9	3.5	1.8	5.8
Long retirement	130	289	236	385	360	1,400
%	41.9	45.9	53.5	36.8	48.6	44.2
Other	22	46	38	49	41	196
%	7.1	7.3	8.6	4.7	5.5	6.2
Suicide	7	1	4	3	2	17
%	2.3	0.2	0.9	0.3	0.3	0.5
Unknown/ambiguous	5	15	8	11	3	42
%	1.6	2.4	1.8	1.1	0.4	1.3
Total	310	629	441	1,047	740	3,167
%	100.0	100.0	100.0	100.0	100.0	100.0

[3]We code the institutions on the year the leader left office, not the year they died. The Pearson χ^2 test with 32 d.o.f. is 291. $Pr = 0.000$.

Retirement indicates that the leader lived at least 10 years after leaving office. Some of the patterns in the table are readily explained by temporal trends. For instance, a much higher percentage of large coalition leaders are still alive than in small coalition systems. This result is a function of democracies being much more prevalent in recent years. Particularly noticeable is the much higher rate at which small coalition leaders are killed compared to large coalition leaders.

Measures of wealth (per capita GDP in constant $), economic growth, population size and the extent of a nation's natural resources wealth (as a % of GDP) are taken from the World Development Indicators (World Bank, 2016).

Age is a major indicator of mortality risk. Rather than use nominal age, we account for changes in life expectancy due to medical advances. In particular, we compare leader age with the contemporaneous life expectancy of Swedes at age 10 (Roser, 2017). Sweden is a relatively advanced nation that quickly adopted medical advances and it also avoided most of the large conflicts of the last two centuries that diminished life expectancy elsewhere. As Siverson and Johnson (2014) have shown, political elites are more likely to have life spans commensurate with the best medical practices of the era rather than the life expectancy of their populations. The variable Relative Age is defined as leader age minus Swedish life expectancy and should be considered as age relative to expected life span.

Analysis

Table 3 shows the average age at which leaders enter and exit office, their age and relative age at time of death. The table also shows median and mean tenure in office and statistics on the length of retirement; that is, time between leaving office and death. The differences in relative age and tenure across W are statistically significant.[4] Given the hazard analyses to follow, it is worthwhile commenting on the average tenure of leaders. On average, small coalition leaders survive in office longer than their large coalition counterparts, with the difference in means being larger than the difference in medians, (5.24 minus 3.09) versus (2.36 minus 1.56). The selectorate approach we advocate argues that survival becomes easier over time for small coalition leaders as supporters become more confident of receiving a long-term flow of valuable private goods. An alternative explanation is that large coalition (democratic) leaders are term limited. Although Baturo (2014, p. 1) shows that over a quarter of nominally term-limited leaders extend their term, we take the term limits critique seriously. In the supplementary material, we use data from

[4]Comparison of Wilcoxon Rank Sums and T-tests shows that the differences across groups are statistically significant. For instance, leaders from $W = 1$ systems are statistically different from leaders with smaller coalition, except for entry and exit ages if $W = 0.75$.

Table 3: Age of entry, exit and death for leaders.

	Winning coalition size, W				
Leader statistics	0	0.25	0.5	0.75	1
Entry age					
mean	51.09	51.39	51.81	54.94	55.71
std.dev.	12.91	11.99	10.82	10.53	8.78
Exit age					
mean	56.36	55.95	56.45	58.57	58.77
std.dev.	11.58	11.62	11.77	10.83	8.85
Death age					
mean	68.99	71.61	71.54	74.28	76.57
std.dev.	14.61	14.01	13.22	12.36	11.39
Relative death age					
mean	−4.52	−0.97	1.12	−0.50	−1.89
std.dev.	13.21	13.68	11.08	11.37	9.45
Tenure					
median	2.36	1.32	2.18	2.26	1.56
mean	5.24	4.51	4.56	3.63	3.09
std.dev.	7.48	7.76	7.08	4.57	3.73
Retirement					
median	6.95	13.10	11.70	11.86	16.62
mean	11.38	15.12	14.68	13.93	17.94
std.dev.	12.52	13.42	14.00	11.32	11.85

Carter and Nordstrom (2017) to exclude all term-limited leaders. We then replicate our basic analyses and obtain similar results with or without the correction for term limits.

