The Dictator's Inner Circle

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PRELIMINARY

Abstract

We posit the problem of an autocrat who has to allocate access to the executive positions in his inner circle and define the career profile of his own insiders. Statically, granting access to an executive post to a more experienced subordinate increases political returns to the post, but is more threatening to the leader in case of a coup. Dynamically, the leader monitors the capacity of staging a coup by his subordinates, which grows over time, and the incentives of trading a subordinate's own position for a potential shot at the leadership, which defines the incentives of staging a palace coup for each member of the inner circle. We map these theoretical elements into structurally estimable hazard functions of terminations of cabinet ministers for a panel of post-colonial Sub-Saharan African countries. The hazard functions initially increase over time, indicating that most government insiders quickly wear out their welcome, and then drop once the minister is fully entrenched in the current regime. Hazard rates are higher in more powerful posts, which are more threatening to the leader, than junior posts and inexperienced leaders are constrained to employ only inexperienced ministers. We argue that the survival concerns of the leader in granting access to his inner circle can cover much ground in explaining the widespread lack of competence of African governments and the vast heterogeneity of political performance between and within these regimes.

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1 Introduction

African recent economic history is replete with massive political failure (Herbst, 2000). Some of it has been ascribed to a political class that is both rapacious and myopic, much like roving bandits à la Olson (2000), or the African predatory officials in Shleifer and Vishny (1993). This paper shows how the very nature of the threats to a leader's survival that arise from allowing government insiders sufficiently long time horizons may be an essential part of the problem when it comes to positions of national prominence, such as cabinet posts[1].

Specifically, we study the political survival of national cabinet members in a panel of sub-Saharan African countries. Our goal is to provide a unique perspective on the internal organization of autocratic regimes in Africa. In Section 2 we begin by uncovering a novel set of stylized facts based on a newly collected data set featuring the annual composition of national cabinets in a large set of countries. First, we show that leaders with more experience in government (in terms of number of years in which they are observed in past executive posts before taking office) tend to hire from the outset of their regimes ministers with more experience (again proxied by number of years in previous cabinets). In addition, leaders systematically select more experienced ministers for more senior posts within their inner circle. We also report novel regularities concerning the survival in office of both leaders and ministers, showing that for both groups hazard rates are time-varying. While leaders face decreasing hazards of termination over time, extending earlier work by Bienen and Van De Walle (1989), ministers face increasing termination hazards over time under a given leader. Only after a specific number of years in government do termination hazards drop. We also show that more senior ministers face steeper increasing hazards of termination, but hazards drop and the ministers become 'safe' sooner.

We then provide a theoretical model able to reconcile the stylized facts parsimoniously. In Section 3 we focus on the problem of a leader selecting and terminating government insiders

[1] See Arriola (2009), Burgess et al. (2011), Rainer and Trebbi (2011) and Francois, Rainer, and Trebbi (2012) for a discussion of the role of national posts as prominent sources of political patronage playing a key role in prebendalist societies like the ones we study.

based on the time his subordinates have spent inside the 'palace'. Statically, we posit that more experienced ministers (i.e. endowed with more past experience in government and more political capital in general) are able to produce more value for a leader, but are also more adept at capturing a larger share of that value. Dynamically, we allow that time spent inside the palace increases the capacity for insiders to stage coups. Ministers have the potential of becoming "*rivals [...] developing their own power base*" (Bratton and Van De Walle, 1994, p.463). As a consequence, a leader will tend to terminate ministers if they become too much of threat to him[2] and increasingly so over time, as they learn their way through the government organization. Specifically, in our model the leader keeps a check on the capacity of ministers to stage coups, and their incentives to remain loyal versus attempting coups. We show, in particular, that these features naturally deliver non-monotonic hazard functions for ministerial termination risk under a single leader. These take the form of a minister-specific 'safe date', a point in time after which, even when given the opportunity of staging a coup, a minister will not take it.

Our theoretical setup naturally delivers a competing-risks model with parametric hazard functions that can be brought directly to the data; an exercise we perform in Sections 4 and 5. The structural estimation of the model delivers estimates of the parameters pertaining to the minister-leader bilateral bargaining problem, the shape of the coup success/coup capacity function, and the differential riskiness to the leader from senior versus junior executive posts. In Section 6 we also contrast our model with relevant alternatives arguing that numerous aspects favour this approach over competing theoretical mechanisms.

By explicitly linking the survival risks of dictators and their ministers, we are able to provide a unified theory of termination risks under autocracy. The implications are of consequence outside the strict confines of ministerial risks studied here. For example, the robust evidence of increasing hazard risks of termination for top politicians within these systems

[2]In the words of Soest (2007 p.8) African leaders uproot ministers from their current posts "*in order to prevent any potential opponent from developing his or her own power base*". Indeed, the literature has often ascribed the "*ministerial game of musical chairs*" (Tordoff and Molteno 1974 p. 254) to this goal.

strongly indicates how pressing leader's survival concerns are. By affecting the time horizons of politicians in power it is easy to see why myopic predation could be pervasive in these polities, possibly trickling down the whole clientelistic chain from ministerial posts to the bureaucracy, curtailing valued political investment and ultimately affecting economic performance.[3] In addition, since these survival concerns vary across regimes and lessen over time within the same regime, we provide a novel explanation for the massive variation in performance observed across autocracies (Besley and Kudamatsu, 2008).

This paper speaks to a vast literature on the political economy of development (Bates, 1981) and on the internal organization of weakly institutionalized countries (Tullock, 1987; Wintrobe, 1998; Acemoglu and Robinson 2005; Bueno de Mesquita, Smith, Siverson, and Morrow, 2003). In particular with respect to Africa, at least since Jackson and Rosberg (1982) the literature has evolved around the study of individual incentives of elites/clients within the complex structure of personal relationships at the basis of neopatrimonial societies.

This paper is most closely related to previous work on the internal organization of autocracies (Geddes, 2003; Gandhi and Przeworski, 2006; Haber, 2006; Besley and Kudamatsu, 2008; Arriola, 2009; Francois, Rainer, and Trebbi, 2012) and from a theoretical standpoint to recent research on incentives of dictators in selecting insiders (Egorov and Sonin, 2011).

Finally, this work also speaks to the large political science literature on cabinet duration[4] and ministerial survival[5]. Relative to this literature, we depart in terms of focus, by targeting weakly institutionalized countries, and methodology by addressing the specific time dependency profile of the hazard functions, as opposed to investigating hazard shifters within partial likelihood approaches, as in the popular Cox model.

[3] See Dal Bo' and Rossi (2011) for systematic evidence in Argentina.

[4] King et al (1990), Kam and Indridason (2005). Particularly, see Diermeier and Stevenson (1999) for a competing risk model of cabinet duration.

[5] The political science literature typically does not consider individual ministers as the relevant unit of observation, focusing instead on the entire cabinet. Alt (1975) and Berlinski et al. (2007) are exceptions centered on British cabinet members, while Huber and Gallardo (2008) focus on nineteen parliamentary democracies. To the best of our knowledge this is the first systematic study of this type focused on autocratic regimes.

2 Leadership and Ministerial Survival in Africa

This section presents, in nonparametric form, a set of stylized facts characterizing the process of selection and termination of national ministers in Africa. We will use this set of empirical regularities to guide the discussion in the following sections, but also to present new evidence unburdened by any modeling structure.

We recorded the names and positions of every government member that appears in the annual publications of *Africa South of the Sahara* or *The Europa World Year Book* between 1960 and 2004 and employ data on each national minister since independence on Benin, Cameroon, Cote d'Ivoire, Democratic Republic of Congo, Gabon, Ghana, Guinea, Liberia, Nigeria, Republic of Congo, Sierra Leone, Tanzania, Togo, Kenya, and Uganda. These fifteen countries jointly comprise a population of 492 million, or 45 percent of the whole continent's population. The details on the ministerial data, as well as a thorough discussion of the evidence in support of the relevance of national governments in African politics, can be found in Rainer and Trebbi (2011). Summary statistics of the sample by country can be found in Table 1. Table 2 reports spell specific information for all ministers in the sample.

In Figure 1 we show our first empirical regularity. Leaders with more experience in government at the onset of their regime tend to systematically hire ministers with more experience in government (both proxied by the number of years recorded in previous cabinets). The figure reports both the linear fit and a nonparametric lowess fit, both underscoring a positive and significant statistical relationship between ministerial past political experience and leader's experience at regime onset (the regression coefficient is 0.79 with a robust standard error clustered at the country level of 0.01). In Figure 2 we split senior and junior government posts. We define as senior posts the Presidency/Premiership, Defense, Budget, Commerce, Finance, Treasury, Economy, Agriculture, Justice, Foreign Affairs. Leaders select more experienced ministers for more senior posts and they appear to do more so as their experience grows.

We now proceed to illustrating termination risks of both leaders and ministers. One

important finding that will underline all our subsequent analysis is that in both groups hazard rates exhibit distinctive time dependence, but of completely different nature across the two.

Let us begin by considering the termination risk of leaders, as this areas has already received some investigation in the literature (see Bienen and Van De Walle, 1989). In Figure 3 we report nonparametric hazard estimates for the pooled sample of post independence African leaders, for ease of comparison with Bienen and Van De Walle's analysis, while in Figure 4 we report nonparametric hazard estimates for the fifteen countries in our sample. Although Figure 4 is naturally more noisy, both hazard functions exhibit sharp negative time dependence. The termination risk starts around 17% during the first year in office for the leader, gradually reaching about half that likelihood of termination conditional on reaching 10 years in office. These figures are remarkably similar to what reported in Bienen and Van De Walle's analysis which essentially excludes the full post Cold War period.

More novel are our results on the nonparametric hazard functions for the risk of termination of a minister under the same leadership. We report these results in the various panels of Figure 5, which present the minister's empirical conditional probabilities of being terminated also conditional on not being terminated because the leader exits (this is a competing risk we model explicitly below, but treated as independent here). We report the analysis country by country, in order to reduce the risk of unobserved heterogeneity to a minimum.[6] The patterns are striking. For the vast majority of countries in our sample, ministers face increasing termination hazards over time under the same leader. In a subset of countries, after a specific number of years in government, hazard rates eventually drop, leading to a characteristic hump shape. Typically between the first and fifth year in office a minister sees his likelihood of dismissal increasing by about 50%.[7] To the best of our knowledge this fact

[6] Indeed, it is a known issue in duration analysis that pure statistical heterogeneity across hazard functions implies, when naively aggregated, a hazard function for the mixture distribution that is necessarily declining in analysis time; Farber (1994).

[7] Note also the different levels of the baseline hazard rates for the different countries, strongly supporting our approach of addressing country heterogenity in the most conservative way possible. Alternative corrections would require the use of parameterizations for the frailty in the data. We do not follow this approach

is new per se and proves a remarkable departure from estimated termination risks – not just of leaders – but relative to almost any other employment sector (Farber, 1994).

Finally, due to the sparse nature of the spell observations by country when splitting senior and junior ministerial spells, we refrain here from presenting separate hazard functions for both classes of ministerial posts. However, below we will show that senior ministers face steeper increasing hazards of termination, but for them hazard risks also drop sooner in analysis time.

3 Model

We describe the problem of a leader who has to choose the personnel that will fill executive positions (ministries) in his inner circle. Calendar time $t = 0, 1, ...$ is infinite and discrete, and leaders choose the cabinet at the start of every period. All individuals discount the future due to their own mortality risk; the details of which we specify below.

3.1 Ministry Output and Division

Each time a government insider, also referred to as a minister, is replaced in his post, the leader incurs a cost, denoted $\varepsilon > 0$, which we allow to be arbitrarily small. Let $k_i(t)$ be the political capital of minister i at time t. Political capital is accumulated through political experience, growing at constant rate g with time in office, and is useful in generating ministerial output. Specifically, if i is a minister in period t in a ministry m his output is $(k_i(t))^{\beta_m}$. Assume there are two types of ministries: $m = J$ denotes a junior ministry and $m = S$ a senior one, with $\beta_S > \beta_J$. Assume that there is an elastic supply of ministers for each and every level of experience.

Denote the leader by l and assume that the leader installed at time t_l has capital level $k_l(t) = (1+g)^{t-t_l} k_l^0$; i.e., the leader's growth rate is also g while in office and k_l^0 is the leader's

here.

political capital at entry into the leadership. A leader l placing individual i in ministry m has the potential to hold up production in $i's$ ministry. Intuitively, from time-to-time the minister in charge of a ministry requires an essential input, which the leader controls and can withhold. Formally, we allow this to be governed by a stochastic process: with probability H the leader can hold-up any single ministry, m in any period t. This random variable is i.i.d. across ministries and is drawn each period, separately for each ministry.

We assume that the hold up problem, when it arises, is solved by Nash Bargaining between the leader and minister over the ministry's output. Let the leader's bargaining power (in the Nash Bargaining sense) be denoted α_m, with $1-\alpha_m$ denoting the minister's. Suppressing time notation, this leads to the following division of ministerial surplus generated in a period where hold up in ministry m occurs (where w denotes the amount of the ministry's value paid to the minister):

$$\max_{w} \left[\left(k_i^{\beta_m} - w \right)^{\alpha_m} w^{1-\alpha_m} \right]. \tag{1}$$

The threat points for each player are zero output in the ministry – either the minister contributes no effort, and/or the leader withholds the essential input.

