An Economic Theory of Leadership Turnover*

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Abstract

In an infinite horizon model, a leader of a group of citizens exerts effort in each period to maintain a public good that enhances the profits of a group of kingmakers. In each period, the kingmakers decide whether to overthrow the current leader so as to have a chance of becoming the new leader. Consistent with the stylized facts of the empirical literature, we find that (1) leadership turnover declines with duration in office; (2) leadership turnover decreases as productivity improves; (3) leadership turnover occurs when the kingmakers' expected earnings are low; (4) leadership turnover increase as the number of kingmakers increases.

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1. Introduction

A majority of the world's fallen political leaders are not defeated in popular elections (Blondel, 1980, p.198, Table 1). Of 1,028 leaders who reached high office between 1945 and 1976, 169 remained in office in 1976; of the 859 who had fallen from power, only 5% were defeated at election. By contrast, 20% of leadership turnovers were due to pressures such as a coup. Despite the paucity of examples of removal from office at election, the attention devoted to modeling coups d'état and other non-democratic processes has been small compared with that devoted to "democratic" electoral processes. The objective of this paper is to understand the relation between changes in economic conditions and leadership turnover in non-democratic processes. We develop a dynamic model that is consistent with the following four stylized facts.

1. The risk of leadership turnover in any given year is inversely related to the length of time in office (Bienen and van de Walle, 1991).

2. A high coup propensity in any given period is associated with low per capita real GDP growth (*lagged:* Londregan and Poole, 1990, 1992 and Londregan et al., 1995; *current*: Alesina et al., 1996).

3. A high coup propensity in a given period is associated with low per capita lagged real investment (Gallego, 1998).

4. The risk of leadership turnover in African countries is positively related to the share of the leader's ethnic group (Londregan et al., 1995).

We study an infinite-horizon model of an economy in which the leader is maintained in power by the support of a finite subgroup of economic agents, called kingmakers. In each period, the leader first receives a fixed payment, then observes the realization of an exogenous shock, and finally exerts costly effort. The payoff to each kingmaker depends positively on both the level of the shock and the leader's effort. After observing the shock and the leader's effort, the kingmakers decide individually whether or not to withdraw support from the leader. If the leader is overthrown, a new leader is chosen at random from among the kingmakers, and a member of the population at large is chosen to replace the promoted kingmaker. We show that this model is consistent with the stylized facts 2, 3, and 4 above. All four stylized facts are consistent with an extension of the model in which dictators vary in ability.

The model draws on previous principal-agent models of both political competition and dictatorship that are based on Green and Porter[1] (1984). The models in this literature assume, as we do, that the leader of a group provides costly effort to maintain a public good that enhances the well-being of a subgroup. The subgroup can discipline the leader by withholding support. In this literature, it is assumed that subsequent leaders are chosen from outside the subgroup, so that, in the absence of variable leader ability, the subgroup is indifferent between an old and new leader. The distinguishing feature of our model arises from the following assumption.

- **Assumption 1**: Subsequent leaders are chosen at random from a finite subgroup whose support is necessary for the leader's survival so that leadership turnover confers a benefit on a random member of the subgroup.

One of the distinguishing features of our results is that support for the agent may be withdrawn in the presence of perfect or imperfect monitoring. In the literature, effort is monitored imperfectly. A belief commonly held in this literature is that in the presence of perfect monitoring, support for the agent is never withdrawn by the principal since the efficient level of effort is exerted by the agent in equilibrium in response to a forcing contract. This belief is incorrect

[1]For principal-agent models of political competition, see Ferejohn (1986), Cukierman and Meltzer (1986), Rogoff and Sibert (1988), Austen-Smith and Banks (1989), Banks (1990), Rogoff (1990) and Banks and Sundaram (1991). For dictatorship models, see Grossman and Noh (1990), Olson (1991,1993), O'Flaherty (1991) and Grosman (1991). Our model draws on the work of Green and Porter (1984), Shapiro and Stiglitz (1984), Ferejohn (1986), Olson (1991,1993), and O'Flaherty (1991).

under Assumption 1, however, since support for the agent may be withdrawn in the presence of perfect or imperfect monitoring. In the model, we assume that the principal can monitor the agent perfectly not because we believe that perfect monitoring occurs in reality. We do so in order to provide insights into the effect that Assumption 1 has on the principal-agent model used in the political economy literature. The predictions of our model are consistent with the stylized facts in the literature, and remain so in the presence of imperfect monitoring[2] so that our results do not rely on the assumption of perfect monitoring.

In common with the principal-agent models in the political economy literature, the threat of leadership turnover disciplines the actions of the leader. In our model, leadership turnover also provides each member of the subgroup with a chance to change status. In the unique Markov trembling-hand perfect equilibrium (MTHPNE), the subgroup "votes" for leadership turnover whenever the expected capital gain of a change in status is larger than the flow of benefits of remaining as kingmaker. Furthermore, the unique MTHPNE that we find remains an equilibrium in several extensions of the model: imperfect monitoring, correlation of shocks across periods, the dependence of rents on the shock, the dependence of future production on current effort, the availability of bribes, and the uncertain success of a coup. Lastly, the unique MTHPNE that we find yields predictions that conform with the stylized facts in the literature.

2. Related Literature

In the dictatorship model of O'Flaherty (1991), a dictator's strength in office depends on the support of a core group. In the absence of uncertainty, O'Flaherty finds that the dictator is never ousted. In the case of variable dictator ability, he obtains that dictators are either ousted in the first period or rule forever.[3] Thus,

[2] In an extension of the model, we assume (as does Ferejohn, 1986) that information is skewed in favour of the dictator. See the details in a footnote following Theorem 4.1.

[3] O'Flaherty conjectures that a marriage of his model with an on-the-job screening model might explain the stochastic nature of the exit probabilities that are observed empirically.

O'Flaherty's turnover rate decreases from the first period to the second but stays constant at zero forever after. By contrast, we provide a model that is consistent with the stylized facts on leadership turnover given above.

In a non-interactive optimization model of tinpot dictatorship, Wintrobe (1990) assumes that tinpot dictators minimize the costs of staying in power in order to continue to reap its benefits. The aim of his paper is to explain the changes in repression that occur with changes in economic performance. Coups d'état do not occur in his model.

In the electoral competition model of Ferejohn (1986), an office holder observes the value of a random variable and then takes an action. Though the primitive assumptions of his model and ours are related, the aims differ. Ferejohn is interested in the ability of the electorate to control the office holder as a function of the competition between parties. We are interested in the stochastic nature of leadership turnover as a function of the economy and the number of kingmakers.