Figure 1 shows the Kaplan–Meier estimates of survival for leaders under each value of W. Effectively, the graph shows the proportion of leaders still in office as time elapses.[5] The figure shows some important features. The rate at which leaders are removed differs over time. In the first year, large coalition leaders ($W = 1$) are the least likely to be removed from office. However, over time it becomes much harder for such leaders to survive. On the right-hand side of the figure, it is the small coalition leaders ($W = 0$, 0.25, 0.5) who are most likely to still be in office at the 10 year mark despite being most likely to be

[5] Figure 1 was constructed making no differentiation between method of exit.

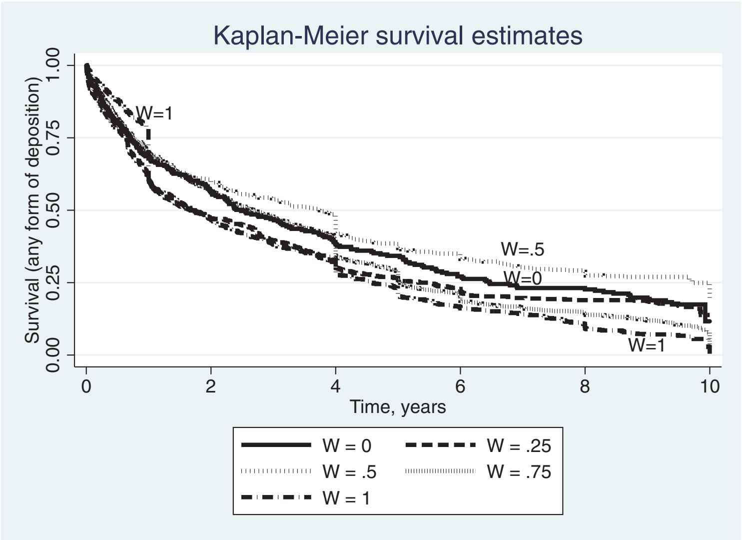

Figure 1: Kaplan–Meier survival graph across institutions.

removed in the first year. This result is consistent with selectorate expectations, and past findings. It also implies that when we use statistical approaches to analyze the survival of leaders we need to use methods in which the hazard rate can vary over time differently for different institutional configurations. Although the semi-parametric Cox Proportionate Hazard model is perhaps the most common hazard analysis tool used in political science (Box-Steffensmeier and Zorn, 2001), it is inappropriate in our context because of institutional difference in the underlying hazard rate.

The Cox model assumes that there is some underlying hazard rate and then assesses how the impact of covariates shift the hazard rate relative to the baseline. Given strong theoretical expectations that the proportionality assumption of the Cox model is violated in a specific manner, we use the Weibull parametric approach. Given the prevalence of Cox models in political science, we present Cox regression analyses in the appendix (Table A6) and obtain similar substantive results regarding health.

Institutions and Time-Dependent Risk: Weibull Model

Hazard analysis estimates the probability of failure at time t, conditional upon failure not having occurred prior to t. In the current context, failure means removal from office. Below we discuss the competing methods by which leaders are removed. We use a Weibull model in which the hazard rate is

$H(t) = p\lambda t^{p-1}$, where $\lambda = e^{X\beta}$ with X being the standard vector of covariates and β being the coefficients that determine the impact of these variables on the risk of being removed. The Weibull model allows the hazard rate to vary over time. If $p = 1$, then the hazard rate is constant over time. As we will see, large coalition leaders find themselves in circumstances close to $p = 1$. In contrast, if $p < 1$, then survival becomes easier over time, a setting small coalition leaders find themselves in. As required by the theory, the ancillary parameter p is modeled as a function of coalition size. The tables containing hazard analyses are divided into two sections. The top part of the tables, labeled $X\beta$, show the estimates of how covariates affect the hazard rate. The lower sections show estimates of the ancillary parameter, $ln(p)$, as a linear function of political institutions.