The relative bargaining power, α_m, is assumed to be determined according to the relative capital level of the leader l and his chosen minister, i, according to: $\alpha_m = \frac{k_l}{k_l + k_i}$.[8] Leaders can appropriate a larger share of ministry spoils the more powerful they are relative to their chosen minister.

3.2 Coup Threats: Means, Motive, and Opportunity.

Endogenous coups d'état come from government insiders seeking to become leaders. Realistically we assume coups are extremely costly to the leader. Specifically, we assume that falling victim to a coup leads to a large negative shock to leader utility (e.g. death). As will

[8] Note that this notation does not depened on either i or l's characteristics, for reasons that will become obvious below.

be shown, any non-negligible cost to coups and non-negligible probability of coup success will lead to the outcomes we characterize, so we proceed as seems realistic by leaving the costs of losing a coup as large without pinning it down further.[9]

Three factors determine whether a minister will decide to mount a coup: i) having the means to stage it; ii) having the incentives to stage it (i.e. "motive" in undertaking a sanctionable action); and iii) having the actual opportunity of following through. In our model the leader will monitor means and motive, and, when necessary, preclude opportunity.

3.2.1 Means

In order to mount a coup, a government insider must establish sufficient connections within the government to coordinate the coup action. This plotting capacity is a function of the length of tenure an individual has had within the government and depends positively on the importance of the individual's position. Specifically, individuals grow their own coup capacity by the amount $m(t)c_i(t)$ each period t of their current stint in office, where $c_i(t)$ is an i.i.d. draw from a stationary distribution C with non-negative support. In our estimation we will assume C to be $Exponential(\varsigma_c)$ with scale ς_c; a convenient form as it has positive support, only one parameter, and its convolution is closed-form. We assume that $m(t) = 1$ if $m = J$ at time t and $m(t) = M_S > 1$ if $m = S$, implying that the plotting capacity of a minister grows proportionately more with time spent in senior ministries (central and important posts, like Defense) as opposed to junior ones (peripheral, like Sports). Assume that coup capacity is regime-specific (unlike k, which persists across regimes). Thus, at calendar time t minister i who first entered into the government at time $t_i^0 < t$ has accumulated coup capacity $\sum_{\tau=t_i^0}^{t} m(\tau)\, c_i(\tau)$, where the aggregation is over the duration of the spell in government in a ministry of type m. Coup capacity is common knowledge, and gives a minister the capacity to mount a coup if and only if it reaches a critical threshold, denoted $\bar{c}$; that is, if and only if $\sum_{\tau=t_i^0}^{t} m(\tau)\, c_i(\tau) \geq \bar{c}$. Since $c(t)$ are

[9] Because the costs of turnover are small, and because leaders have full information about coup capacity.

independent draws from an exponential with scale ς_c, then $\sum_{t=1}^{T} c(t) \sim Gamma(T, \varsigma_c)$, where T is the Gamma's shape and ς_c its scale. Since ς_c is not separately identifiable from M_S or $\bar{c}$, we will normalize $\bar{c} = 1$.

Exogenous Threats

Leaders can also be terminated for exogenous reasons other than coups. We assume a base leadership hazard $(1 - \delta)$ that applies per period of leadership ad infinitum. This proxies for mortality/termination threats of a standard physiological nature. We similarly assume a base leadership hazard for ministers for reasons like ill health, retirement from politics etc.: a $1 - \sigma$ probability event. We explicitly allow this to be different than the base leadership hazard in reflection of the fact that leaders run qualitatively different risks of being removed –regime continuation, and personal assassination threats. Additionally, the data shows a high potential for external threats to leaders early on in a regime (for an early contribution, see Bienen and Van De Walle, 1989). Upon inception, new regimes are extremely fragile, with a high probability of termination due to factors like insurgencies or foreign military interventions. We model these external threats in a reduced-form way, positing that this exogenous fragility declines through time as a sequence of regime age specific continuation probabilities $\rho(t)$. We assume that a leader coming to power in period t_l has heightened fragility for t_δ periods implying that $\rho(\tau - t_l) < 1$ for $t_l < \tau < t_l + t_\delta$ and increasing with τ until $\rho(\tau - t_l) = 1$ for $\tau \geq t_l + t_\delta$. This implies that at time t_l the time path of discounting for a leader l follows $\delta\rho(1), ..., \delta^{t_\delta}\Pi_{s=1}^{t_\delta}\rho(s), \delta^{t_\delta+1}\Pi_{s=1}^{t_\delta}\rho(s), ...$

3.2.2 Timing

Each existing minister comes in to period t with his personal coup capacity, $\sum_{\tau=t_i^0}^{t} m(\tau) c_i(\tau)$ for minister i, where period $t's$ draw was at the end of period $t - 1$. The leader observes each minister's capacity and decides whether he will continue in his portfolio, or whether to replace him with a new minister who necessarily will have zero coup capacity. Hold-up opportunities are then realized, and in ministries where these occur, the minister and leader

bargain over the division of ministerial surplus. Production occurs and consumption shares are allocated according to the Nash Bargain. Exogenous termination draws for both ministers and leader then occur. Exogenous terminations for the leader imply dissolution of the cabinet, and a new leader, randomly drawn from the set of all individuals, to start next period (at which point he selects a new cabinet). Exogenous terminations for a minister leave a ministry vacancy to be filled at the start of the next period by the existing leader. Surviving ministers with sufficient coup capacity then decide whether to mount a coup or not. If so, and successful, the coup leader will start as leader in the next period (multiple coups are allowed, and if more than one succeeds, a leader is drawn from the successors randomly). If the coup fails or none is attempted, the leader stays in place. Failed coup plotters are removed and excluded from all future ministerial rents. At the end of the period, the increment to each minister's coup capacity is drawn from distribution C. Surviving ministers carry their coup capacity to the start of $t+1$ after which the sequence repeats.

3.2.3 Motive and Opportunity

The Value of Being Leader

Let $V^l\left(k_i\left(t\right),t\right)$, denote the net present monetary value that an individual of experience $k_i\left(t\right)$ has to becoming the leader at calendar time t. This monetary value is the aggregation of the leader's share of ministerial rents captured through hold up and the ensuing bilateral bargaining over ministerial spoils in each ministry, through time. Let $V^l\left(k_i\left(t\right),t\right) = \sum_{m=J,S} N_m V_m^l\left(k_i\left(t\right),t\right)$, where $V_m^l\left(k_i\left(t\right),t\right)$ denotes the corresponding net present monetary value for ministry m, and the total number of ministries is given by the sum of junior and senior posts[10], $N = N_J + N_s$. Since an unsuccessful coup leads to the protagonist's dismissal from government (and rents) forever, the net present value for a minister with capital $k_i\left(t\right)$ staging a coup at t that succeeds with probability $\gamma \in [0,1]$ equals $\gamma V^l\left(k_i\left(t\right),t\right)$.

[10] We do not model the size of the cabinet endogenously. See Arriola (2009) for a discussion of how the cabinet size may be related to clientelistic motives.

The Value of being a Minister

Let $V^m(k_i(t), t_l)$ denote the net present value of being a minister in ministry m, with capital $k_i(t)$ operating within a regime whose leader l took office at t_l. The value of being a minister depends on the flow value created by an individual's time in the ministry, the share of that flow value he appropriates, and the minister's estimates of his likelihood of continuing in office. Three different hazard risks affect this continuation probability each period. The first risk arises from something exogenous happening to the minister; the $1-\sigma$ exogenous events described above. A second risk arises from the conscious decisions of the leader to terminate a minister's appointment. If the leader decides i has become an insupportable risk, then minister i must go. This removes "opportunity" for the minister, which we assume can no longer stage a palace coup when ousted. The third threat to continuation for a minister arises from the leader being actually hit by his own exogenous threats, in case of which the whole cabinet is replaced.[11] This means that the $(1-\rho(t))$ and $(1-\delta)$ risks also enter into the hazard function of a minister.

Ministerial coup incentives

A minister with capital $k_i(t)$, in a regime where the leader came to power in period t_l has no incentive to mount a coup against the leader in period t if and only if:

$$\gamma V^l(k_i(t), t) \leq V^m(k_i(t), t_l). \tag{2}$$

3.3 Analysis

3.3.1 Optimal ministerial experience.

The Nash bargain in (1) yields $w^* = (1-\alpha_m) k_i^{\beta_m}$, so that the leader's share of output is $\alpha_m k_i^{\beta_m}$. Given this, leader l chooses k_i at any time t to maximize the value he obtains from filling the ministry in the event that he has a hold up opportunity.[12] Specifically, leader with

[11] We could, more correctly, allow for this discount to be less than $1-\delta$ for a minister, since some ministers remain in cabinet when leaders are exogenously removed. For now, assume full turnover.

[12] When he cannot hold up the ministry, his ministerial choice is payoff irrelevant.

k_l solves:

$$\max_{k_i} \left[\frac{k_l}{k_l + k_i} k_i^{\beta_m} \right]$$

where again we suppress time notation for simplicity. We denote the solution of the first order condition for ministry m by:

$$k_i^m(k_l) = \frac{\beta_m}{1 - \beta_m} k_l. \tag{3}$$

The optimal solution for ministerial capital in m also determines α_m:

$$\alpha_m = \frac{k_l}{k_l + \frac{\beta_m}{1-\beta_m} k_l} = 1 - \beta_m.$$

Thus the bargaining power that ensues reflects the endogenous effect of the ministry's primitive β_m on bargaining shares through the leader's optimal choice of ministerial experience. Note that the optimal solution as a ratio of leader's seniority is invariant to the leader's experience and therefore stationary in calendar time: $\frac{k_i^m(k_l(t))}{k_l(t)} = \frac{\beta_m}{1-\beta_m}$ for all t. We summarize:

Proposition 1. *1. Leaders pick identically experienced ministers for cabinet posts of the same seniority level.*

2. Leaders select ministers with more experience for senior posts.

3. Leaders with more experience pick cabinets with more experience.

4. The leader's experience and that of his optimal minister in any post grow proportionately.

The model thus presents no reason to turn over ministers in terms of productivity, since ministerial and leadership experience grow at the same rate. We now study what shapes ministerial incentives to stage palace coups and how the incentive compatibility constraint they face can render them a threat, and thus result in endogenous turnover.

3.3.2 Incentives to mount a coup

For a leader having come to power in period t_l his valuation of the leadership stream at any time $t \geq t_l$ is:

$$\begin{aligned} & V^l\left(k_l\left(t\right), t_l\right) \\ = \; & H \sum_{m=J,S} N_m \alpha_m \sum_{\tau=t}^{\infty} \delta^{\tau-t} \prod_{s=t+1}^{\tau+1} \rho\left(s-t_l\right) \left(k_i^m\left(k_l\left(\tau\right)\right)\right)^{\beta_m} \end{aligned}$$

where the notation $k_i^m\left(k_l\left(\tau\right)\right)$ denotes the leader choosing a minister of k_i^m for $m = J, S$ given his own seniority $k_l\left(\tau\right)$. Note that this value function is expressed assuming that discounting arises only due to the terms δ and $\rho\left(t-t_l\right)$, with no risks due to "endogenous" coups along the equilibrium path, a feature we will demonstrate subsequently. Using (3), the fact that $\alpha_m = 1 - \beta_m$ and the constantly growing political capital, we can compute these infinite sums, yielding:

$$\begin{aligned} & V^l\left(k_l\left(t\right), t_l\right) \\ = \; & H \sum_{m=J,S} N_m \left(1-\beta_m\right) \sum_{\tau=t}^{\infty} \delta^{\tau-t} \prod_{s=t+1}^{\tau+1} \rho\left(s-t_l\right) \left(\frac{\beta_m}{1-\beta_m}\left(1+g\right)^{\tau-t} k_l\left(t\right)\right)^{\beta_m} \end{aligned}$$

Since from $\tau = t_l + t_\delta$ onwards we know that $\rho\left(t\right) = 1$, this implies that the valuation can be expressed in a finite form as follows:

$$\begin{aligned} (4) \qquad & V^l\left(k_l\left(t\right), t_l\right) \\ = \; & H \sum_{m=J,S} N_m \left(1-\beta_m\right) \left[\begin{array}{l} \sum_{\tau=t}^{t_l+t_\delta} \delta^{\tau-t} \prod_{s=t+1}^{\tau+1} \rho\left(s-t_l\right) \left(\frac{\beta_m}{1-\beta_m}\left(1+g\right)^{\tau-t} k_l\left(t\right)\right)^{\beta_m} + \\ \delta^{t_l+t_\delta-t} \prod_{s=t+1}^{t_l+t_\delta+1} \rho\left(s-t_l\right) \left(\frac{\beta_m}{1-\beta_m} k_l\left(t_l+t_\delta\right)\right)^{\beta_m} \frac{1}{1-\delta(1+g)^{\beta_m}} \end{array} \right]. \end{aligned}$$

We have already established from (2) that the incentives for a minister to mount a coup at any time, t, depend on a comparison between the value to the minister of becoming leader, weighted by coup success probability, $\gamma V^l\left(k_l\left(t\right), t_l\right)$, and the value of remaining a

minister $V^m(k_i(t), t_l)$ at that time. The dynamics of coup incentives (together with coup capacity) determine the shape of a minister's hazard function through time; since leaders will terminate ministers with both capacity and incentives to mount coups. Thus the ministerial hazard through time is critically affected by the relationship between the shapes of these two value functions along a minister's tenure. However, since $V^m(k_i(t), t_l)$ depends on the endogenous decisions of the leader to dismiss the minister at all points in future, it is not possible to simply characterize the relationship between these two value functions.