In an infinite horizon asymmetric information model of electoral competition, Banks and Sundaram (1993) consider a median voter who elects a candidate to perform a costly task. In common with the explanation proposed in Bienen and van de Walle (1991) for the declining hazard rate, Banks and Sundaram obtain that under variable leader ability, the probability of re-election increases with an incumbent's length of time in office. They are interested in how voters choose election rules to mitigate against the presence of moral hazard and adverse selection. Observable exogenous shocks have no effect on leadership turnover. By contrast, we are interested in how the economy affects non-electoral leadership turnover. If the data exhibit negative effects of observable exogenous shocks on coups d'état then our model can explain the phenomenon.

3. The Model

The model that we use is applicable to leadership turnover in a variety of groups. Our model has implications for political party leadership turnover since party leadership depends on support from the party caucus and future leaders are chosen from a select group[4]. It has implications for dictatorship turnover since a newly installed dictator is invariably found to be a member of the subgroup of "kingmakers" who participated in the coup. We cast our model in the framework of a dictator and a subgroup of kingmakers. Luttwak (1979, p.35) argues that one precondition for a coup is the existence of a small, educated, well-fed élite in whose hands power lies. He states (p.38) that the benefits of a coup are clear when power is concentrated in a small élite. We abstract away from the planning, decision-making, and risk taking of the coup maker. Instead we concentrate on the élite whose cooperation is necessary to stage a coup or maintain a leader.

The game is played over an indefinite number of periods. The set of players consists of a dictator and an infinite supply of kingmakers, n of whom are *active* and own equal shares in an export firm in any given period. At the beginning of each period, the players observe the random price, p, of the export. The price is independent and identically distributed each period[5] (i.i.d.) according to a distribution function F whose support is $[0, \infty)$.

At the beginning of each period, the dictator receives a fixed rent[6], W, from the citizens, sees the price, p, and chooses how much effort, $x \in [0, 1]$, to exert on a public good that positively affects the profits[7] of the export firm. The period payoff[8] to a dictator who chooses x is $W - C(x)$ where $C : [0, 1] \rightarrow \Re^+$ is an increasing, convex, non-negative, real-valued function with $C(0) = 0$. The lifetime payoff to a dictator is the discounted sum of the period payoffs from the period of initial incumbency up to and including the first period in which kingmakers

[4]Margaret Thatcher's exit as leader of Britain was due to the loss of support of her party.

[5]Our predictions remain intact if we relax this assumption. See the footnotes following the main theorem.

[6]The predictions of the model remain if the rent depends on the price in each period. See the footnote in the proof following the main theorem.

[7]The predictions of our model remain if we allow current effort to affect future production. See the footnotes in Section 4.1.

[8]In Ferejohn (1986), the office holder sees a random variable θ and chooses how much effort to exert on the voters' behalf. The period payoff to an office holder who exerts effort a is $W - \phi(a)$.

decide to stage a coup against the dictator.

In each period, subsequent to observing the dictator's effort and the price of exports[9], the group of *active* kingmakers decides whether to stage a coup that overthrows the dictator. A coup is staged only if each *active* kingmaker chooses to stage a coup[10]. The *active* kingmakers receive period dividends that depend negatively on the probability of a coup and positively on both the exogenous price and the effort expended by the dictator. (Alternatively, the exogenous fluctuations in the kingmakers' payoffs could be due to aggregate changes in weather or tastes, for example.) If the *active* kingmakers stage a coup, the dictator is replaced by a randomly chosen *active* kingmaker who is, in turn, replaced by an *inactive* kingmaker; each *active* kingmaker's payoff in this period is 0. If the *active* kingmakers do not stage a coup, each *active* kingmaker's period payoff[11] is $pY(x)/n$ where $Y : [0, 1] \to \Re^+$ is an increasing, concave, non-negative, real-valued function with $Y(0) = 0$. The lifetime payoff of an *active* kingmaker is the discounted sum of the period payoffs that the kingmaker receives while *active,* plus the expected payoff that the kingmaker receives if chosen to be dictator after a coup is staged. The common discount factor is $\delta \in (0, 1)$. Inactive kingmakers receive no payoff while inactive. In what follows we use the term kingmaker to refer to an *active* kingmaker.

4. Equilibrium

Formally, the model is stochastic in nature. The payoffs to the players in each period are determined solely by the observed price and current actions so that the past does not influence the current opportunity set directly. After seeing the price, the dictator chooses a level of effort. After seeing the price and the effort level,

[9] The predictions of the model remain if we assume that kingmakers observe the dictator's effort with noise. See the footnotes following the main theorem.

[10] The predictions of the model remain if we allow the dictator to bribe a kingmaker directly. See the footnotes following the main theorem.

[11] In Ferejohn (1986), the voter receives $u(a, \theta)$ where a is the effort exerted by the office holder and θ is a random variable.

each kingmaker decides whether or not to stage a coup. There are a multitude of Nash equilibrium outcomes in the model[12]. There are two approaches one might take to narrow down the set of equilibria. One might appeal to a refinement that is compelling or one might appeal to the empirical evidence.

We first restrict to Markov equilibria. The Markov refinement can be justified on both theoretical and empirical grounds. As the only payoff relevant history is the current price, it is reasonable to look for an equilibrium strategy profile in which the strategy in period i depends only on observables in period i. In addition, there is empirical evidence that suggests that it is current economic variables that affect the probability of a coup. Alesina et al. (1996) find (in two separate regressions) that the probability of a coup is significantly affected by either current or lagged GDP growth[13] and other variables.[14] However, the coefficient on lagged growth is insignificant when the probability of a coup is estimated using both current and lagged growth in a single equation. Since current growth and lagged growth are correlated this explains why the coefficient on lagged growth is significant in a separate regression even if the true model is that in which the probability of a coup is affected directly by current growth only. We conclude that the empirical evidence is consistent with the use of Markov equilibria.

There remain a plethora of Markov Nash equilibria in the model. There are Markov equilibria in which no leader is ousted because every kingmaker expects at least one other kingmaker not to oust. Each kingmaker's strategy is to support the dictator regardless of the effort exerted. The strategies are equilibrium strategies because a kingmaker who expects that at least one other kingmaker will not stage a coup is indifferent between ousting or not because unanimity is required to stage a coup. However, these equilibria are not trembling hand perfect. Trembling hand

[12]There is a Nash equilibrium in which the players use infinite punishment to support an outcome in which a coup is never staged. The model also has an equilibrium in which the representative kingmaker always chooses to stage a coup and the dictator exerts zero effort.