Competing Risks

Censoring is an important concept in hazard analysis. If a leader is still in office, then we do not know how long she will survive, but we do know that she has survived at least as long as her current tenure. A leader can depart office for numerous reasons and leaving office for any one particular reason censors our ability to know when she would have left office for another reason (Box-Steffensmeier and Jones, 2004; Clayton, 1978; David and Moeschberger, 1978).

Table 4 divides the cause of deposition into four groups: regular removal, irregular removal, died in office and removal by a foreign power. The regular/irregular removal coding is taken from Archigos. We treat removal by one of these means as censoring our ability to observe when a leader would have been removed by other means. For instance, suppose $T_{naturaldeath}$ represents the time at which a leader would die naturally (not killed). $T_{regular}$, $T_{irregular}$ and $T_{foreign}$ represent the times at which a leader is removed from power regularly, irregularly or by a foreign power. If a leader dies in office, then $T_{naturaldeath} < T_{regular}, T_{irregular}, T_{foreign}$. We observe $T_{naturaldeath}$ in this case but we are censored in our ability to know when a leader would have been deposed had she not died. Likewise, if a leader is deposed by a foreign power,

Table 4: Institutions and how leader leaves office.

	Winning coalition size, W					
Removal	0	0.25	0.5	0.75	1	Total
Regular	0.2387	0.5710	0.6059	0.8596	0.9473	0.7128
Irregular	0.4645	0.2648	0.2118	0.0535	0.0068	0.1456
Died in office	0.1290	0.0973	0.1162	0.0506	0.0284	0.0739
Foreign removal	0.0806	0.0351	0.0182	0.0038	0.0000	0.0221

then our ability to observe when she would have been deposed domestically is censored.

In our initial analyses we focus on domestic deposition, without regard for whether the removal was regular or irregular; that is, events for which $T_{domestic} = min\{T_{regular}, T_{irregular}\} < min\{T_{naturaldeath}, T_{foreign}\}$. That is, leaders are actively removed domestically rather than dying in office or being removed by a foreign power.

While natural death in office censors our ability to observe when a leader would have been deposed domestically, the reverse often is not true. As seen in Table 2, we know the cause of death for leaders even if they were deposed earlier. A major hypothesis to be tested here is that the approach of $T_{naturaldeath}$ triggers other forms of removal if the leader's impending demise is foreseeable. Unfortunately we cannot always observe $T_{naturaldeath}$. For instance, some former leaders are still alive. Others are assassinated, executed or die in an accident that prevents us from observing when they would have died from natural causes. We take a conservative coding position that such leaders had no imminent health concerns.

CloseToDeath is an important variable in our analysis, reflecting ex post knowledge of how close a leader was to dying of natural causes. Let deathyear be the year in which a leader dies of natural causes (which for operational purposes is defined here as not killed or not dying in an incident).[6] Given the conservative coding decision discussed above, if a leader is killed or dies in an incident, events that censor our ability to observe $T_{naturaldeath}$, we code $CloseToDeath = 0$. Similarly if $deathyear - year > 5$, then $CloseToDeath = 0$. For observations in which the leader dies of natural causes within five years of leaving office,

$$CloseToDeath = \frac{1}{1 + deathyear - year}$$

With respect to cause of death, the key theoretical concept is the ability of supporters to anticipate a leader's forthcoming demise. Chronic diseases increase the likelihood that near-term death is anticipated. Table 1 showed causes of death. The variable Chronic is coded as 1 for leaders who died of chronic causes. The variable *CloseToDeath*: *Chronic* indicates how proximate death was for leaders with chronic health conditions, reflecting that the chronic illness was serious and probably detected. The variable *CloseToDeath*: *Non-Chronic* = *CloseToDeath* * (1-*Chronic*) indicates the nearness of death for leaders not suffering from a chronic condition.