We thus proceed as follows. Denote by $\widetilde{V}^m(k_i(t), t_l)$ the net present value of being a minister in ministry m, with capital $k_i(t)$ operating within a regime whose leader l took office at t_l, under the assumption that l will never 'endogenously' remove i from office, nor move i to a different ministry $m' \neq m$. This value is (weakly) higher than the true net present value of being a minister at t, $V^m(k_i(t), t_l)$, as it removes from the true set of hazards the possibility of a leader deciding to remove i from office endogenously. It turns out to be easier to work with this simpler object $\widetilde{V}^m(k_i(t), t_l)$, and we will do so in what follows. It can be expressed as:

$$
\begin{aligned}
(5) \qquad & \widetilde{V}^m(k_i(t), t_l) \\
= \; & \sum_{\tau=t}^{t_l+t_\delta} (\sigma\delta)^{\tau-t} \prod_{s=t+1}^{\tau+1} \rho(s-t_l)\, \beta_m \left((1+g)^{\tau-t} k_i(t)\right)^{\beta_m} \\
& + (\sigma\delta)^{(\max[t_l+t_\delta-t,0])} \prod_{s=t+1}^{t_l+t_\delta+1} \rho(s-t_l) \frac{\beta_m}{1-\sigma\delta(1+g)^{\beta_m}} \left((1+g)^{(\max[t_l+t_\delta-t,0])} k_i(t)\right)^{\beta_m}.
\end{aligned}
$$

Though simpler, it is still not possible to directly characterize the evolution of these two value functions. However, the following result simplifies the problem considerably.

Lemma 1. *If $\widetilde{V}^m(k_i(t), t_l) < \gamma V^l(k_i(t), t)$ at t, then minister i will mount a coup against leader l in any period $\tau \leq t$ where he has the capacity to do so.*

All Proofs are in the Appendix.

Intuitively, the lemma tells the leader that a minister with incentive to mount a coup at

some future date, will also have incentive to mount a coup today if he has the capacity to do so. Since coup capacity does not decay, the leader knows that eventually such a minister will have incentive to act on his current coup capacity. But if he would do so eventually, he will be dismissed by the leader for certain before reaching that date. Anticipating this dismissal he will act pro-actively and attempt a coup before that date, but the leader knowing this will dismiss him first, and so on up until the first date at which a coup capacity ensues.

3.3.3 Optimal Ministerial Turnover

Notice that the reasoning above does not depend on the relationship between the quasi value function $\widetilde{V}^m(k_i(\tau), t_l)$ and value function $\gamma V^l(k_i(\tau), \tau)$ at any points $\tau < t$, so that the difficult problem of characterizing the evolution of these functions through a minister's tenure can be avoided. This allows us to characterize optimal ministerial turnover in terms of a single "safe" date for minister i with respect to leader l in ministry m, denoted $\bar{T}_i = \bar{T}(m, k_i(t), t_l)$. Define $\bar{T}_i$ as the date at and after which minister i will NOT mount a coup against leader l, and before which minister i will, if he has coup capacity. We now show the existence of such a safe date, and how it is determined by comparing these value functions at a single point.

Lemma 2. *Consider the quasi value function for a loyal minister* $\widetilde{V}^m(k_i(t), t_l)$*, the value of challenging* $\gamma V^l(k_i(t), t)$*, and the set of crossing points in these functions, defined over the complete possible tenure of minister* m*. Denote this set* Υ*. It includes all the elements of* t *such that* $\widetilde{V}^m(k_i(t-1), t_l) < (\geq)\ \gamma V^l(k_i(t-1), t-1)$ *and* $\widetilde{V}^m(k_i(t), t_l) \geq (<)\ \gamma V^l(k_i(t), t)$.

If $\Upsilon = \emptyset$*, then:*

1. If and only if $\widetilde{V}^m(k_i(t_0), t_l) \geq \gamma V^l(k_i(t_0), t_0)$*:* $\bar{T}_i = t_0$,

2. otherwise $\bar{T}_i$ *does not exist.*

If $\Upsilon \neq \emptyset$*, then:*

1. If and only if at $t \equiv \sup \Upsilon : \widetilde{V}^m(k_i(t), t_l) \geq \gamma V^l(k_i(t), t)$ *then* $\bar{T}_i = \sup \Upsilon$,

2. otherwise $\bar{T}_i$ *does not exist.*

The Lemma provides a simple means by which to calculate a minister's safe date. It requires considering the crossing of the quasi value function of a loyal minister $\widetilde{V}^m(k_i(t), t_l)$ with that of a coup challenge $\gamma V^l(k_i(t), t)$ only at the last date where these intersect.[13] If beyond that date a minister with capacity wants to undertake coups, then by Lemma 1, the minister will undertake coups whenever he has the capacity; a safe date does not exist. If beyond that date the minister does not want to undertake coups, then he will not do so once the date is reached, but will strictly wish to do so before hand again due to Lemma 1; thus defining the safe date. If the two value functions never intersect, then the minister is either always safe or never safe, depending on which value function is greater according to condition (2).

Leaders incur costs, $\varepsilon \to 0$ when replacing a minister. Therefore if a minister does not present a coup threat to the leader, and presuming that he was chosen optimally in the previous period, the leader strictly prefers to keep him in the next period. We have already seen that in order to determine whether the minister is a coup threat, at any time t the leader monitors both the minister i's means and incentives via the safe date. This allows for a simple characterization of ministerial turnover. The following describes how the leader determines ministerial turnover.

Proposition 2. *Consider minister i in post m at time t under a leader of vintage t_l. If*

$$\sum_{\tau=t_i^0}^{t} m(\tau)\, c_i(\tau) \geq \overline{c}. \tag{6}$$

does NOT hold, then minister i is reappointed for another period.
If (6) holds, then leader l dismisses m if and only if $t < \bar{T}_i = \bar{T}(m, k_i(t), t_l)$.

The proposition outlines the two-step decision process a leader makes for each minister's renewal. Each period the leader computes coup capacity (6) and the safe date

[13] Note that the definition of Υ excludes a situation where the highest intersection point is where the value functions are equal for more than one period. This is a point of measure zero in the model's parameter space. Including this possibility changes no results. It does require introducing more cumbersome notation so we proceed by ignoring it. Details are available from the authors upon request.

$\bar{T}_i = \bar{T}(m, k_i(t), t_l)$ for all N ministers. He replaces a minister if and only if (6) holds and they are not at their safe date. Otherwise, the minister lasts another period.

4 Hazard Functions and Likelihood

So far we have focused on calendar time t. Let us now introduce notation for analysis time (i.e. time since minister i takes office at t_i^0) and use $'$ to distinguish analysis time from calendar time, or $t_i' = t - (t_i^0 - 1)$. Stripping away unnecessary indexes, we now start by defining the unconditional probability of an insider's termination after t' periods after his appointment, $f(t')$. Notice that $f : \mathbb{N}^+ \to [0,1]$ is a discrete density function defined over years in office (the sample frequency available to us) and let us indicate with $F(t')$ its corresponding cumulative function, thus defining the survival function $S(t') = 1 - F(t')$.

The model postulates the presence of three competing and statistically independent termination risks for a minister: i) the minister's endogenous dismissal likelihood $\Pr\left(\sum_{\tau=0}^{t'} m(\tau)\, c(\tau) > \bar{c}\right)$ before $\bar{T}' = \max\left[\bar{T} - (t^0 - 1), 0\right]$ periods ; ii) the minister's idiosyncratic dismissal likelihood $1 - \sigma$; and iii) termination due to the leader's demise (due to $1 - \delta$ or $1 - \rho(t - t_l)$). The data enable to distinguish whether the minister is terminated under the same leader (and hence must have be victim of an endogenous termination or a shock $1 - \sigma$), indexed by $r = 1$, or whether the minister is terminated because the leader changed (and hence due to either a shock $1 - \delta$ or $1 - \rho(t - t_l)$) indexed by $r = 2$[14]. It is useful to distinguish the overall hazard for a minister, $\lambda(t', t_l, m) = f(t', t_l, m)/S(t', t_l, m)$, from the risk-specific hazards $\lambda_r(t', t_l, m)$ for $r = 1, 2$.

It follows that the survival and hazard functions are:

Proposition 3. *The survival function probability of minister i to t_i' in post m under a leader*

[14] We are not able to separate endogenous terminations of ministers on the part of leaders from sudden death or incapacitation $(1-\sigma)$, because of lack of data on natural incapacitations for our ministers. We could separate terminations of ministers due to sudden death or incapacitation of the leader $(1 - \delta)$ from those due to exogenous threats to the leadership $(1 - \rho(t - t_l))$ because data on natural incapacitations/deaths for all leaders are available, but we chose not to. The literature has already established good benchmarks for δ and we can simplify the estimation by calibrating this (not particularly interesting) parameter.

installed at t_l is:

$$S(t_i', t_l, m) = \begin{cases} \sigma^{t_i'-1}\delta^{t_i'-1}\Pi_{s=1}^{t_i'-1}\rho\left(t_i^0+s-t_l\right)\Pr\left(\sum_{\tau=1}^{t_i'-1} m\left(\tau\right)c\left(\tau\right)\leq\bar{c}\right) & if\ t_i' < \bar{T}_i' \\ \sigma^{t_i'-1}\delta^{t_i'-1}\Pi_{s=1}^{t_i'-1}\rho\left(t_i^0+s-t_l\right)\Pr\left(\sum_{\tau=1}^{\bar{T}_i'} m\left(\tau\right)c\left(\tau\right)\leq\bar{c}\right) & if\ t_i' \geq \bar{T}_i', \end{cases}$$

where $\bar{T}_i' = \max\left[\bar{T}-\left(t^0-1\right),0\right]$. The probability of a minister to be terminated after t_i' periods is:

$$f(t_i', t_l, m) = \begin{cases} S\left(t_i', t_l, m\right) \times \left[1-\sigma\delta\rho\left(t_i^0+t_i'-t_l\right)\Pr\left(\sum_{\tau=1}^{t_i'} m\left(\tau\right)c\left(\tau\right)\leq\bar{c}\right)\right] & if\ t_i' < \bar{T}_i' \\ S\left(t_i', t_l, m\right) \times \left[1-\sigma\delta\rho\left(t_i^0+t_i'-t_l\right)\right] & if\ t_i' \geq \bar{T}_i'. \end{cases}$$

The hazard function $\lambda\left(t', t_l\right)$ indicating the probability of a minister to be terminated during period t' conditional on having survived up to analysis time t_i', is

$$\lambda(t_i', t_l, m) = \begin{cases} 1-\sigma\delta\rho\left(t_i^0+t_i'-t_l\right)\Pr\left(\sum_{\tau=1}^{t_i'} m\left(\tau\right)c\left(\tau\right)\leq\bar{c}\right) & if\ t_i' < \bar{T}_i' \\ 1-\sigma\delta\rho\left(t_i^0+t_i'-t_l\right) & if\ t_i' \geq \bar{T}_i'. \end{cases}$$

The cause-specific hazard functions, representing the conditional probability that a minister is dismissed in the interval $[t-1, t]$ and the cause is r, are determined by:

Proposition 4. *The hazard function $\lambda_1\left(t_i', t_l, m\right)$, indicating the probability of an insider to be terminated endogenously by the leader during period t_i' or being incapacitated, conditional on having survived up to analysis time t_i' in post m, is*

$$\lambda_1(t', t_l, m) = \begin{cases} 1-\sigma\Pr\left(\sum_{\tau=1}^{t_i'} m\left(\tau\right)c\left(\tau\right)\leq\bar{c}\right) & if\ t_i' < \bar{T}_i' \\ 1-\sigma & if\ t_i' \geq \bar{T}_i'. \end{cases}$$

The hazard function $\lambda_2\left(t_i', t_l\right)$, indicating the probability of an insider to be terminated due a

leader change during period t_i', conditional on having survived up to analysis time t_i', is

$$\lambda_2(t_i', t_l) = 1 - \delta\rho\left(t^0 + t_i' - t_l\right) = 1 - \delta\rho\left(t - (t_l - 1)\right).$$

Furthermore, the hazard function $\lambda_1(t_i', t_l, m)$ satisfies the following properties:

1. *For $m = J, S$ $\frac{d\lambda_1(t', t_l, m)}{dt'} > 0$ for analysis time $t' < \bar{T}'\left(m, k_i\left(t\right), t_l\right)$ and $\lambda_1(\bar{T}' - \xi, m) > \lambda_1(\bar{T}', m)$ for $\xi \to 0^+$ and $\frac{d\lambda_1(t', t_l, m)}{dt'} = 0$ for $t' \geq \bar{T}'\left(m, k_i\left(t\right)\right)$;*

2. *$\lambda_1(t', t_l, J) \leq \lambda_1(t', t_l, S)$ for $t' < \min\left[\bar{T}'\left(S, k_i\left(t\right), t_l\right), \bar{T}\left(J, k_i\left(t\right), t_l\right)\right]$;*

and the hazard function $\lambda_2(t_i', t_l)$ is constant across all ministers and only function of the number of periods in power of the leader l. Recall that it satisfies the following properties:

1. *For any minister $\frac{d\lambda_2(t, t_l)}{dt} < 0$ for calendar time $t < t_l + t_\delta$;*

2. *For any minister $\frac{d\lambda_2(t, t_l)}{dt} = 0$ for calendar time $t \geq t_l + t_\delta$.*

The first feature of $\lambda_1(t', t_l, m)$ is that for $t' < \bar{T}'$ the hazard is strictly increasing, as the probability of remaining below the minimal coup capacity $\Pr\left(\sum_{\tau=1}^{t'} m\left(\tau\right) c\left(\tau\right) \leq \bar{c}\right)$ decreases over time. The second is that once an insider passes the threshold time $\bar{T}'$, the hazard function drops discontinuously, as the minister's endogenous dismissal likelihood goes to zero, and the hazard rate for $r = 1$ becomes constant. If i is in a senior ministry the drop will come sooner, but the hazards will drop from a higher level, specifically by a shift factor $M_S > 1$ if $m = S$ until the time of the drop. In comparative terms, the hazard function will be higher at the start for senior ministers, then lower after the senior ministers become safe but the juniors have still not reached safety, and then both will eventually plateau to $1 - \sigma$ beyond each critical point. In addition, the critical $\bar{T}' < +\infty$ at which the hazard rate drops comes later for younger leaders for given calendar time t. The hazard function $\lambda_2(t', t_l)$ is monotonically decreasing in analysis time before calendar time $t_l + t_\delta$ is reached, at which point it becomes constant at $1 - \delta$.

Parametric Specifications

A set of parametric restrictions are required before specifying the likelihood function. First, a process for the leader's fragility to external threats $\rho(t-t_l)$ is necessary. We allow a nonlinear increase over calendar time $[t_l, t_l+t_\delta]$ as $\rho(t-t_l) = \left(\frac{t-t_l}{t_\delta}\right)^\zeta$ with $\zeta > 0$. We also calibrate $\delta = 0.95$, $g = 0.05$, and $H = 1$, as H cannot be separately identified from γ (and with the understanding that the estimated γ will be deflated by the holdup risk). For minister i under leader of vintage t_l observed to leave the cabinet after t_i' periods due to risk r, define the dummy $d_i = 1$ if i is not right censored[15] and 0 otherwise, and the dummy $r_i = 1$ if i is terminated by risk 1 and 0 otherwise. For the likelihood of coup success γ we propose a flexible parametric form with a time varying component $\gamma = \chi_1 + (1-\chi_1) * \left(1 - e^{-\chi_2(t_i^0 - t_l)}\right)$ with $0 < \chi_1 < 1$, which allows the estimator more flexibility in allowing different safe dates for different cohorts of ministers[16]. Define the set of structural parameters of the desire and capacity functions $\Gamma = (\beta_J, \beta_S, \sigma, \chi_1, \chi_2, \varsigma_c, M_S, t_\delta, \zeta)$.

An additional piece of information necessary for estimation is the amount of political capital of each minister $k_i(t)$. We do not observe $k_i(t)$, but we have handy observational proxies of political capital for ministers and leaders. Define the observed cumulated experience in government (i.e. number of years served in any cabinet capacity) at calendar time t by minister i, $\tilde{k}_i(t)$ and likewise for the leader l, $\tilde{k}_l(t)$. We can realistically posit that years of experience are a noisy, but unbiased, proxy of political capital:

$$\begin{aligned} k_l(t) &= \tilde{k}_l(t) + \varepsilon_{lt} \\ k_i^m(k_l(t)) &= \tilde{k}_i(t) + \varepsilon_{it} \end{aligned}$$

where ε is a mean zero error uncorrelated across individuals. Recall that at any date t the model implies $k_i^m(k_l(t))/k_l(t) = \beta_m/(1-\beta_m)$ as a steady relationship between ministerial

[15] Left censoring is not possible within our sample, as all countries are considered from the start of their postcolonial history.

[16] We can also estimate the model using a single γ parameter. This would identify only two safe dates $\bar{T}(m, k_i(t), t_l)$ $m = J, S$ common to all ministers under leader l.

and leader's political capital[17]. By rearranging and pooling across all leaders/countries in our sample l and all i at t_l it is therefore possible to estimate:

$$\tilde{k}_i(t_l) = \frac{\beta_m}{1-\beta_m}\tilde{k}_l(t_l) + \varphi_{lt_l} + \varepsilon^*_{it_l} \tag{7}$$

where $\varphi_{lt_l} = \frac{\beta_m}{1-\beta_m}\varepsilon_{lt_l}$ is a leader-specific fixed effect. The auxiliary regression (7) is particularly useful as it delivers directly estimates for $\hat{\beta}_J$, $\hat{\beta}_S$ and the predicted $\hat{k}_l(t_l)$ independently of the other parameters of the model.

Likelihood Function

Finally, define for a minister i given experience at entry of his leader k_l^0 vintage t_l and spell history $\mathbf{m}_i = [m_i(1), ..., m_i(t_i')]$ the vector $\mathbf{x}_i = [k_l^0, t_l, \mathbf{m}_i, r_i]$. The likelihood contribution of observing exit at t_i' is then:

$$\begin{aligned} g(t_i', \mathbf{x}_i; \Gamma) &= f(t_i', \mathbf{x}_i; \Gamma)^{d_i} * S(t_i', \mathbf{x}_i; \Gamma)^{(1-d_i)} \\ &= \lambda_1(t_i', \mathbf{x}_i; \Gamma)^{r_i d_i} * \lambda_2(t, t_l)^{(1-r_i)d_i} * S(t_i', \mathbf{x}_i; \Gamma) \end{aligned}$$

where $S(.)$ and $\lambda_r(.)$ are defined in Proposition (3) and (4), respectively. Notice that ministers terminated jointly with the leader ($r = 2$) look very much like censored ministers ($d = 0$), with the sole difference of being multiplied by a factor $\lambda_2(t, t_l)$, that essentially amounts to the leader's own hazard from external threats. The log-likelihood for a sample $i = 1, ..., I$ of

[17] Although apparently restrictive, the result of constant capital across ministries of type m is a necessary condition for dealing parsimoniously with the lack of clear proxies of political capital of government insiders. Such a metric would be arduous to define for democratic regimes, where political data is much more transparent and readily available than in Africa, but it is even more so in this context. Clearly the observed cumulated experience in government of any politician is only one partial dimension of his/her political capital. Focusing only on previous years in government as a measure of political experience of a minister could underestimate the effective level of political capital. For instance, experience as a party cadre or within particular pre-colonial ethnic institutions (i.e. the role of paramount chiefs in Sierra Leone) are hard to measure, but surely a factor in determining the amount of political capital of leaders and insiders. Our approach is to leverage on multiple observations of career ministers over time in order to pin down the patterns of average political experience within the dictator's inner circle. This obviously sacrifices some heterogeneity across ministers along the $k_i(t)$ dimension, but it is the consequence of paucity of accurate proxies for $k_i(t)$. Part of this heterogeneity is however recovered in estimation by allowing for country-specific parameters.

ministerial spells[18] is then:

$$\mathcal{L}(\Theta, \Pi, \Gamma) = \sum_{i=1}^{I} \ln g(t_i', \mathbf{x}_i; \Gamma). \tag{8}$$

The apparently simple formulation (8) is deceptive, as much of the identification here relies on the unobserved safe dates $\bar{T}_i'$ which impose stark discontinuities to the hazard functions. We can however take advantage of the particular separability of our problem. Parameters (β_J, β_S) are directly identified by (7) and the remaining parameters of the hazard λ_2, (t_δ, ζ), can be easily recovered by fitting a parametric hazard model to the leaders' termination data. We impose common parameters across countries $(\beta_J, \beta_S, t_\delta, \zeta)$, but allow the exogenous discount, the coup success, and coup capacity parameters $(\sigma, \chi_1, \chi_2, \varsigma_c, M_S)$ to vary by country[19].

5 Estimation

Table 3 reports the maximum likelihood estimates for all countries, split by whether the model fits a safe date or not for the country. That is, just for exposition, we simply divide our countries in two groups, the first group with hump shaped ministerial termination hazard risk 1 and a second groups where the risk of being terminated under the same leader is always increasing. The table also reports asymptotic standard errors computed at the level of individual country likelihood function.

One first important parameter that is estimated in the data is the minister exogenous portion of the discount factor σ, capturing life expectancy, political threats from rival politi-

[18] With a slight abuse of notation we indicate with i both the minister and ministerial spells. Typically ministers present only one spell, but certainly not always. The implication in the loglikelihood (8) is that we consider here separate spells of the same minister as different observations with respect to the draws of θ and the initial level of the coup network stock. However, we do maintain memory of the experience of the minister through the initial political capital stock k_i^0, which also influences the coup incentives and is higher at every subsequent spell of the same individual.

[19] Given the parsimony of our model, the likelihood function depends on a relatively small number of parameters. This allows for a fairly extensive search for global optima over the parametric space. In particular, we employ a pattern search optimizer and extensively experiment with initial seed values.

cians, etc. The estimates range from a very low 76% in Congo and Liberia to 92% in Uganda, implying a risk of exit as high as 24% per year in government. Indeed, the troubled political histories of some of these countries can help rationalize this finding.

We are also able to estimate the technological parameters (β_J, β_S), which also identify the bargaining power of the leader relative to his cabinet members of various type. We impose common (β_J, β_S) for all countries, but when computing the standard errors we always employ the country-specific outer product of gradients matrix in order to assess the precision of our estimates relative to the amount of variation in that particular country. Diminishing returns to ministerial political capital seem to kick in very quickly in the data, as the estimated $\beta_J = .119$ and $\beta_S = .137$ imply a substantial degree of curvature in the production function. This implies a relative insensitivity of the political production process to the experience of the minister. Consequently, in our sample the bargaining power of the minister appears low. The bargaining power of the leader can be computed as $\alpha_J = .881$ relative to junior ministers and $\alpha_S = .863$ relative to senior ministers.

The coup capacity parameters $(\chi_1, \chi_2, \varsigma_c, M_S)$ are essential in determining whether a country exhibits a safe date or not. The coup success probability function is based on the two parameters (χ_1, χ_2). This is the hardest part of the parameter space to pin down due to the sharp discontinuity presented by (1). We are however able to identify the parameters in Montecarlo simulations, so the issue is the amount of variation in the data. The parameter χ_1 ranges from .001 to .005. This does not obviously imply implausible unlikely coup success probabilities, because one has to remember that this figure has to be scaled by parameter H. What is reassuring is that the estimates appear larger in countries with more troubled histories of coups and plotting like Congo and Nigeria, than in countries with relatively more stable autocratic governments, like Gabon and Cameroon. The data seem to reject any role for the time-varying component of risk χ_2.

The estimates for ς_c are indicative of the speed at which the coup capacity threshold (6) is met by a government insider. Specifically, ς_c identifies the scale of the exponential

shocks to the capacity of staging coups, or building a "power base" (Soest, 2007), by the ministers. The higher ς_c the faster coup capacity accumulates and the faster the leader fires his ministers. The range of ς_c is varied. For example the "musical chairs" of Mobutu's Congo generate a high estimate of .53; implying extremely high churning. The more stable Gabon has a value of .11. To see why a scale of .53 would imply a high value of churning one has to compute the expected time at which a threshold of 1 is reached[20] by the convolution of the coup capacity c shocks. Since the scale of an exponential located at 0 is its expected value, then in Congo there's an accumulation of .53 per period, or the threshold is reached in less than 2 years. Instead, for $\varsigma_c = .11$ the threshold is reached in 9 years.

In the majority of countries the estimates of M_S are above 1 indicating, in accordance to point 2 in (4), steeper hazard functions at the start for senior ministers, and a higher coup capacity accumulation rate for more relevant position. For the set of countries where $M_S > 1$ the evidence points towards higher risk of endogenous termination by action of the leader. This is consistent with the view that more senior posts may be more fertile breeding grounds for potential rivals to the leadership, therefore requiring sharper pruning by the autocrat.