[13]See the Conclusion for a detailed discussion of the relationship between GDP growth and the probability of a coup in our model.

[14]As do Londregan and Poole (1990,1992).

perfection in a game of imperfect information is the analog of subgame perfection in a game of perfect information. When it is in a kingmaker's interest to want a coup, the kingmaker is better off to set the stage (that is vote yes) just in case all others also do so. The kingmaker never loses by doing so and might gain, so that trembling hand perfection requires that the kingmaker sets the stage for a coup whenever the kingmaker would like a coup to occur. Then, if all other kingmakers have also done so, a coup will occur. Otherwise, a coup will not occur. We argue below that if we refine our notion of Markov Nash equilibrium to that of Markov trembling hand perfection then this is equivalent to refining our solution concept to that of a Markov subgame perfect equilibrium in the game between the dictator and a representative kingmaker. We justify the restriction to trembling hand perfect equilibria on theoretical grounds. We take the view that equilibria that are supported by incredible threats are not compelling.

The kingmakers act simultaneously and so any kingmaker's information is imperfect regarding the simultaneous actions of the other kingmakers. However, both the dictator and the kingmakers are perfectly informed of previous actions. If we demand that the equilibrium be trembling hand perfect then since kingmakers' payoffs are perfectly aligned, each kingmaker is representative of the others. In essence, we require unanimity among the homogeneous kingmakers when a coup is staged. If we use a representative kingmaker, there is perfect information between the representative kingmaker and the dictator so that to look for a trembling hand perfect equilibrium is to look for a subgame perfect equilibrium in the game between the dictator and the representative kingmaker.

Though there is a multitude of Nash equilibria in the game, we prove that there is only one equilibrium outcome that is a Markov trembling-hand perfect Nash equilibrium (MTHPNE). That is, there is a unique Markov subgame-perfect Nash equilibrium (MSPNE) outcome in the game between the dictator and the representative kingmaker. Predictions based on this unique outcome[15] are consistent

[15]We do not examine whether there are non-Markov-trembling-hand perfect equilibria that are also consistent with the stylized facts. If such equilibria do exist, then the test of which

with the stylized facts on leadership turnover.

Thus, we look for a Markov strategy profile in which the state is the current price. A Markov strategy for a dictator is a function $X : [0, \infty) \rightarrow [0, 1]$ that transforms prices into effort levels. A Markov strategy for a kingmaker is a function $S : [0, \infty) \times [0, 1] \rightarrow \{0, 1\}$ that transforms the current price and effort into a decision to stage a coup (denoted by 1) or not to stage a coup (denoted by 0)[16].

Since, in each subgame, only the current price influences strategies directly, if all other players use Markov strategies then a player has a best response that is also a Markov strategy. Thus, a MSPNE in the game between the dictator and a representative kingmaker is an equilibrium in the game in which players are not restricted to Markov subgame perfect strategies. (See Fudenberg and Tirole (1992, ch. 13) for more discussion of Markov perfect equilibria.)

4.1. The best response function of a representative kingmaker

As stated in Abreu (1988), in a repeated game with discounting, a strategy profile is a subgame perfect equilibrium if and only if no player can gain by deviating in a single period after any history. (For a proof of the statement, see Fudenberg and Tirole, 1992, Theorem 4.2, p. 110 or Osborne and Rubinstein, 1994, p. 153.) This result applies to our game. To check whether a pair (X, S) of Markov strategies is a subgame perfect equilibrium we can restrict attention to alternative strategies that differ from a player's designated strategy only in the actions prescribed in any one period. We begin with the best response function of a kingmaker. A kingmaker's payoff in any period depends positively on both the dictator's effort and the price. This has two implications for a kingmaker's best response function. If a kingmaker's best response is to stage a coup for some effort level x when facing a given price p, then the kingmaker's best response is to stage a coup for any effort

equilbrium to choose is an empirical question.

[16]We make the polar assumption that the probability of success is 1 when a coup is staged. The essence of the model is not changed if we relax this assumption. The free rider problem associated with the relaxed assumption is solved by requiring unanimity among the kingmakers when a coup is staged.

level less than x. If a kingmaker's best response is to stage a coup for some price p and effort level x, then the kingmaker's best response is to stage a coup for any price less than p when facing x. Thus, when facing a price p and a strategy X of the dictator, there is a reservation function $R_k(X, p)$ (non-increasing in p) such that only for $x < R_k(X, p)$ does the kingmaker strictly prefer to stage a coup.

What is a kingmaker's optimal reservation standard when a dictator exerts effort x and the price is p? If the kingmakers choose not to stage a coup and thereby maintain the status quo, then each kingmaker earns $pY(x)/n$ from exports in this period and expects to earn $\delta\mathbf{E}K$ in the ensuing periods where K represents the present value of a kingmaker's maximum earnings and $\mathbf{E}$ denotes the expectation operator over $p \in [0, \infty)$. The benefit of remaining as kingmaker, or equivalently, the opportunity cost of a coup is therefore $(pY(x)/n) + \delta\mathbf{E}K$. If the kingmakers choose to stage a coup and thereby take an opportunity to change status, then each kingmaker earns zero this period. In the subsequent period, each kingmaker remains a kingmaker with probability $(n-1)/n$ and changes status by becoming a dictator with probability $1/n$. Thus, when the kingmakers choose to stage a coup, each kingmaker earns $[\delta\mathbf{E}K(n-1)/n] + [\delta\mathbf{E}D/n]$ (which represents the expected capital gain of changing status and so is the benefit of a coup) where D represents the present value of a dictator's maximum earnings. Formally, a kingmaker's maximization problem is a stationary dynamic programming problem for which the Bellman equation is

$$K(p) = \max\left\{p\frac{Y(x)}{n} + \delta\mathbf{E}K, \frac{n-1}{n}\delta\mathbf{E}K + \frac{1}{n}\delta\mathbf{E}D\right\} \tag{4.1}$$

Subgame perfection requires that the representative kingmaker chooses to stage a coup whenever the opportunity cost of a coup (the benefit of remaining as kingmaker) is less than the benefit of a coup (the expected capital gain of a change in status) (i.e. $x < Y^{-1}(\delta[\mathbf{E}D - \mathbf{E}K]/p)$) and to avert a coup whenever the opportunity cost is greater than the benefit (i.e. $x > Y^{-1}(\delta[\mathbf{E}D - \mathbf{E}K]/p)$). Thus, formally, a best response[17] of a kingmaker to the dictator's strategy X is

[17] The kingmaker is indifferent between staging and averting a coup when $x = Y^{-1}(\delta[\mathbf{E}D -$

the strategy

$$S(p,x) = \begin{cases} 1 & \text{if} \quad x < Y^{-1}(\frac{\delta[\mathbf{E}D - \mathbf{E}K]}{p}) \\ 0 & \text{if} \quad x \geq Y^{-1}(\frac{\delta[\mathbf{E}D - \mathbf{E}K]}{p}) \end{cases}$$

We call such a strategy a *reservation strategy* with reservation standard function $R_k(X,p) = Y^{-1}(\delta[\mathbf{E}D - \mathbf{E}K]/p)$.