[6] It is useful to code the nearness of death in this manner rather than distance from death because we anticipate diminishing marginal returns to each additional year and it avoids having to censor observations of leaders who are still alive and hence have no deathyear date. Obviously the choice of a five-year limit is arbitrary but it reflects a compromise between a continuous measure for all leaders and avoiding censoring too many observations due to leaders not having retired long enough to code the variable. We obtain similar results using other limits.

As discussed, in cases listed as heart attacks, strokes and natural causes, we could not determine whether these were acute or chronic conditions. To generate a broader definition of anticipatory death, we code Ill Health as equal to 1 if the cause of death is chronic or if the leader dies of one of the following: heart attack, stroke or natural causes, and the leader's relative age is positive. This latter condition indicates the leader is older than the average life expectancy. In all other cases, Ill Health is coded as zero. For robustness, we replicate a number of analyses using this broader health definition in the Appendix.

Hazard Analysis

Table 5 contains three Weibull hazard analyses of domestic deposition; that is to say, the leader is removed by regular or irregular means rather than dying in office or being removed by a foreign power. The latter forms of leaving office are regarded as censored observations.

We focus first on the impact of institutions on domestic deposition. Winning coalition size appears in both the $X\beta$ and the $Ln(p)$ sections. With respect to the standard covariate portion $(X\beta)$, in models M1 and M2, W has no statistically significant effect. In model M3, W's effect is negative and weakly statistically significant. The negative coefficients indicate that initially large coalition leaders face a lower risk of deposition than small coalition leaders (about 20–40% less likely to be removed). However, the incumbency advantage quickly grows for small coalition leaders. Examining the $Ln(p)$ section, the coefficient estimate for W is of a similar magnitude to that of the constant (which is negative in sign). That is, for large coalition leaders, the estimated ancillary parameter p is close to one. In contrast, for a small coalition leader $(W = 0)$, the estimated ancillary parameter p is about half. Over time, survival becomes easier and the incumbency advantage grows more for small coalition leaders than large coalition leaders.[7]

Figure 2 plots the predicted hazard rates over time for large and small coalition leaders and for sick and healthy leaders (based on the estimates in model M1). In large coalition systems the risk of removal remains nearly constant over time. In contrast, for small coalition leaders the hazard declines sharply over time. Autocrats initially struggle to survive but those who survive long enough then face a much lower risk of deposition. These results are as predicted by the theory.

Sickly leaders face an increased risk of being deposed. Across all models, the coefficient estimates for *CloseToDeath*: *Chronic* and *CloseToDeath*: *Non-Chronic* are positive, with the former being of larger magnitude. As leaders

[7]Consistent with these findings, the Cox analyses in the Appendix (Table A6) find that the institutional variables violate the proportionate hazard analysis.

Table 5: Determinants of domestic deposition (Weibull model).