Finally, Table 3 reports the leader's hazard parameters. Again, we impose common (t_δ, ζ_2) for all countries, but when computing the standard errors we employ the country-specific outer product of gradients matrix in order to assess the precision of our estimates relative to the amount of variation in that particular country. Leaders reach a point of constant low hazard δ after $t_\delta = 16$ years in office and along the way we observe a smooth drop in regime fragility ($\zeta_2 = .047$).

Concerning the fit, the model is able to capture the non-monotonic nature of the hazard functions in the countries with safe dates, while accommodating monotonically increasing hazard functions in the other countries. In Figure 7 we report the model fit for Kenya, a safe date country, and Benin, an country for which we do not fit a safe date, as an illustration.

[20] 1 is in fact our normalized value for the coup capacity threat level $\bar{c}$.

6 Alternative Duration Models

This section discusses in more detail a set of relevant alternatives relative to our main model. The goal is to provide support for our modeling choices by rejecting competing theoretical mechanisms that do not match the data.

Consider first what is, likely, the most intuitive of all alternatives: leaders are tantamount to employers hiring workers (their ministers) and try to select the best ones, laying off the rest. This is essentially a pure *selection* mechanism of ministerial personnel based on learning workers' type/match quality on the part of the leader. Without providing an exact microfoundation, which would be redundant, the idea of a selection motive affecting termination risks for ministers would work through a discovery of the minister's type and termination of the bad types. Early on in their tenure bad ministers would be screened out and only talented ministers, which would then likely remain bar some random separation shock, would remain.

This mechanism intuitively delivers a downward-sloping hazard function in time in office under the same leader for any minister. This is, in fact, amply discussed in the vast and related labor economics literature concerned with job separations in duration models of employment (or so called 'inspection good models' with no gradual learning about the employer-employee match, Jovanovich, 1984). Where we can safely reject this alternative is in that it would fail to predict initially or continually increasing hazard rates, which we have shown previously to be a robust feature of the data. This very same fact would reject *learning by doing* on the part of ministers as an alternative mechanism as well. That is, a setting in which early on in his career a ministers makes a lot of mistakes that could potentially cost him his job, but whose likelihood decreases as he gets more acquainted with his role over time. Again the predicted equilibrium hazard function would be downward sloping in analysis time under this alternative scenario (see Nagypal, 2007).

Assuming a leader has only partial information about the true political quality (say, valence) of his own ministers, but observes informative signals slowly over time, under Bayesian

learning the accumulation of information would determine a certain delay in firing low quality ministers, due to the likely use of optimal thresholds in posterior beliefs for determining (with a sufficient degree of certainty) a rational selection decision. This particular setup would likely deliver what could be called a *selection with delay* hazard function. As it takes time to assess the (initially unknown) quality of every minister in order to keep the 'good' ministers and drop the 'bad', initially increasing hazards could be generated in equilibrium, while the drop could be a simple consequence of selection dynamics described above.[21] Where this mechanism would fail empirically would be in matching another important feature of the data: the fact that more experienced leaders tend to systematically hire more experienced ministers and less senior leaders tend to hire less experienced ministers. In fact, any model simply pivoting around selection incentives based on discovering the true type of a minister would likely tend to imply a preference for more experienced ministers by both experienced and unexperienced leaders alike, for experienced ministers are, in many respects, a better known entity.

Another reasonable interpretation for the process of political appointment in neopatrimonialist systems, like the African ones we consider, is what could be referred to as "*my turn to eat*" hypothesis[22]. In the words of van Soest (2007) "*neopatrimonial rulers frequently rotate the political elite [...] in order to extend the clientelist network*", while Snyder (1992) states that "*Mobutu's patronage network was characterized by such frequent circulation of elites that Thomas Turner likened Zaire's politics to a 'game of musical chairs'. Elite circulation atomized Zairian elites by pressuring them to focus exclusively on self-aggrandizement during the short period they had access to state power and perquisites.*" Turner and Young (1985), cited by Acemoglu, Robinson, and Verdier (2004), specifically talk with respect to Mobutu of "*Client office holders have been constantly reminded of the precariousness of tenure by the*

[21] Non-monotone hazard rates (first increasing and eventually decreasing over tenure) are common in models with job-matching where the quality of the match is unknown at the time of the match formation and is revealed over time through observing one's productivity on the job. See Jovanovic (1979, 1984) for early examples within the labor economics literature.

[22] We thank Leonard Wantchekon at Princeton University for suggesting this alternative.

frequency of office rotation, which simultaneously fuels the hopes of those Zairians anxiously waiting just outside the portals of power". More precisely, suppose there is a set of political elites that a country leader has to "feed" with patronage disbursements waiting on the national cabinet's sidelines and that ministerial posts precisely serve this purpose, as vastly documented (Arriola, 2009; Francois, Rainer, and Trebbi, 2012). Essentially, elites are to be assigned positions, be fed, and eventually let go. This mechanism would arguably predict initially increasing hazard rates, as it takes time to extract patronage. It would hardly fit decreasing hazards, however, as the likelihood of a politician been satiated and let go should increase over time. Even more starkly, this alternative mechanism would hardly provide in itself any intuition for why more experienced leaders may tend to hire more experienced ministers.

7 Conclusions

This paper studies the cabinet survival of national ministers in a sample of fifteen sub-Saharan countries since independence. We show that the hazard risk of termination of cabinet members under the same leader display increasing hazard rates, particularly over the first five years in office, a strikingly different pattern from that found in the same continent for hazard risks of national leaders (which are typically decreasing in analysis time). We show that this specific pattern of time dependency can be successfully rationalized by a model in which leaders optimally select and dismiss cabinet members based on their value (in terms of ministerial output) and their threat (as a potential replacement for the leader) which increases as their capacity to form coups rises over time.

The model provides a complete parametric representation of the hazard function, which we then estimate structurally to derive information on the bargaining problem between the leader and his ministers and on the dynamic process of coup capacity accumulation in these countries. The fit of the model in terms of hazard risks and survival probabilities is excellent

and the model performs well when pinned against several relevant alternatives.

Overall, these findings speak directly to the debate on systematic political failure in Africa. While the continent's recent economic history is replete with massive political failures taking many forms (from civil conflict to patrimonialism), some of it has been ascribed directly to a political class that is both rapacious and myopic, as in the description of roving bandits (Olson, 2000) or in the analysis of corruption (Shleifer and Vishny, 1993). Our paper, by highlighting the role of leadership survival as central to the organization of African national governments, presents a novel mechanism in the analysis of political incentives in these weakly institutionalized environments.

8 Appendix

Proof of Lemma 1

Proof. Since $\widetilde{V}^m(k_i(t), t_l) \geq V^m(k_i(t), t_l)$, $\widetilde{V}^m(k_i(t), t_l) < \gamma V^l(k_i(t), t)$ implies $V^m(k_i(t), t_l) < \gamma V^l(k_i(t), t)$. Minister m has incentive to mount a coup against l in period t, and will do so if $\sum_{\tau=t_i^0}^{t} m(\tau) c_i(\tau) \geq \overline{c}$, i.e., he has the capacity at time t. Now consider period $t-1$, and suppose that $\sum_{\tau=t_i^0}^{t-1} m(\tau) c_i(\tau) \geq \overline{c}$, i.e., minister i has capacity to mount a coup against l then. Since $c_i(t)$ is drawn from C, which has non-negative support, i will also have capacity to mount a coup against l in t. Thus, leader l will dismiss i from the ministry in t, since he would mount a coup with certainty if he were to remain. A minister dismissed at t will never re-enter under the current leader because, from (3), $k_i^m(k_l) = \frac{\beta_m}{1-\beta_m} k_l$, and k_l grows at $1+g$ per period, whereas a dismissed minister's capital does not grow when out of office. Consequently, minister m will attempt a coup at the end of period $t-1$. Since $m's$ coup capacity and experience are public knowledge, l will dismiss m at the start of period $t-1$. Notice that this result does not depend on the relationship between $\widetilde{V}^m(k_i(t-1), t_l)$ and $\gamma V^l(k_i(t-1), t-1)$, and follows only from $\widetilde{V}^m(k_i(t), t_l) < \gamma V^l(k_i(t), t)$ and the fact of coup capacity at $t-1$. Consequently, in period $t-2$, if m has coup capacity then, he will also have it in $t-1$, and therefore in t. He will be dismissed at the start of $t-1$, and by identical reasoning, he will thus be dismissed at the start of $t-2$. The same argument can be applied to period $t-3$ and so on up to the first period, denote it t_1, at which $\sum_{\tau=t_i^0}^{t_1} m(\tau) c_i(\tau) \geq \overline{c}$.□

Proof of Lemma 2

Proof. Suppose $\Upsilon = \emptyset$. Then $\widetilde{V}^m(k_i(t_0), t_l) \geq \gamma V^l(k_i(t_0), t_0)$ implies $\widetilde{V}^m(k_i(t), t_l) \geq \gamma V^l(k_i(t), t)\ \forall t > t_0$. Then, provided $\widetilde{V}^m(k_i(t), t_l) = V^m(k_i(t), t_l)$ holds, minister i has never an incentive to mount a coup against l. But a necessary condition for there to exist a t such that $\widetilde{V}^m(k_i(t), t_l) > V^m(k_i(t), t_l)$ is that there exists a $\tau \geq t$ such that $\widetilde{V}^m(k_i(\tau), t_l) < \gamma V^l(k_i(\tau), \tau)$ is satisfied. However, this is not possible if $\Upsilon = \emptyset$ and $\widetilde{V}^m(k_i(t_0), t_l) \geq \gamma V^l(k_i(t_0), t_0)$, thus it must be that $\widetilde{V}^m(k_i(t), t_l) = V^m(k_i(t), t_l)$. It then follows that $V^m(k_i(t_0), t_l) \geq \gamma V^l(k_i(t_0), t_0)$ and also for all $t > t_0$, so that $\bar{T}_i = t_0$.
Suppose $\Upsilon = \emptyset$. Then $\widetilde{V}^m(k_i(t_0), t_l) < \gamma V^l(k_i(t_0), t_0)$ implies $\widetilde{V}^m(k_i(t), t_l) < \gamma V^l(k_i(t), t)$ $\forall t$. This implies that $\widetilde{V}^m(k_i(t), t_l) > V^m(k_i(t), t_l)\ \forall t$. But if that is the case, then it must be that $V^m(k_i(t), t_l) < \gamma V^l(k_i(t), t)\ \forall t$ and $\bar{T}_i$ does not exist.
Suppose now $\Upsilon \neq \emptyset$, and suppose that at $t = \sup \Upsilon$ it is the case that $\widetilde{V}^m(k_i(t), t_l) \geq \gamma V^l(k_i(t), t)$. Then, necessarily, because t is $\sup \Upsilon$, it must be that $\widetilde{V}^m(k_i(\tau), t_l) \geq \gamma V^l(k_i(\tau), \tau)\ \forall \tau > t$. But then, necessarily, $\widetilde{V}^m(k_i(\tau), t_l) = V^m(k_i(\tau), t_l)\ \forall \tau > t$, so it follows that $V^m(k_i(\tau), t_l) \geq \gamma V^l(k_i(\tau), \tau)\ \forall \tau > t$. This proves that then, beyond $\sup \Upsilon$, i will never mount a coup against l. However, for $\hat{\tau} = \sup \Upsilon - 1$, by the definition of $\sup \Upsilon$ and the supposition that at $t = \sup \Upsilon$ the condition $\widetilde{V}^m(k_i(t), t_l) \geq \gamma V^l(k_i(t), t)$ is verified, it must be that $\widetilde{V}^m(k_i(\hat{\tau}), t_l) < \gamma V^l(k_i(\hat{\tau}), \hat{\tau})$. Thus it follows directly from Lemma 1 that i will mount a coup against l at $\hat{\tau}$ and at all earlier dates, if he happens to have accumulated sufficient capacity to do so. Consequently $\bar{T}_i = \sup \Upsilon$.
Suppose $\Upsilon \neq \emptyset$, and suppose instead that at $t = \sup \Upsilon$ it is the case that $\widetilde{V}^m(k_i(t), t_l) < \gamma V^l(k_i(t), t)$. Then, necessarily, we have that $V^m(k_i(t), t_l) < \widetilde{V}^m(k_i(t), t_l) < \gamma V^l(k_i(t), t)$,

implying that i will mount a coup against l at $t = \sup \Upsilon$ if he has the capacity to do so. It also follows from the definition of $\sup \Upsilon$ that $V^m\left(k_i\left(\tau\right), t_l\right) < \widetilde{V}^m\left(k_i\left(\tau\right), t_l\right) < \gamma V^l\left(k_i\left(\tau\right), \tau\right)$ $\forall \tau > t$. It follows directly from Lemma 1 that i will mount a coup against l at all $\tau < t = \sup \Upsilon$ if he has the capacity to do so. Consequently $\bar{T}_i$ does not exist.□

Proof of Proposition 2

Proof. Since leaders have full information, if (6) fails, then minister i is not a threat, has optimal k, and will not be terminated given ε costs. If (6) holds, the minister can mount a coup. The leader then considers i's incentive to mount a coup. From Lemma 2, this amounts to comparing t to the safe date $\bar{T}_i$, which directly implies termination if and only if the inequality in the statement of the proposition holds.□