Note that the kingmakers' variable reservation standard decreases[18] in p since Y is increasing in effort. That is, the effort required of the dictator to avert a coup decreases in p. The intuition for this fact is as follows. The benefit of a coup to a kingmaker derives from the chance to become a dictator tomorrow. The benefit of being a dictator tomorrow derives from the stream of future export prices and so is independent of the present price. The net[19] opportunity cost of a coup is the product of the export price and the effort exerted by the dictator. The kingmakers' reservation standard is the level of effort that compensates the kingmakers exactly for a change in price. As the export price decreases, the compensating level of effort must increase so that the reservation standard decreases in price.

4.2. The best response function of a dictator

As the only feasible MSPNE strategy of a representative kingmaker is a reservation strategy, we need to find the best response of a dictator to strategies of this kind. Suppose that a dictator faces a reservation strategy of the representative kingmaker that has a decreasing reservation standard $r_k(p)$. The probability of a

$\mathbf{E}K]/p)$. Consequently, the kingmaker's best response is to stage a coup with probability $q \in [0,1]$ when $x = R_k(X,p)$. However, as shown in a footnote below, the only candidate for an equilibrium reservation strategy is that in which $q = 0$ when $x = R_k(X,p)$.

[18] In the above analysis, the effort of a dictator in any period does not permanently affect output. The kingmaker's reservation standard may decrease in p even in the case that the dictator's effort does permanently affect output. Let $\rho(x) = \delta(\mathbf{E}D - \mathbf{E}K)(x)$. Suppose that $\rho(x)$ and $pY(x)$ are concave and increasing in x and that for each p there exists a unique point of intersection. Note that at $x = 0$, $\rho(0) > 0$ while $pY(0) = 0$ so that $\rho(x)$ is above $pY(x)$ for x below the intersection and is below for x above the intersection point. Let $p_1 < p_2$. Let x_i represent the unique intersection of $p_iY(x)$ with $\rho(x)$. Since $p_1Y(x) < p_2Y(x)$ for all x, it must be that $\rho(x_1) = p_1Y(x_1) < p_2Y(x_1)$ so that $x_1 > x_2$. Thus, since the kingmaker's reservation standard equates $\rho(x)$ to $pY(x)$, the reservation effort decreases as price increases.

[19] Net of $\delta\mathbf{E}K$.

coup is one unless the dictator exerts effort greater than or equal to the variable reservation standard. A dictator's payoff in any period is independent of p but depends negatively on both the dictator's effort and on the probability that a coup is staged. Thus, the dictator either exerts zero effort or meets the kingmakers' reservation standard. However, the reservation standard decreases in p. This has two implications for a dictator's best response. If a dictator's best response is to exert zero effort for some price p, then a dictator's best response is to exert zero effort for all prices less than p. If a dictator's best response is to meet the kingmakers reservation value $r_k(p)$ for some price p, then a dictator's best response is to meet the variable reservation standard for all prices greater than p. Thus, when facing a decreasing reservation standard of the kingmakers, there is a reservation value $R_d(r_k)$ (independent of p) such that only for $r_k(p) \leq R_d(r_k)$ does the dictator meet the kingmakers' variable reservation standard. We are now able to calculate the dictator's optimal reservation value $R_d(r_k)$ in response to the kingmakers' reservation strategy that has decreasing reservation standard r_k.

The incumbent dictator wants to maximize lifetime earnings and faces the price p this period. If the dictator exerts zero effort, then a coup is staged and the dictator earns W in this period and zero ever after. If the dictator exerts effort $r_k(p)$, a coup is averted, and the dictator earns $W - C(r_k(p))$ in this period and then continues as dictator in the next period. The dictator meets the kingmakers' variable reservation standard when it is lower than the maximum effort that the dictator is willing to exert (given W and the future benefit of remaining as dictator). Formally, the maximization problem that the dictator faces is a stationary dynamic programming problem for which the Bellman equation is

$$D(p) = \max\{W - C(r_k(p)) + \delta \mathbf{E}D, W\} \tag{4.2}$$

where we recall that $\mathbf{E}D$ is the expected present value of a dictator's maximum earnings. We note that $\mathbf{E}D$ depends on the kingmakers' reservation standard. Subgame perfection requires that the dictator choose to meet the kingmakers' standard whenever the cost of doing so is less than the benefit of remaining as dictator (i.e., $r_k(p) \leq C^{-1}(\delta \mathbf{E}D)$). Thus, formally, the best response of a dictator to the kingmakers' reservation standard r_k is the strategy

$$X(p) = \begin{cases} 0 & \text{if} \quad r_k(p) > C^{-1}(\delta \mathbf{E}D_{r_k}) \\ r_k(p) & \text{if} \quad r_k(p) \leq C^{-1}(\delta \mathbf{E}D_{r_k}) \end{cases}$$

We call such a strategy a *reservation strategy* with reservation value

$$R_d(r_k) = C^{-1}(\delta \mathbf{E}D_{r_k}) \tag{4.3}$$

that is independent of the current price. If $r_k(p) = C^{-1}(\delta \mathbf{E}D_{r_k})$ then the dictator is indifferent between exerting effort $r_k(p)$ and 0 and strictly prefers either to any other effort[20]. Thus, a dictator's best response is to exert positive effort $r_k(p)$ when $r_k(p) < C^{-1}(\delta \mathbf{E}D_{r_k})$ and to exert zero effort when $r_k(p) > C^{-1}(\delta \mathbf{E}D_{r_k})$.