	M1	M2	M3
	b/se	b/se	b/se
$X\beta$			
W	−0.221	−0.398	-0.527^{*}
	(0.190)	(0.213)	(0.226)
S	-0.678^{***}	-0.497^{***}	-0.719^{***}
	(0.120)	(0.136)	(0.120)
CloseToDeath: Chronic	1.305^{***}	1.445^{***}	1.406^{*}
	(0.270)	(0.297)	(0.619)
CloseToDeath: Non-chronic	0.970^{**}	1.001^{*}	1.124^{*}
	(0.307)	(0.390)	(0.555)
W * CloseToDeath: Chronic			−0.222
			(0.969)
W * CloseToDeath: Non-chronic			−0.202
			(0.813)
Rel. Age	0.015^{***}	0.012^{***}	0.030^{***}
	(0.003)	(0.003)	(0.007)
W * Rel. Age			-0.025^{**}
			(0.009)
Ln(GDPpc)	0.057^{*}	0.037	0.048^{*}
	(0.023)	(0.025)	(0.023)
Ln(Pop)	0.032	0.035	0.031
	(0.018)	(0.019)	(0.018)
Growth	-0.023^{***}	-0.026^{***}	-0.016^{*}
	(0.004)	(0.005)	(0.008)
W * Growth			−0.015
			(0.015)
Resource Rents		-0.016^{***}	
		(0.004)	
Const.	-1.348^{***}	-1.232^{**}	-1.013^{**}
	(0.352)	(0.382)	(0.369)
Ln(p)			
W	0.659^{***}	0.697^{***}	0.718^{***}
	(0.075)	(0.085)	(0.079)
Const.	-0.670^{***}	-0.667^{***}	-0.710^{***}
	(0.055)	(0.064)	(0.058)
Observations	7955	6980	7955
Number of leaders	1473	1293	1473
Failures	1220	1056	1220
LogLikelihood	−2287.012	−1920.068	−2282.349

$*p < 0.05, **p < 0.01, ***p < 0.001.$

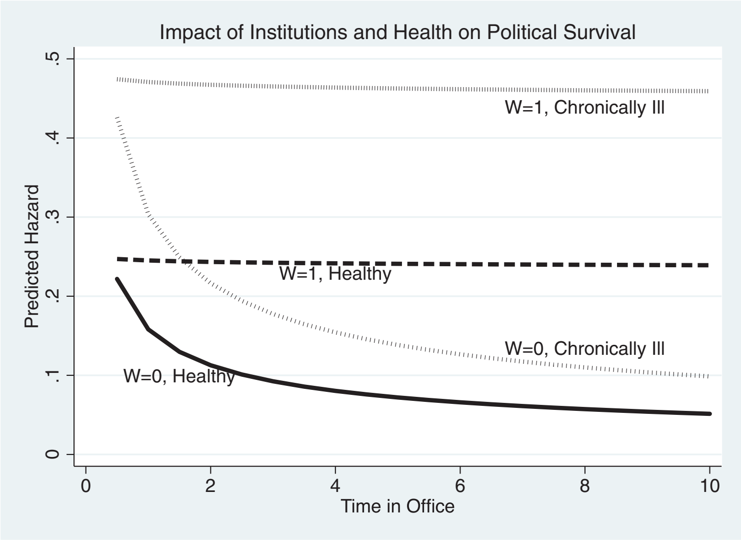

Figure 2: Impact of health and institutions on the political survival of leaders.

become sickly and close to death (and remember the CloseToDeath variable is positive only for leaders who die a natural death), they face an increased risk of domestic deposition. In the year of a leader's death by a natural cause not coded as chronic, a leader faces approximately a 2.5 times increase in the risk of domestic deposition. If the cause of death is coded as chronic and the leader is close to death, then the domestic deposition risk is nearly four times higher than for a healthy leader. It is important to remember that if the leader actually dies in office, then we treat the observation as censored and not as an incidence of domestic deposition. Consistent with predictions, expectations of a leader's demise increase the risk of domestic deposition, and this risk is highest when the leader suffers from a chronic condition.

Figure 2 provides a graphical comparison of hazard rates for healthy and chronically ill leaders. The curves labeled "Chronically Ill" correspond to cases of chronic illness in which the leader will die in the following year (a.k.a. $CloseToDeath$: $Chronic = \frac{1}{2}$). As the figure makes clear, health problems increase the vulnerability of leaders to domestic deposition.[8] Further reinforcing the impact of health, we see that the coefficient of *Relative Age*

[8] The figure is constructed assuming average population and wealth, zero economic growth, $S = 1$ and leaders relative age is -8.5 (the sample mean). Chronically ill is coded as death in the following year from a chronic illness. The estimates are taken from model M1 in Table 5.

is positive, although the magnitude of the effect is fairly modest. Getting 10 years older increases the risk of domestic deposition by about 20%.