Proof of Proposition 4

Proof. With abuse of notation, given that time is discrete, indicate the changes of the hazard risk 1 as $\frac{d\lambda_1(t', t_l, m)}{dt'}$. At any analysis time $t' \geq \bar{T}'$ the minister is safe and his hazard is flat at $1 - \sigma$. At any analysis time $t' < \bar{T}'$ hazard risk 1 increments are governed by either $c\left(t'\right)$ or $M_s c\left(t'\right)$ depending on the ministerial type. Under the assumption that $c\left(t\right)$ are i.i.d. draw from a stationary distribution C with non-negative support and that $M_s > 1$ point 1 of the proposition follows, and so does point 2.□

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Table 1: African Cabinets - Summary Statistics by Country

Country	Time Period Covered	Years Missing	Years with Two Governments	Number of Governments	Number of Leaders in Power	Number of Government-Ministers	Average Size of Government (# posts)	Total Number of Unique Ministers	Average Number of Governments per Minister
Benin	1960-2004	1969, 1975	1968, 1970	45	10	730	16.22	209	3.49
Cameroon	1960-2004	1969, 1975	1968	44	2	1445	32.84	262	5.52
Cote d'Ivoire	1960-2004	1975	1970	45	4	1256	27.91	233	5.39
Dem. Rep. Congo	1961-2004	1972, 1974	1970, 1973	44	4	1352	30.73	515	2.63
Gabon	1960-2004	1975		44	2	1173	26.66	185	6.34
Ghana	1960-2004	1975	1970	45	9	1140	25.33	362	3.15
Guinea	1960-2004	1975	1969	45	2	1213	26.96	244	4.97
Kenya	1964-2004	1975	1970	41	3	1010	24.63	155	6.52
Liberia	1960-2004	1975	1970	45	10	938	20.84	272	3.45
Nigeria	1961-2004	1975	1970	44	11	1499	34.07	473	3.17
Rep. of Congo	1960-2004	1969, 1975	1968, 1970	45	7	918	20.40	239	3.84
Sierra Leone	1960-2004	1972, 1975	1970, 1973	45	9	1109	24.64	288	3.85
Tanzania	1965-2004	1972, 1974	1970, 1973	40	3	1016	25.40	158	6.43
Togo	1960-2004	1975	1970	45	3	757	16.82	199	3.80
Uganda	1963-2004	1972, 1974	1970, 1973	42	6	1037	24.69	205	5.06

Notes: In the "Number of Leaders in Power" column, we count a new nonconsecutive term in office of the same leader as a new leader. Source: Rainer and Trebbi (2011).

Table 2: Summary Statistics for Durations				
Variable	**N. Obs.**	**Average**	**Min**	**Max**
Leadership Spells Sample (All Africa)				
Initial Year	262	1980.084	1941	2004
Spell Durationn	262	8.40458	1	40
Censored	262	0.145038	0	1
Leadership Spells Sample				
Initial Year	85	1978.871	1960	2004
Spell Durationn	85	7.788235	1	38
Censored	85	0.176471	0	1
Ministerial Spells Sample				
Initial Year	5009	1983.994	1960	2004
Spell Durationn	5009	3.185067	1	31
Censored	5009	0.092234	0	1
Risk 1 Exit	5009	0.593931	0	1
Risk 2 Exit	5009	0.313835	0	1

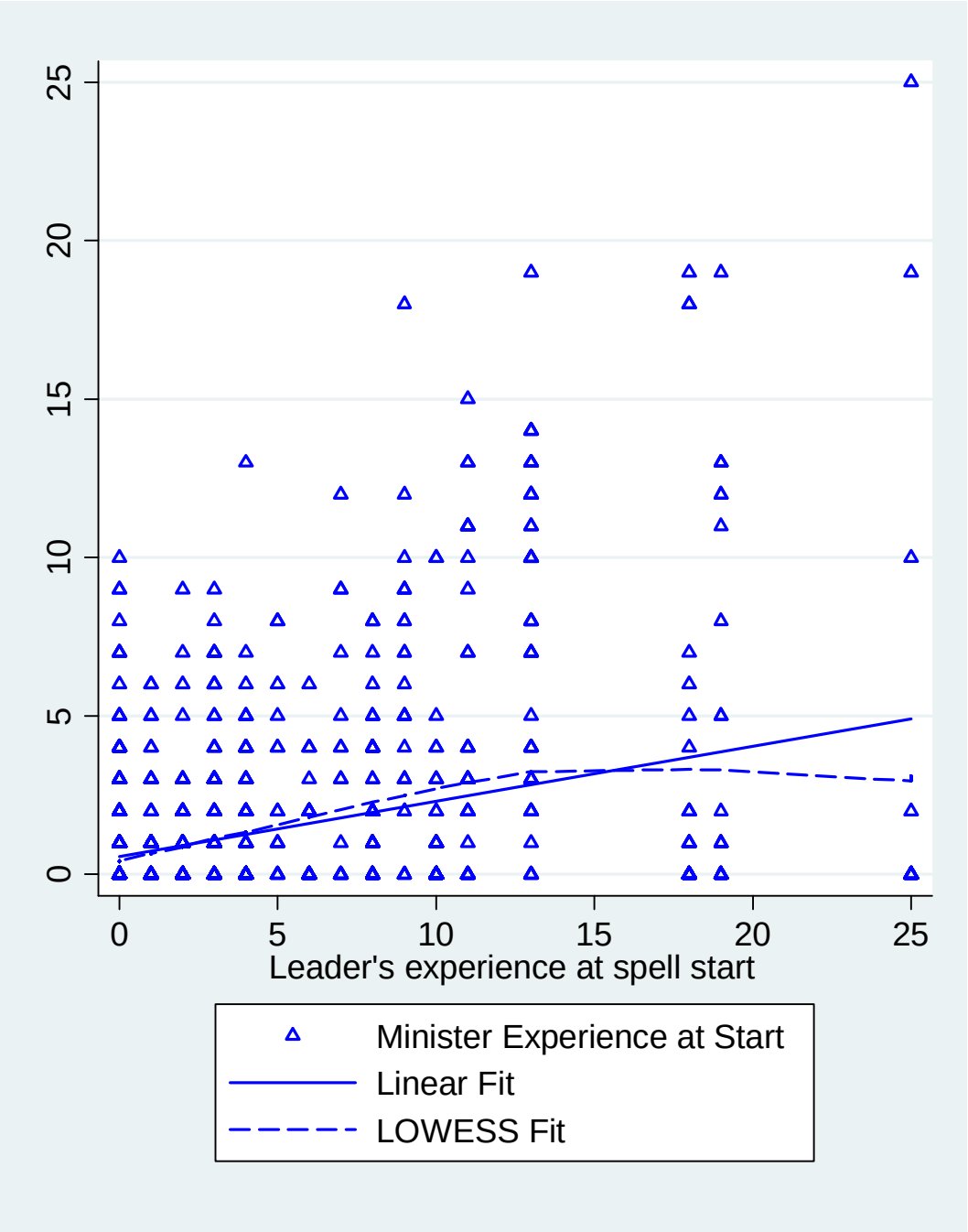
Table 3: All Ministers - Maximum Likelihood Estimates														
	Cameroon	**s.e.**	**Cote D'Ivoire**	**s.e.**	**Gabon**	**s.e.**	**Ghana**	**s.e.**	**Kenya**	**s.e.**	**Tanzania**	**s.e.**	**Uganda**	**s.e.**
Minister Exogenous Hazard														
σ	0.828	0.201	0.890	0.172	0.863	0.198	0.821	0.334	0.874	0.182	0.895	0.209	0.919	0.198
Bargaining Parameters														
β_J	0.119	0.095	0.119	0.188	0.119	0.073	0.119	0.177	0.119	0.307	0.119	0.063	0.119	1.327
β_S	0.137	0.281	0.137	0.040	0.137	0.027	0.137	0.233	0.137	0.211	0.137	0.044	0.137	0.928
Coup Capacity Parameters														
χ_1	0.002	0.002	0.003	0.014	0.003	0.005	0.002	0.001	0.001	0.019	0.004	0.001	0.005	0.007
χ_2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
ς_c	0.069	0.114	0.089	0.091	0.113	0.144	0.176	0.459	0.158	0.173	0.147	0.138	0.142	0.132
M_s	2.161	8.857	1.000	1.991	1.270	6.433	1.000	10.419	1.253	5.715	1.270	2.466	1.424	2.453
Leader's Hazard Parameters														
t_δ	16.000	22.303	16.000	142.035	16.000	51.994	16.000	32.860	16.000	84.400	16.000	12.001	16.000	34.534
ζ_2	0.047	0.367	0.047	0.303	0.047	0.480	0.047	0.143	0.047	0.274	0.047	0.236	0.047	0.150
LogLL	813.6		674.5		605.1		952.9		573.3		589.8		682.1	

Notes: Asymptotic Standard Errors in Parentheses. The *logLL* reported is specific to the contribution of each country.

Table 3: All Ministers - Maximum Likelihood Estimates																
	Benin	**s.e.**	**Congo (Dem. Rep.)**	**s.e.**	**Guinea**	**s.e.**	**Liberia**	**s.e.**	**Nigeria**	**s.e.**	**Rep. of Congo**	**s.e.**	**Sierra Leone**	**s.e.**	**Togo**	**s.e.**
Minister Exogenous Hazard																
σ	0.823	0.320	0.760	0.945	0.788	0.228	0.760	0.352	0.864	0.372	0.787	0.281	0.871	0.273	0.808	0.311
Bargaining Parameters																
β_J	0.119	0.019	0.119	0.019	0.119	0.019	0.119	0.019	0.119	0.019	0.119	0.019	0.119	0.019	0.119	0.019
β_S	0.137	0.020	0.137	0.020	0.137	0.020	0.137	0.020	0.137	0.020	0.137	0.020	0.137	0.020	0.137	0.020
Coup Capacity Parameters																
χ_1	0.016	[0.0046,1	0.016	[0.0019,1	0.000	[0,1]	0.016	[0,1]	0.016	[0.0024,1	0.016	[0.0031,1	0.016	[0.0036,1	0.016	[0.0041,1]
χ_2	0.000	[0,Inf]	0.000	[0,Inf]	0.016	[0,Inf]	0.000	[0,Inf]	0.000	[0,Inf]	0.000	[0,Inf]	0.000	[0,Inf]	0.000	[0,Inf]
ς_c	0.163	0.240	0.532	1.253	0.003	4.500	0.003	3.600	0.225	0.432	0.117	0.327	0.160	0.263	0.183	0.243
M_s	1.000	1.974	1.000	2.575	1.030	0.000	1.030	0.000	1.000	3.098	1.000	3.880	1.022	2.501	1.000	1.594
Leader's Hazard Parameters																
t_δ	16.000	197.160	16.000	440.640	16.000	244.279	16.000	107.704	16.000	160.038	16.000	93.801	16.000	152.766	16.000	360.792
ζ_2	0.047	0.362	0.047	1.017	0.047	0.646	0.047	0.202	0.047	0.273	0.047	0.267	0.047	0.267	0.047	0.824
LogLL	569.5		1027.6		733.9		840.0		1376.5		709.5		868.9		446.7	

Notes: Asymptotic Standard Errors in Parentheses. The *logLL* reported is specific to the contribution of each country.