4.3. The trigger price associated with a pair of best response functions

The only strategy profiles that are candidates for a MTHPNE are pairs of reservation strategies for the dictator and representative kingmaker. A dictator uses a reservation strategy with a reservation value r_d that is independent of price. A representative kingmaker uses a reservation standard function $r_k(p) = Y^{-1}(\delta[\mathbf{E}D - \mathbf{E}K_{r_d}]/p)$ that maintains equality between the fixed benefit and the cost of a coup and therefore decreases from ∞ to 0 as p increases. (We note that both $\mathbf{E}D$ and $\mathbf{E}K$ depend on r_k and r_d.) This implies that there exists a unique intersection point of the reservations at the trigger price

$$T(r_d) = \frac{\delta[\mathbf{E}D - \mathbf{E}K_{r_d}]}{Y(r_d)}. \tag{4.4}$$

[20]If the kingmakers' reservation standard is r_k and a coup is staged with probability $q \in (0, 1]$ when $x = r_k(p)$ then, as above, the dictator strictly prefers to exert zero effort when $r_k(p) > C^{-1}(\delta \mathbf{E}D_{r_k})$. When $r_k(p) < C^{-1}(\delta \mathbf{E}D_{r_k})$ the dictator strictly prefers to avert a coup by exerting effort $x \in (r_k(p), C^{-1}(\delta \mathbf{E}D_{r_k}))$ rather than precipitate a coup by exerting zero effort or effort $r_k(p)$. Since the dictator's payoff decreases in effort, the dictator would like to be strictly above but as close as possible to $r_k(p)$. Thus, there is no strict best response of the dictator to such a reservation strategy of the kingmakers. Therefore, kingmakers' reservation strategies that are feasible equilibrium strategies are those in which the variable reservation standard decreases in p and a coup is staged with probability $q = 0$ when the dictator's effort x meets the kingmakers' reservation value $r_k(p)$.

For prices above $T(r_d)$, the representative kingmaker's reservation value $r_k(p)$ is less than the dictator's reservation value r_d, so that the dictator exerts the required effort and a coup is averted. For prices below $T(r_d)$, the representative kingmaker's reservation value $r_k(p)$ is greater than the dictator's reservation value r_d, so that the dictator exerts zero effort and a coup[21] is staged. At the trigger price, $r_k(T(r_d)) = r_d$ so that the representative kingmaker's reservation value equals the dictator's reservation value which implies that the dictator is indifferent between meeting the reservation standard and exerting zero effort. Thus, a coup is staged only for prices below the trigger.

4.4. Existence and Uniqueness of Equilibrium

Now that we have winnowed the feasible MTHPNE strategy profiles to be reservation strategy profiles[22], we look for a pair of reservation strategies such that each is a best response to the other. The dictator's equilibrium strategy $X^*(p)$ is a reservation strategy with the following properties: exert effort 0 if the price $p < T(r_d^*)$, the equilibrium trigger price; exert effort $r_k^*(p)$ (the kingmakers' equilibrium reservation standard), if the price $p \geq T(r_d^*)$, the equilibrium trigger price. The kingmakers' equilibrium strategy $S^*(p, x)$ is a reservation strategy with the following properties: stage a coup if the dictator's effort $x < r_k^*(p)$, the kingmakers' equilibrium reservation standard; maintain the status quo if the dictator's effort $x \geq r_k^*(p)$, the kingmakers' equilibrium reservation standard.

The theorem and corollary below state that the equilibrium values for the trigger price, the kingmakers' reservation standard, the dictator's reservation value, and the lifetime payoffs are unique.

Theorem 4.1. *The unique (up to a set of measure zero) Markov, trembling-hand*

[21] If the probability of success of a coup attempt were less than 1 then the kingmaker's reservation value would be lower and the trigger price would be lower. However, the basic insight remains. Coups occur when prices are low enough.

[22] We cannot tie down the dictator's strategy exactly at the trigger price $T(r_d)$ since any distribution over $\{r_k(T(r_d)), 0\}$ is a best response of the dictator and the kingmakers' best response is not dependent on the distribution that the dictator uses at the trigger price.

perfect Nash equilibrium is the pair of reservation strategies (X^*, S^*) *for which the present value of a dictator's lifetime equilibrium earnings, is* $\mathbf{E}D^*$, *the unique solution, in* $\mathbf{E}D$, *to*

$$\mathbf{E}D = W + \int_{T(C^{-1}(\delta\mathbf{E}D))}^{\infty} \left\{ \delta\mathbf{E}D - C \circ Y^{-1} \left(\frac{\delta\mathbf{E}Dn(1-\delta)}{p[n(1-\delta)+\delta]} \right) \right\} dF(p).$$

Proof. See the Appendix[23] for the details. Recall that trembling-hand perfection in the original game is equivalent to subgame perfection in the game between the dictator and representative kingmaker. ■

Corollary 4.2. *In the unique Markov, trembling-hand perfect Nash equilibrium for which* $\mathbf{E}D^* \in (W, W/(1-\delta))$ *is the present value of a dictator's lifetime equilibrium earnings, the dictator's reservation value is* $r_d^* = C^{-1}(\delta\mathbf{E}D^*)$, *the present value of a kingmaker's equilibrium lifetime earnings is*

$$\mathbf{E}K^* = \frac{\delta\mathbf{E}D^*}{n(1-\delta)+\delta},$$

the kingmakers' reservation standard is

$$r_k^*(p) = Y^{-1} \left(\frac{\delta\mathbf{E}D^* n(1-\delta)}{p[n(1-\delta)+\delta]} \right),$$

and the positive trigger price is

$$T(r_d^*) = \frac{\delta\mathbf{E}D^* n(1-\delta)}{Y \circ C^{-1}(\delta\mathbf{E}D^*)[n(1-\delta)+\delta]}. \quad (4.5)$$

Proof. That the trigger price is positive follows from the fact that $\mathbf{E}D^* \in (W, W/(1-\delta))$ and $\delta \in (0,1)$. The rest of the Corollary follows immediately from the proof of Theorem 4.1 in the Appendix. ■

[23] If the rent, W, depends on the price, p, in each period, then the only change to the statement of the theorem occurs in the equation whose solution equals the expected lifetime earning of the dictator. We need only replace W with $\mathbf{E}W$ in this equation to obtain the correct statement of the theorem in this case.

Our model has a unique MTHPNE. This equilibrium remains an equilibrium in extensions of the model in which information is imperfect[24], prices are serially correlated[25], or bribes are available[26]. In equilibrium, the dictator is ousted whenever the export price is below some trigger price so that the probability of a coup is non-increasing in price.

[24]If we follow Ferejohn (1986) and assume that information is asymmetric and skewed in favour of the dictator rather than symmetric as in our basic model, then the results remain intact. For example, suppose that the price p is observable only by the dictator. After observing p, the dictator exerts effort x. The effort x is unobservable by the kingmakers. The kingmakers observe the value $pY(x)$ before deciding whether to stage a coup. In this case, the results are analogous to those obtained in the basic model. Alternatively assume that p is observable by all agents but let θ be a shock that is observable by the dictator but not by the kingmakers. After observing p and θ, the dictator exerts effort x. The effort x is unobservable by the kingmakers. The kingmakers observe p and the value $x\theta$ before deciding whether to stage a coup. Again, the results are analogous to those obtained in the basic model.