Examining the other coefficient estimates in Table 5 we see that, consistent with predictions, a large selectorate increases survival, as does economic growth. The estimates on wealth (Ln(GDPpc)) and population (Ln(PoP)) indicate that leaders of wealthy nations face a slightly elevated risk of deposition while population size appears to matter relatively little. Model M2 includes a measure of *ResourceRents* as a percentage of GDP. Consistent with a large literature on the deleterious effects of natural resources (Ross, 2001; Wright *et al.*, 2013), we find that a 10% increase in natural resources corresponds to about a 17% reduction in the risk of deposition.[9] Model M3 examines the interaction of institutions with the health variables. The results suggest that both small and large W leaders face risks from health, with the health risks slightly ameliorated for large W leaders.

Means of Removal

As seen in Table 4, small coalition leaders are much more likely to be removed via irregular means, such as revolutions and coups, than large coalition leaders. Here we decompose the method of domestic deposition into regular and irregular. As discussed earlier, if a leader is deposed via regular means then we treat this as censoring our ability to observe when she would have been removed by irregular means (or by foreign means). Table 6 reports the competing hazard analyses in which leaders can be removed by regular means, irregular means or by dying in office. The *Died in Office* model excludes the CloseToDeath variables since their inclusion would effectively put the dependent variable on the right hand side.[10]

We start with an examination of the determinants of the ancillary parameter. With respect to removal by regular means, we find the same pattern observed earlier, although with even stronger effects. For large coalition leaders, the risk of regular removal remains relatively constant over time. However, for small coalition leaders the risk of regular removal declines greatly over time; for $W = 0$ leaders, the estimate of the ancillary parameter is $p = 0.37$. In contrast,

[9] We do not include the resource rent variable in all specifications because it diminishes the number of observations. Our results are robust to the inclusion of numerous other controls, for example, civil war, interstate war and aid receipts.

[10] With respect to the coding of regular removal, we include leaders who are coded by Archigos as regular removal and retirements. The irregular removal category in Archigos included examples where foreign powers assisted in removal. To focus on domestic protest, revolution and coups, the irregular removals used in Table 6 are “Popular Protest, without Foreign Support”, “Removed by Military, without Foreign Support”, “Removed by Other Government Actors, without Foreign Support”, “Removed by Rebels, without Foreign Support” and “Removed in Military Power Struggle Short of Coup”, as coded by Archigos.

Table 6: Competing hazards for leader removal.

	Regular b/se	Irregular b/se	Irregular ($W < 1$) b/se	Died in office b/se
$X\beta$				
W	−0.331	−1.521**	−1.069*	1.790
	(0.218)	(0.471)	(0.497)	(1.321)
S	0.481**	−1.676***	−1.727***	−0.342
	(0.183)	(0.229)	(0.227)	(0.517)
CloseToDeath: Chronic	1.067**	1.019	0.989	
	(0.339)	(0.596)	(0.601)	
CloseToDeath: Non-chronic	0.055	0.991	1.031	
	(0.491)	(0.595)	(0.596)	
Rel. Age	0.013***	0.047***	0.044***	0.080***
	(0.003)	(0.007)	(0.007)	(0.013)
Ln(GDPpc)	0.065*	−0.203***	−0.172**	−0.105
	(0.026)	(0.060)	(0.061)	(0.097)
Ln(Pop)	0.045*	−0.104	−0.098	−0.131
	(0.019)	(0.054)	(0.054)	(0.080)
Growth	−0.019***	−0.033***	−0.033***	0.001
	(0.005)	(0.007)	(0.007)	(0.018)
Const.	−2.727***	2.416*	2.008	−2.815
	(0.398)	(1.047)	(1.059)	(1.703)
Ln(p)				
W	1.054***	−0.611**	−0.702**	−0.555
	(0.093)	(0.222)	(0.233)	(0.290)
Const.	−1.006***	−0.091	−0.072	0.565**
	(0.076)	(0.074)	(0.075)	(0.192)
Observations	7,955	7,955	6,235	7,955
Number of leaders	1,473	1,473	1,098	1,473
Failures	1,005	186	186	62
LogLikelihood	−2029.339	−480.393	−475.280	−192.572