Figure 1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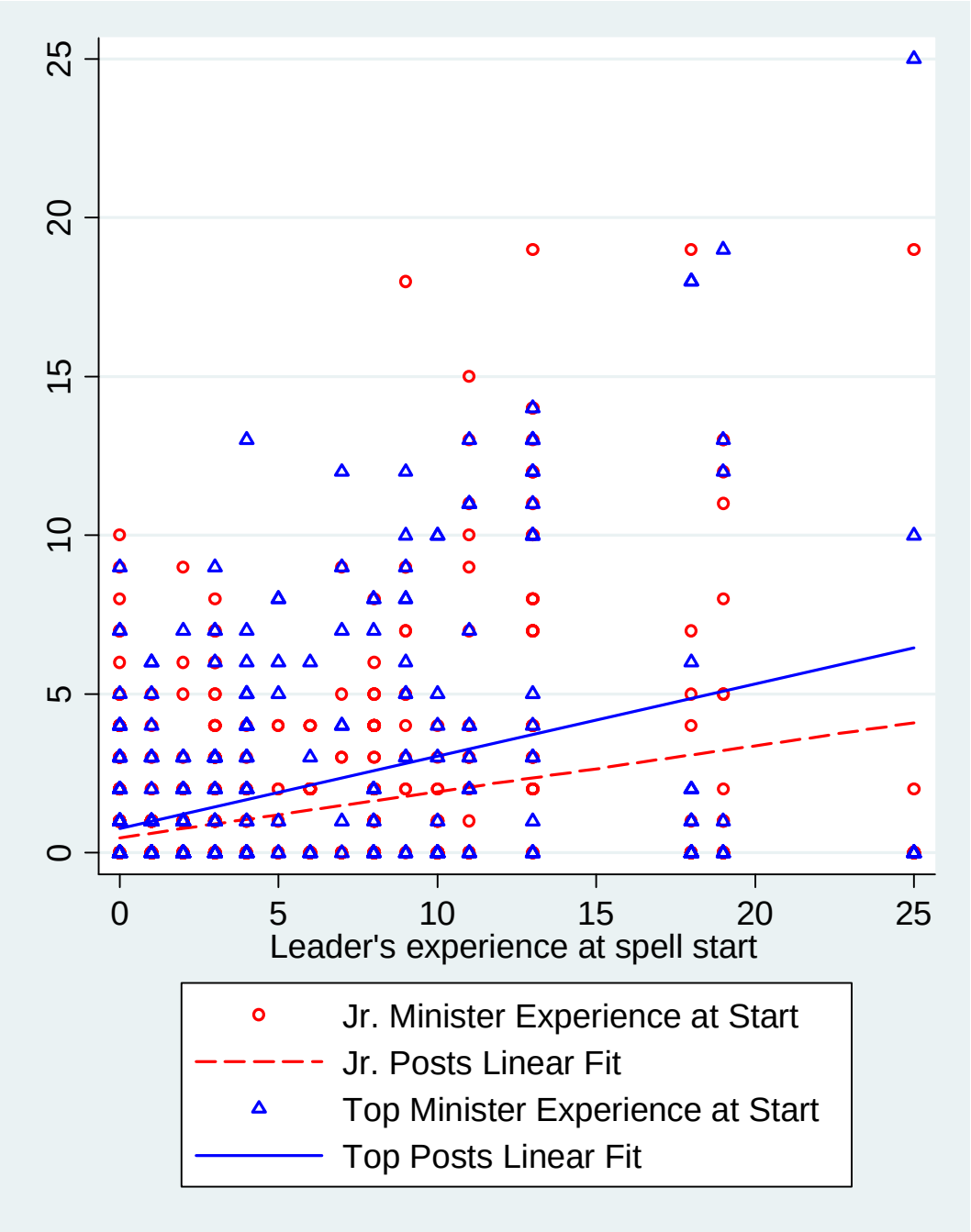
5
10
15
20
25
Leader's experience at spell start
Minister Experience at Start
Linear Fit
LOWESS Fit

Figure 2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15
10
5
0
0
5
10
15
20
25
Leader's experience at spell start
Jr. Minister Experience at Start
Jr. Posts Linear Fit
Top Minister Experience at Start
Top Posts Linear Fit