[25]When prices are serrially correlated rather than i.i.d. as in our basic model, we can obtain equations that are analogous to those obtained in the basic model. The equilibrium strategy of the representative kingmaker is a reservation strategy S with reservation standard function $Y^{-1}(\delta[\mathbf{E}_p D - \mathbf{E}_p K]/p)$ and the equilibrium strategy of a dictator is a reservation strategy with reservation value $C^{-1}(\delta \mathbf{E}_p D)$ where $\mathbf{E}_p$ represents the expectation operator conditional on the price p in the previous period. Thus a coup is staged in a period if and only if the price $p < \delta[\mathbf{E}_p D - \mathbf{E}_p K]/Y \circ C^{-1}(\delta \mathbf{E}_p D)$. For any p from last period, the dictator's expected earnings today lie between W and $W/(1-\delta)$ so that the denominator is a positive finite number. So long as $\delta[\mathbf{E}_p D - \mathbf{E}_p K]$, the expected capital gains, is strictly positive, the numerator is a positive finite number. In this case, the right-hand side of the above inequality is a strictly positive finite number. Since the left-hand side lies between 0 and ∞, we can conclude that no coup is staged when the price is high enough and that a coup is staged when the price is low enough. While we have not shown that the expected capital gain is generally positive for any stochastic process, we have worked out the details of an example in which the price today equals that of yesterday with probability greater than 0.5. In the example, the expected capital gain is indeed positive and there exists a trigger price as in the basic model.

[26]In the basic model, the dictator bribes *all* kingmakers *indirectly* by exerting costly effort. There is no possibility for the dictator to bribe *one* of the kingmakers *directly* by a transfer that convinces a co-opted kingmaker to support the dictator rather than agree to a coup. Suppose instead, that in each period, after the price p is observed, the dictator must choose x (how much effort to exert), τ (how much money to transfer to kingmaker i), and $i \in \{1, 2, ..., n\}$, whom to bribe directly. The dictator pays a direct bribe to a co-opted kingmaker in the hopes that the kingmaker will block a coup desired by the non-co-opted kingmakers. Unless the co-opted kingmaker expects future direct transfers, the one time payment does not affect the kingmaker's decision. Therefore the MSPNE that we find in the basic model remains an equilibrium in this extension.

5. Comparative Statics

From equation 4.5 we know that a coup occurs in equilibrium only when the price is below the trigger price

$$T(C^{-1}(\delta \mathbf{E}D^*)) = \frac{\delta \mathbf{E}D^* n(1-\delta)}{Y \circ C^{-1}(\delta \mathbf{E}D^*)[n(1-\delta)+\delta]}.$$

Therefore, the probability that a coup occurs in a period (also known as the hazard rate) is the probability that the price is less than or equal to the equilibrium trigger price. Thus, coups follow a binomial distribution for which the equilibrium probability that a coup occurs in any period is $F(T(C^{-1}(\delta \mathbf{E}D^*)))$. As the trigger price increases, a coup is more likely to occur in any given period. We now use Theorem 4.1 to provide two comparative static results on the effects of changes in $Y \circ C^{-1}$ and n on the trigger price. The function $Y \circ C^{-1}$ represents the production of private good in our model.[27] However, Y depends directly only on the dictator's effort so that any change in labour, capital, or technology represent a shift in $Y \circ C^{-1}$. The first comparative static states, in effect, that an increase in education, say, decreases the hazard rate.

Corollary 5.1. *If $Y \circ C^{-1}(x) = \Delta g(x)$ (where g is increasing and concave) is the production function, then the equilibrium hazard rate of a coup falls as Δ rises.*

Proof. See the Appendix. ■

An increase in Δ is equivalent to an upward shift in Y and/or a downward shift in C. Intuitively, as, say, the kingmakers' payoffs in the event of a coup (Y) increases, the net[28] benefits for any effort (which equal $pY(x)$) from remaining as kingmaker increases relative to the fixed expected net capital gain of a change in status (which equal $\delta \mathbf{E}Dn(1-\delta)/[n(1-\delta)+\delta]$) so that the kingmaker's reservation standard shifts down which implies that the hazard rate decreases for any given level of $\mathbf{E}D$.

[27]The cost of producing z units of private good using $Y^{-1}(z)$ units of effort is $C \circ Y^{-1}(z)$ so that its inverse $Y \circ C^{-1}$ represents the production function.

[28]Net of $\delta \mathbf{E}K$.

We next consider the effects of increasing the size of the group of kingmakers.

Corollary 5.2. *As the number n of kingmakers increases, the equilibrium hazard rate of a coup rises.*

Proof. See the Appendix. ■

This result follows from the fact that the spoils of dictatorship W remain fixed as n, the size of the subgroup, increases. To avert a coup, the dictator must transfer a portion of W (in the form of effort that affects the level of the public good) to the set of kingmakers. As n increases, for each price, the portion of W required to avert a coup by n kingmakers increases so that it is now more likely to be above the dictator's reservation level of effort. Thus, as n increases, the kingmaker's reservation standard shifts up while that of the dictator remains fixed for any given level of $\mathbf{E}D$ so that the hazard rate increases.

6. Declining Hazard Rate

In the basic model, the probability that a coup occurs is the probability that the price is less than the trigger price. Since the trigger price depends on the dictator's cost of exerting effort and the price in each period is independently drawn from a common distribution, the length of a dictator's term in office cannot affect the trigger price and so cannot affect the hazard rate in the basic model. However, Bienen and van de Walle (1991) find that the hazard rate declines with duration in office. The explanation that they propose is variable innate ability: if leaders differ in ability, then it would be expected that those of lower ability would be weeded out first. In common with the literature, we formalize variable ability as follows. We assume that the cost-of-effort function shifts down as the dictator's ability increases. In theorem B.1 in the appendix we show that, in the game between the dictator and the representative kingmaker, there exists a unique MTHPNE, which has the following properties.

As in the basic model, the kingmakers' equilibrium strategy is a reservation strategy. For each price, the kingmakers' reservation standard function is independent of the dictator in power and decreases in price. The kingmakers' reservation standard is the level of dictatorial effort that offsets the change in price. The compensating level of effort increases as the price decreases so that the kingmakers' reservation standard increases as the price decreases.

The equilibrium strategy of a dictator of type $i = 1, 2$ is to meet the representative kingmaker's reservation value whenever this is low enough relative to the dictator's reservation value. The dictator of higher ability has the higher reservation value. Thus, for each type of dictator, there is a trigger price. The higher is the dictator's ability, the higher is the dictator's reservation value, and so the lower is the trigger price.