$*p < 0.05, **p < 0.01, ***p < 0.001$.

we observe a very different pattern with respect to irregular deposition. For small coalition leaders the risk of deposition as a result of coup or revolution is relatively constant over time. These irregular risks diminish for large coalition leaders. It is important to note that coups and revolutions are extremely rare events in very large coalition systems, a fact anticipated by the theory. Given this rarity, the third model in Table 6 repeats the irregular deposition model looking only at relatively small coalition systems ($W < 1$). Consistent with our fourth hypothesis, we note that not a single case of irregular deposition falls out of the analysis when we shift to $W < 1$, consistent with the claim that sufficiently large coalition systems are virtually immune from coups and revolutions. In the final model (removal via death in office) the estimated ancillary parameter, p, is greater than 1, indicating an increasing hazard over time. As we might expect, time in office increases the risk that a leader dies in office.

Relative age increases the risk of all three forms of deposition; however, the magnitude of the effects differs. Getting 10 years older increases the risk of deposition by regular, irregular and health means by an estimated 10%, 60% and 120% respectively. Impending death from a chronic illness significantly increases the probability of removal by regular means. To illustrate the magnitude of the effect, consider a leader who will die in the following year of a chronic condition. This health problem increases the risk of regular removal by about 70%. The same health problem increases the risk of irregular removal by a similar amount, although the statistical significance is just below the standard 5% level. If we exclude old leaders from the analysis (e.g., those older than life expectancy), then Chronic has a highly significant effect. It should be remembered that our conservative coding scheme for health biases against finding an impact for ill health as many leaders who are deposed by irregular means are killed in the process and so any potential health concerns are censored. The analyses suggest that non-chronic conditions have no significant impact on regular removal. We exclude the CloseToDeath variable with respect to the died in office model for obvious reasons.

Selectorate size affects the risk of regular and irregular removal differently. The selectorate measure is based in part on the presence of a legislature, an institution indicative of electoral replacement, so it is perhaps unsurprising that a large S increases the probability of removal via regular means. In contrast, a large S reduces the risk of irregular deposition. Economic growth decreases the risk of deposition by both regular and irregular means. The impact of wealth is largest with respect to irregular deposition.

The analyses support the prediction that ill health increases the risk of political deposition. We argue that this result is derived from a diminution of political loyalty. However, as noted earlier, an alternative explanation is that sickly leaders have diminished capacity that results in policy failures that lead to political removal.

Alternative Argument: Diminished Capacity

Here we examine the alternative argument that poor health reduces leader ability and that the resultant poor policy performance leads to deposition. If serious chronic illness impairs a leader's ability, then we expect that measures of performance, and we focus on economic growth, should decline when leaders have chronic health conditions. The diminished ability argument implies that if a leader is close to death from natural causes, and especially if the causes are chronic, then economic growth should decline.

In contrast, the selectorate theory argues that, particularly in small coalition systems, it is a leader's ability to credibly promise future private goods that generates loyalty. Only perhaps in large coalition systems, where public policy performance is important, should reduced ability matter. Furthermore, Bueno de Mesquita and Smith (2017) predict that the appropriate response for a leader with a serious chronic health condition is to liberalize politically. Such liberalization is likely to promote economic growth. Hence, the growth implication of illness differs between the selectorate and diminished capacity explanations.