Figure 3

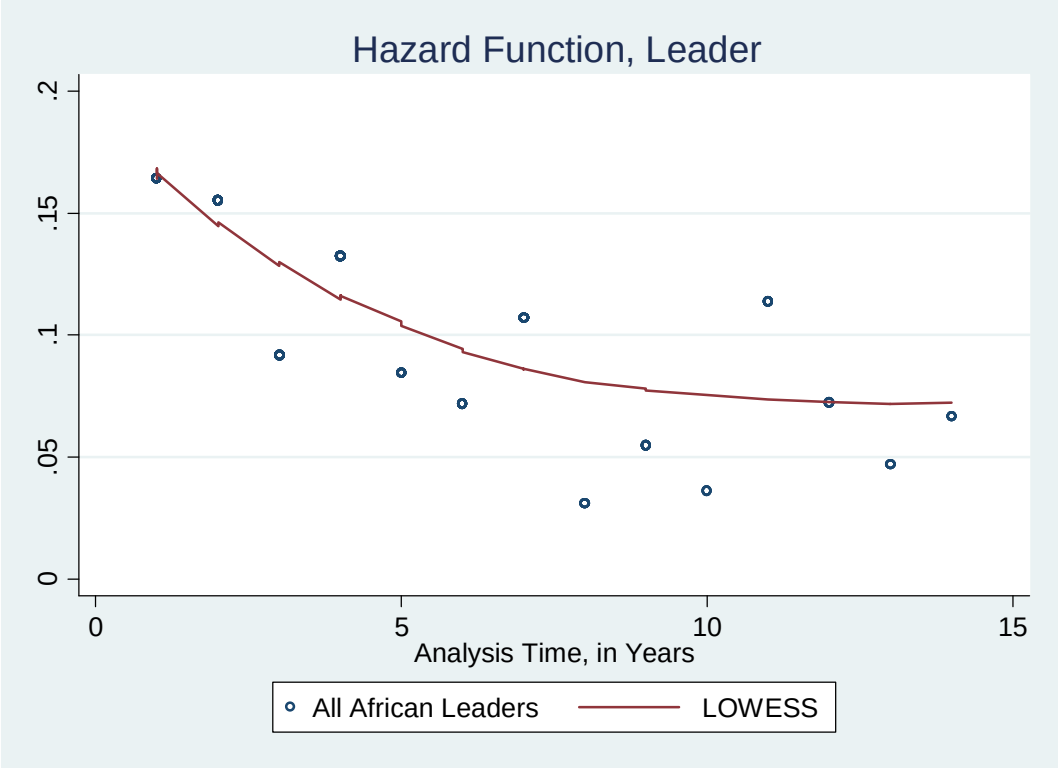


Figure 4

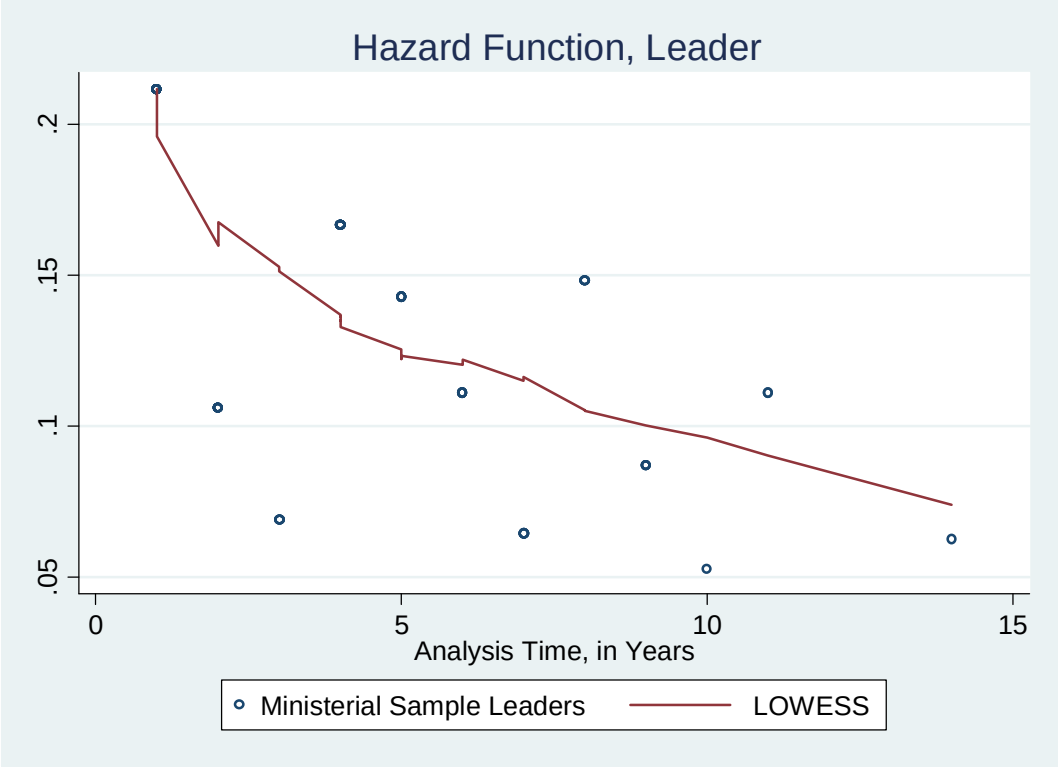


Figure 5a

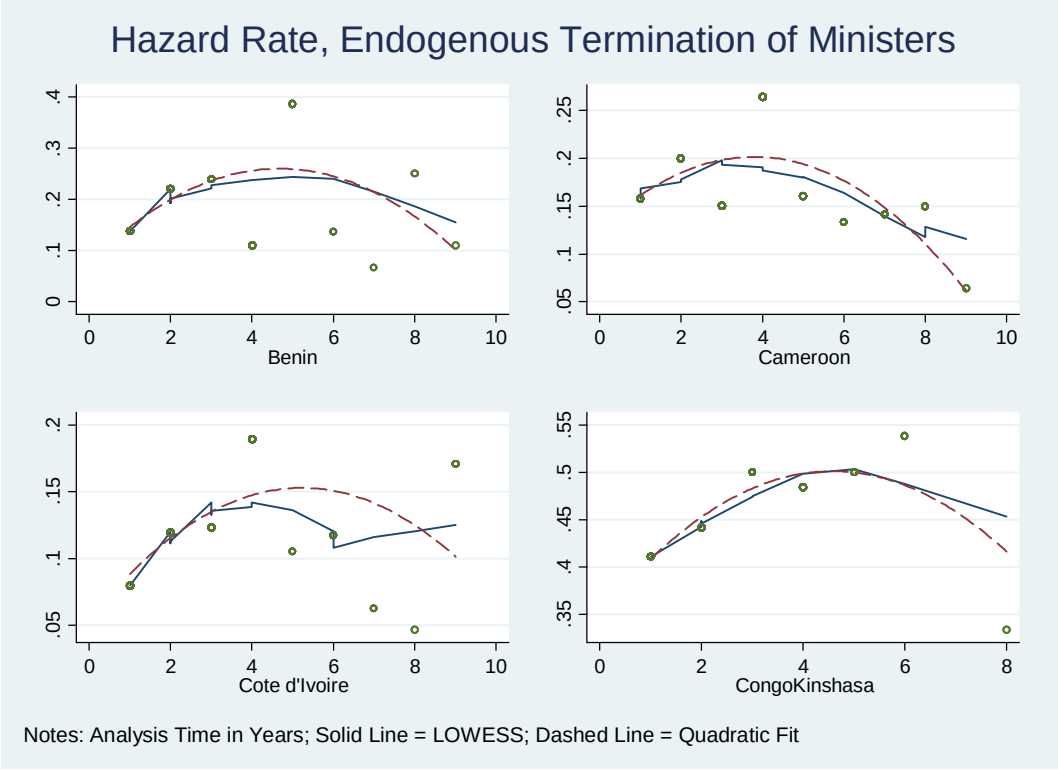


Figure 5b

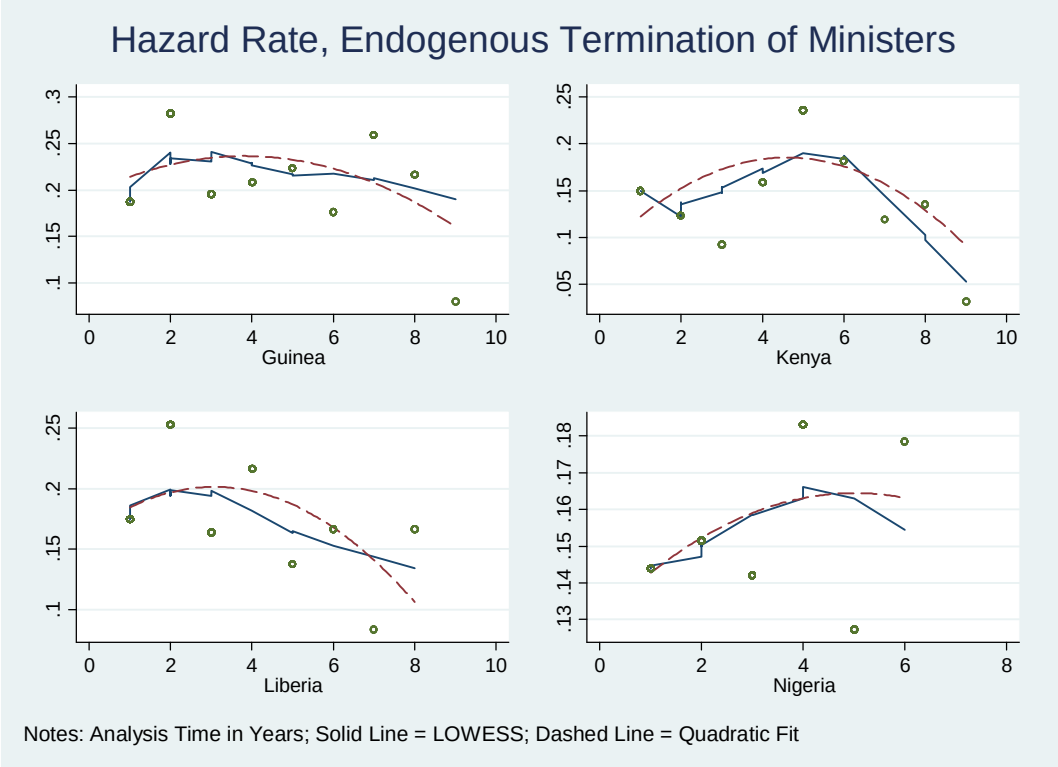


Figure 5c

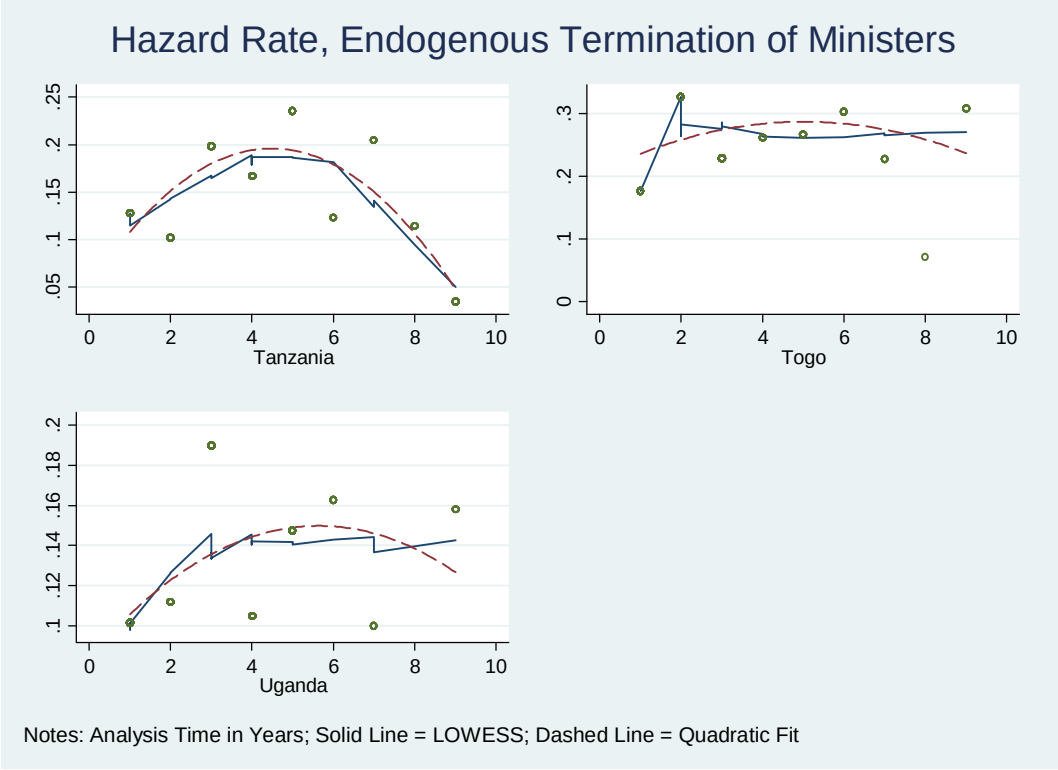


Figure 5d

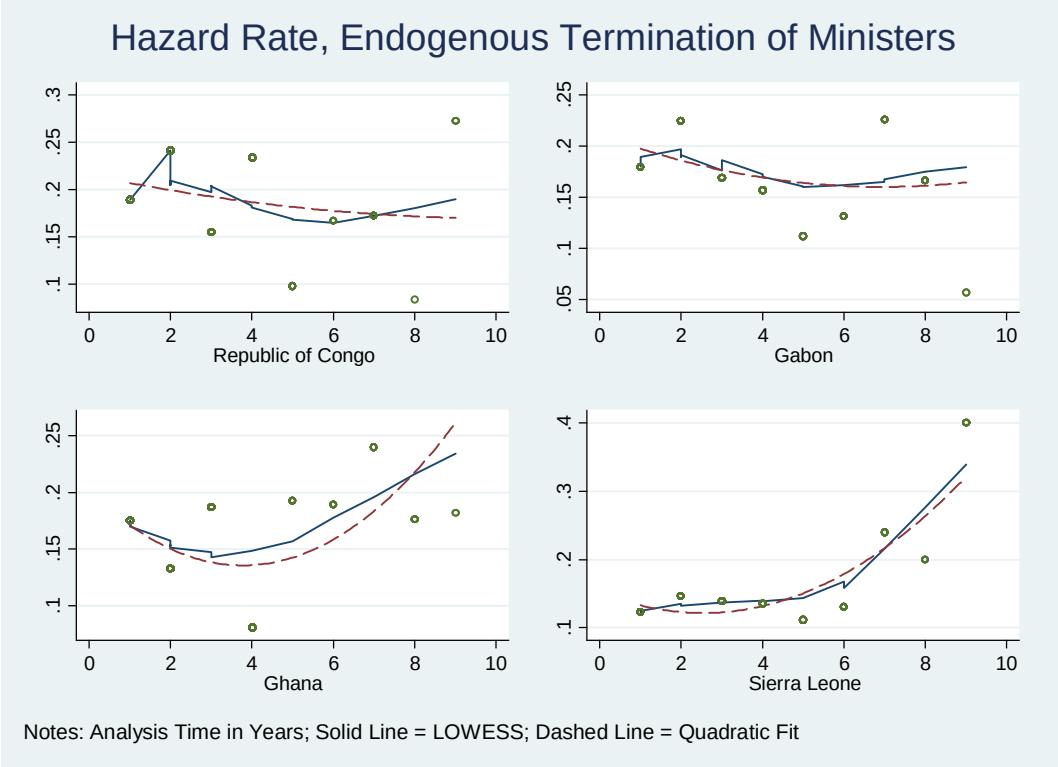


Figure 6: Timing

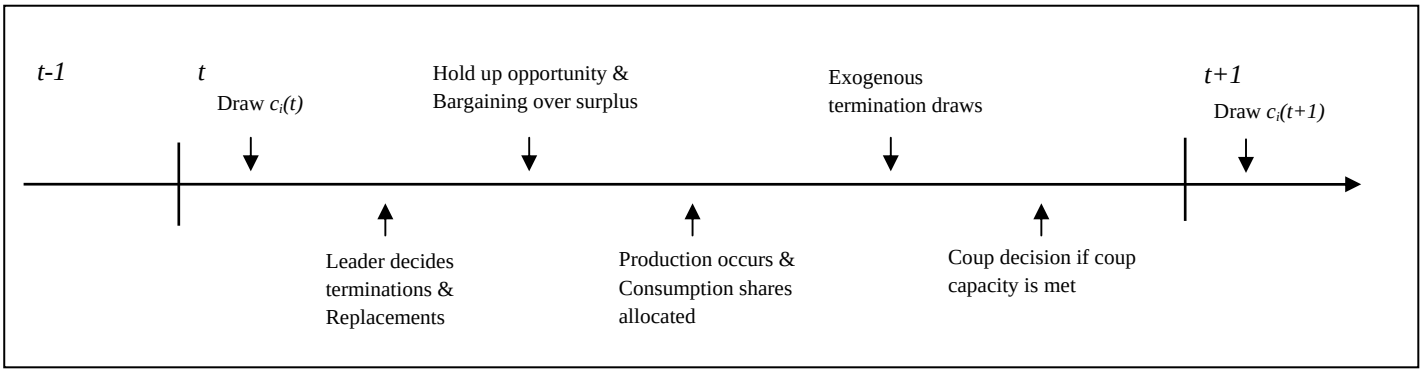


Figure 7a

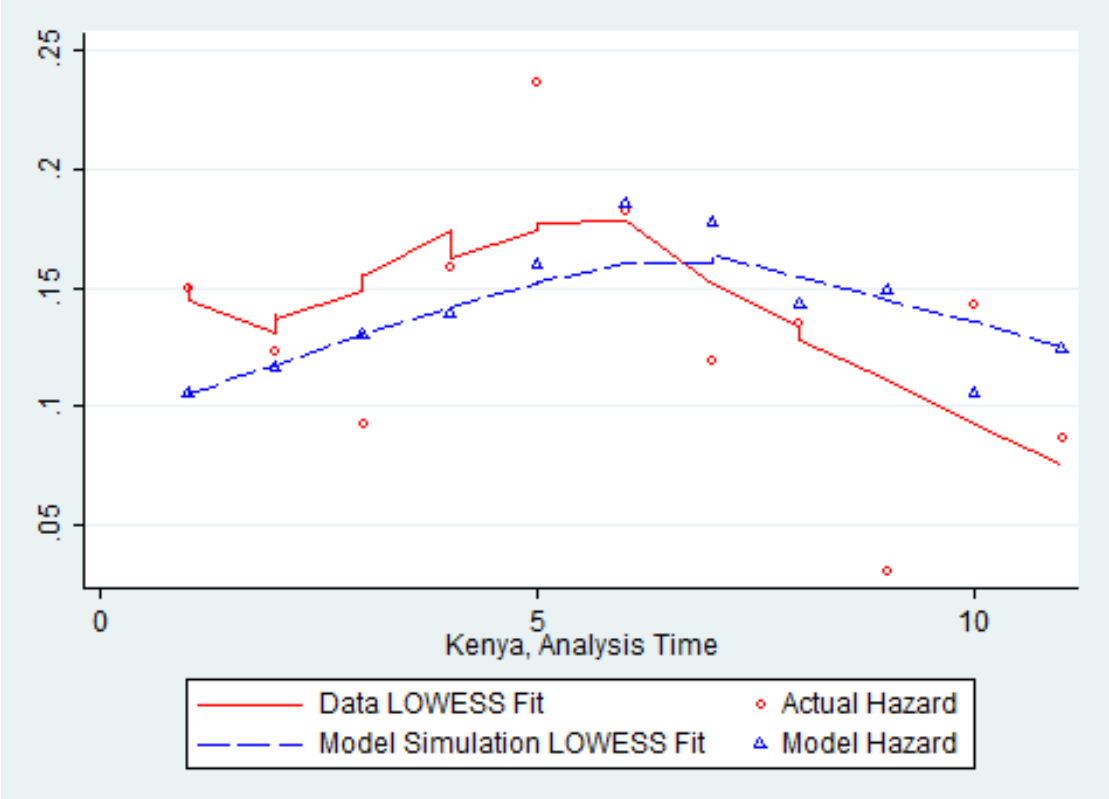
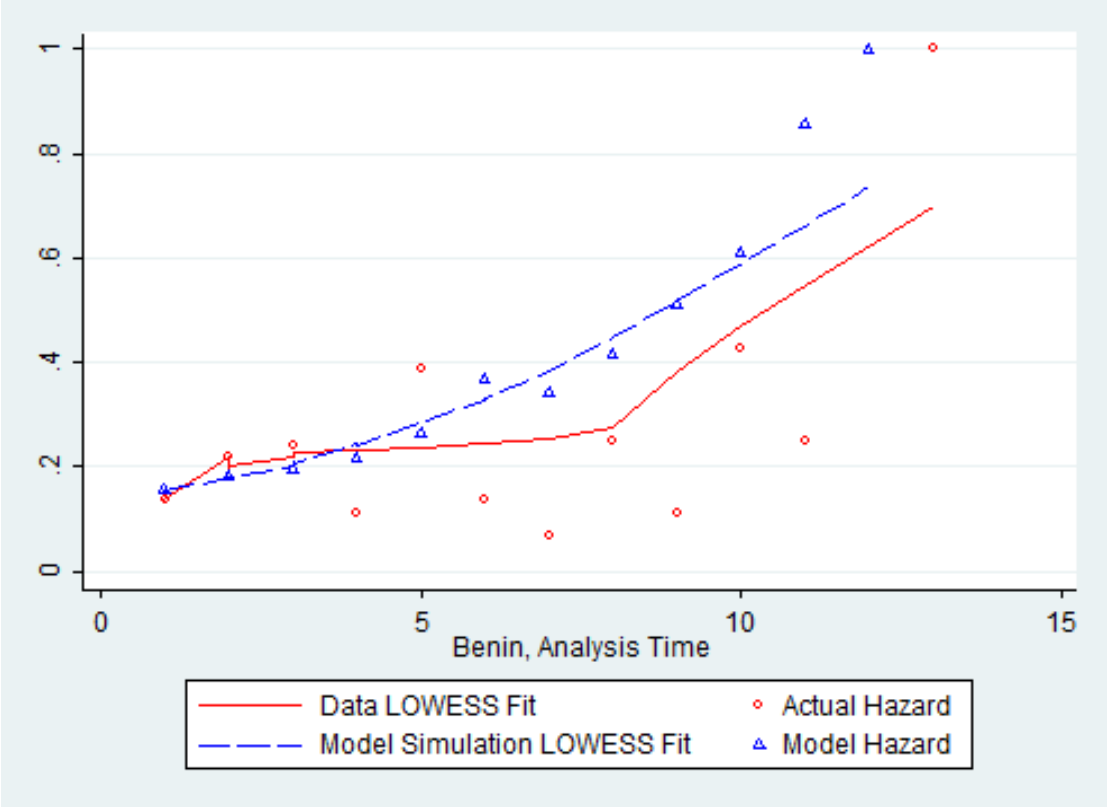


Figure 7b


0
.2
.4
.6
.8
1
0
5
10
15
Benin, Analysis Time
Data LOWESS Fit
Model Simulation LOWESS Fit
Actual Hazard
Model Hazard