In equilibrium, when the prices are low enough in a period, neither type of dictator meets the associated high levels of effort required, so that both types are ousted; when the prices are in some intermediate range, only the dictator of low ability exerts less than the associated levels of effort required and is ousted; when the prices are high enough, both types meet the associated low levels of effort required and no coup is staged. We can now use the fact that the dictator who has the higher ability has the lower trigger price to prove the following result.

Theorem 6.1. *In the presence of variable dictator ability the hazard rate declines with duration in office.*

Proof. See the Appendix. ■

This result is driven by the fact that the higher is the dictator's ability, the lower is the dictator's trigger price. Only the lower trigger price triggers a coup when the higher ability dictator is in power. The longer is a dictator's term in office, the higher is the probability that a price lower than the higher trigger price has occurred during the term. This implies that the longer is the dictator's term in office, the higher is the probability that the dictator has the lower trigger price. It follows that the hazard rate declines with duration.

Analogous results hold if the set of types of dictator is any finite set or an interval. In equilibrium, each kingmaker uses a reservation strategy with a reservation standard that decreases in price and depends on the expected capital gain of changing status and becoming a dictator of unknown type but is independent of the type of dictator currently in power. Each type of dictator exerts the effort required whenever it is low enough relative to the dictator's reservation value. The results follows from the fact that, for each type of dictator, there is an associated trigger price that decreases as the as the cost of effort increases across the different types.

7. Conclusion

Unlike the authors of previous electoral competition and dictatorship models of leadership turnover, we assume that the members of the subgroup whose support is necessary for the leader to stay in power have a chance of becoming the leader when there is turnover. In previous electoral models of political competition, the citizens vote against a candidate who is perceived to be less able to provide them with goods. In our framework, kingmakers might withhold support in order to punish a dictator for not providing effort. In addition, the kingmakers might withhold support in order to seize the opportunity to become the dictator when it is relatively cheaper to do so. Leadership turnover occurs in the equilibrium that we find. The MTHPNE that we find remains an equilibrium in the presence of imperfect monitoring, the availability of bribes, correlation of shocks across periods, the dependence of future production on current effort, the dependence of rents on the shock, and the uncertain success of a coup. We now examine how well our model conforms to the stylized facts.

Our model predicts that the hazard rate declines with duration. Bienen and van de Walle (1991) find that the length of time in office inversely affects the probability of leadership turnover in any given year. That is, their evidence is consistent with our predictions.

In our model, a rational leader chooses to exert zero effort when faced with a negative exogenous shock (i.e., low value of p). The negative shock is associated with low public investment (i.e., low value of x), low period profits of the kingmakers (i.e., low value of $pY(x)$) and a coup. We also find (in our first comparative static result) that as $Y \circ C^{-1}$ shifts up, the trigger price decreases so that the hazard rate falls. Thus, our model predicts that the probability of a coup decreases in public investment, profits of kingmakers, and economic productivity[29]. While we do not know of any empirical papers that measures these variables directly, each of the variables is correlated with GDP growth and INV so that we can proxy for these effects using either of these two measurable variables. GDP growth is correlated with an upward shift[30] in $Y \circ C^{-1}$ and both public investment[31] and private investment[32]. In addition, if we accept that kingmakers are the economic élites in less developed countries[33] (LDC's), and that per capita aggregate real investment[34] is an indicator of the well-being of the élites[35] then we can conclude

[29]The endogenous growth literature decomposes growth into components associated with changes in capital, labour, or increases in productivity. In our model, Y depends directly only on effort so that any change in these components represents a shift in $Y \circ C^{-1}$.

[30]An upward shift in $Y \circ C^{-1}$ can be associated with growth in GDP if the growh is associated with changes like capital, labour and productivity that also affect $Y \circ C^{-1}$. For example, an increase in education might shift $Y \circ C^{-1}$ and might result in GDP growth.

[31]INV and GDP growth are highly correlated.

[32]Public and private investment are complements (Green and Villanueva, 1991).

[33]Clarke (1995) finds that income inequality is significantly and negatively correlated with per capita GDP growth and per capita GDP. When inequality is high we can associate the kingmakers with the élite of a country, so that the existence of a group of kingmakers is associated with low levels of per capita real GDP.

[34]The higher is the sum of private and public investment, the higher is private investment.

[35]We first contend that the élites contribute to the bulk of private investment. Lecaillion et al. (1984) argue that the distribution of capital depends on the distribution of property. Since property is highly concentrated in LDC's, then so is capital. As there is a greater inequality of income from capital than there is from income from work, it is the property owners who invest. We now contend that private investment is a proxy for the well-being of the élites. Perotti (1994) states that in the presence of imperfect capital markets as in LDC's, investment by an individual in human and/or nonhuman assets is limited by the individual's initial wealth. Thus, the level of private investment is an indication of present wealth. It is then reasonable to assume that wealthy upper classes of the LDC's are the ones that have the greatest private investment capabilities. We can now infer that private investment is a proxy for the well-being of the élites.

that private investment is also a proxy for kingmaker profits. Lastly, INV is also a proxy for public investment. We predict, therefore, that the propensity for a coup declines with high GDP growth and high investment.

Londregan and Poole (1990, 1992) (controlling for other political and economic variables in a worldwide sample) and Londregan et al. (1995) (controlling for other political and economic variables in a sample of African countries) find that low per capita *lagged* real GDP[36] growth is associated with a high coup propensity in a given period. Alesina et al. (1996) (controlling for other political and economic variables in a worldwide sample) find that the higher the *current* growth rate, the lower the probability of a coup[37]. In addition, Gallego (1998) (controlling for other political and economic variables in a worldwide sample) finds that the coup propensity in a given period declines with per capita lagged aggregate real investment[38]. We conclude that the above evidence broadly supports our results.

Our second comparative static result is that as the size of the subgroup of kingmakers rises, the hazard rate rises. While we have not found any direct evidence linking changes in the size of the group of kingmakers with the hazard rate we have found evidence that is suggestive of our comparative static result.

In Londregan et al. (1995), there is evidence that relates the probability of an unconstitutional exit in African countries to the size of the leader's ethnic group. They create an ethnicity index that measures the share of the leader's group and that takes into account the degree of diffusion among the country's ethnic groups. Contrary to their expectations, they find, after controlling for relevant economic and political factors, that when the index increases beyond 0.5, the probability of a non-constitutional exit increases. If the size of the group of kingmakers increases

[36]Ideally, the current economic data at the time of exit should be used. However, the data consists of annual information on INV, GDP and hazard rates. The empirical literature on hazard rates uses economic variables from either the previous or the current year. The current year's economic variables are correlated with those of the previous year.