Table 7 contains regression analyses of economic growth rates with nation fixed effects. The unit of observation is the nation-year. In some years a nation

Table 7: Economic performance as leaders get sick.

	Growth1 b/se	Growth2 ($W < 1$) b/se
W	2.265***	2.696***
	(0.436)	(0.527)
CloseToDeath: Chronic	2.156*	2.362*
	(0.869)	(1.007)
CloseToDeath: Non-chronic	−0.551	−1.218
	(1.055)	(1.287)
Rel.Age	0.011	0.004
	(0.009)	(0.011)
Ln(GDPpc)	0.760***	1.366***
	(0.222)	(0.267)
Ln(Pop)	−1.273***	−1.417***
	(0.279)	(0.315)
Leader change	−1.443***	−1.748***
	(0.221)	(0.282)
Const.	15.057***	12.850**
	(4.033)	(4.612)
Observations	7,096	5,628
Nation FE	166	144

$*p < 0.05, **p < 0.01, ***p < 0.001$.

Nation level fixed effects: The unit of observation is nation-year and the leader based variables are measured for the incoming leader (the leader in power at the start of the year).

might have leader turnover. In those cases, we code the characteristics of the leader who starts the year in power. The dummy variable Leader Change indicates that there was more than one leader in power during a nation-year observation. The selectorate theory predicts that leaders with chronic health conditions need to increase rewards to supporters and liberalize. These policy shifts sustain or increase economic growth. In contrast, the diminished capacity argument predicts that leaders close to death by natural causes, particularly when those causes are chronic, are less able and so experience reduced economic growth. There are two models in the table. Both models examine the effect of proximity to death by natural causes, whether that cause is chronic or not. Model G2 replicates G1 but only for relatively small coalition systems, $W < 1$.

The analyses suggest that wealthy nations with a relatively small population and large coalition have higher economic growth rates than large population poor nations with smaller coalitions. In each model, the coefficient estimates for *CloseToDeath*: *Chronic* are positive and statistically significant, which indicates that on average economic growth increases as the condition of chronically ill leaders deteriorates. In neither model is the coefficient estimate for *CloseToDeath*: *Non-chronic* significant. When leader change occurs, economic growth declines significantly. Furthermore, as expected, this effect is greatest in small coalition settings (G2).

The analyses in Table 7 find no support for the diminished capacity explanation. The presence of a sickly leader does not result in lower economic growth. Indeed, the analyses find support for the selectorate hypothesis that ailing leaders increase economic growth.

Conclusions

We have investigated how health risks and age risks influence the likelihood of regular or irregular removal from office. Building on earlier extensions of the selectorate theory of leader survival, and using a new dataset on leader health, we tested and found statistical support for five hypotheses. These hypotheses collectively paint a picture of the dangers incumbents face once their key supporters, members of their winning coalition, come to believe that the leader can no longer be counted on to deliver the flow of private rewards that represent the core advantage enjoyed by being in an incumbent's winning coalition. Especially in small coalition, autocratic, junta, or monarchic, environments, the belief that the incumbent suffers from a serious, life-threatening chronic illness greatly increases the odds that the leader will be overthrown. While the analysis here does not explore all of the theoretical implications regarding leader survival, such as that the belief that the leader suffers a serious illness is a causal mechanism leading to revolution or coup, it does uncover the grave risks of leadership instability during periods of serious chronic illness.

Leaders, of course, try to keep their health challenges secret exactly because of the danger that exposure poses to continuation in office. The data developed here to analyze the theoretical insights must rely on ex post information revelation. However, coalition members, intelligence agencies, and sufficiently interested other contemporaries of a leader, have access to information not readily available to us as researchers. That they have access to better information means that the insights developed here can be exploited by those with real-time information to help shape or prevent sudden, irregular leader deposition. That, in turn, means that the logic behind the analysis presented here can be fruitfully used to alter the risk of political instability in real time.

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