[37]These results are consistent with those of Londgregan and Poole since current and lagged growth rates are correlated. See our discussion at the beginning of Section 4.

[38]Gallego uses the Penn World Data which does not disaggregate INV into its private and public components. The results remain unchanged if INV or lagged INV are used.

as the ethnicity index increases[39] while holding other relevant factors constant, then this evidence supports the prediction that leadership turnover may increase as the size of the group of kingmakers increases[40].

Another prediction of the model is that an observable negative exogenous shock may increase the probability that a coup occurs if the shock is large enough and if the welfare of the kingmakers is dependent on the value of the exogenous parameter. If the data exhibit effects of +negative observable exogenous shocks on coups d'état then our model can explain the phenomenon. Lastly, our model predicts that the hazard rate rises or falls with the trigger price. The trigger price is a product of the ratio of the dictator's expected profits to output with a ratio involving the number of kingmakers and the discount factor. The existence of a significant correlation between the trigger price and the hazard rate would be a more direct test of the model.

Appendix

We now provide the proofs of all theorems and corollaries. We provide intuition for the results in the main text.

A. The Basic Model

Proof. (THEOREM 4.1): Since a MTHPNE in the original game is equivalent to a MSPNE in the game between the dictator and representative kingmaker, in what follows we show that there exists a unique MSPNE in the game between the

[39] It is reasonable to assume that as a particular ethnic group increases, its groups of élites increases. If we can associate the group of kingmakers with the group of élites in the leader's ethnic group then, as the ethnicity index increases (while holding other relevant political and economic variables constant) the group of kingmakers increases.

[40] After controlling for other political variables and duration, Bienen and van de Walle (1991, p.87) find that the hazard rate in Latin America falls as the proportion of the population that is of European descent rises. As they do not control for economic variables (e.g., GDP growth, or any of its components) which are associated (as discussed above) with an upward shift in $Y \circ C^{-1}$, their result is not inconsistent with either the African empirical evidence or our comparative static result.

dictator and representative kingmaker. The idea of the proof is as follows. Two reservation strategies are best responses to each other conditional on a given pair of payoffs. Such a strategy pair is a MSPNE if and only if there exists a pair of payoffs that are consistent with the strategy pair. There exist consistent payoffs if and only if the expected lifetime payoff of the dictator satisfies the defining equation in Theorem 4.1. We then show that there always exists a unique solution to the above equation. We now provide the details.

We have shown that if X is an equilibrium strategy of the dictator then X must be a reservation strategy. The best response of the representative kingmaker to X is a reservation strategy S with reservation standard function $Y^{-1}(\delta[\mathbf{E}D - \mathbf{E}K]/p)$ where K and D solve the Bellman equations 4.1 and 4.2 of the representative kingmaker and dictator respectively. The dictator's optimal reservation standard is $C^{-1}(\delta\mathbf{E}D)$ as shown in the text. If the dictator exerts effort equal to the kingmakers' reservation standard then each kingmaker is indifferent between staging a coup or not. Each kingmaker expects to earn $[\delta\mathbf{E}K(n-1)/n] + [\delta\mathbf{E}D/n]$ if a coup is staged. For prices above the trigger price, the representative kingmaker's optimal reservation standard is less than the dictator's reservation value so that the dictator exerts effort equal to the representative kingmaker's reservation standard, a coup is averted, and each kingmaker earns $[\delta\mathbf{E}K(n-1)/n] + [\delta\mathbf{E}D/n]$. For prices below the trigger price, the representative kingmaker's optimal reservation standard is greater than the dictator's reservation value so that the dictator exerts zero effort and each kingmaker earns $[\delta\mathbf{E}K(n-1)/n] + [\delta\mathbf{E}D/n]$. Thus, the kingmakers' earnings are independent of price and

$$\mathbf{E}K = \frac{\delta\mathbf{E}K(n-1)}{n} + \frac{\delta\mathbf{E}D}{n}$$

which implies

$$\mathbf{E}K = \frac{\delta\mathbf{E}D}{n(1-\delta)+\delta} \tag{A.1}$$

so that the relationship between the present values of the equilibrium earnings is as stated in Corollary 4.2. We can now substitute for $\mathbf{E}K$ in $Y^{-1}(\delta[\mathbf{E}D - \mathbf{E}K]/p)$ to obtain that the representative kingmaker's reservation standard is $Y^{-1}(\delta[n\mathbf{E}D(1-\delta)]/p[n(1-\delta)+\delta])$ where $\mathbf{E}D$ is the present value of the dictator's equilibrium earnings as stated in the Corollary.

Now, if (X, S) is an equilibrium, it must be the case that X is a best response to S so that the reservation value associated with X equals the reservation value associated with the best response to S. This implies that $C^{-1}(\delta\mathbf{E}D) = R_d(C^{-1}(\delta\mathbf{E}D))$ where D solves the dictator's Bellman equation 4.2. We can then substitute for $\mathbf{E}K$ from equation A.1 into equation 4.4 to obtain that the equilibrium trigger price is

$$T(C^{-1}(\delta\mathbf{E}D)) = \frac{\delta\mathbf{E}Dn(1-\delta)}{Y \circ C^{-1}(\delta\mathbf{E}D)[n(1-\delta)+\delta]}$$

as stated in the Corollary.

The above pair of strategies (X, S) is a MSPNE if and only if the expected earnings of the dictator is the solution in $\mathbf{E}D$ to

$$\mathbf{E}D = \int_0^{T(C^{-1}(\delta\mathbf{E}D))} W dF(p) \quad +$$

$$\int_{T(C^{-1}(\delta\mathbf{E}D))}^{\infty} \{W + \delta\mathbf{E}D - C \circ Y^{-1}\left(\tfrac{\delta[\mathbf{E}D-\mathbf{E}K]}{p}\right)\} dF(p)$$

The right-hand side of this equation can be simplified so that a MSPNE exists if and only if there exists a solution to the equation below

$$\mathbf{E}D = W + \int_{T(C^{-1}(\delta\mathbf{E}D))}^{\infty} \{\delta\mathbf{E}D - C \circ Y^{-1}\left(\frac{\delta[\mathbf{E}D-\mathbf{E}K]}{p}\right)\} dF(p) \qquad \text{(A.2)}$$

We can again substitute for $\mathbf{E}K$ from equation A.1 in equation A.2 to obtain that a MSPNE exists if an only if the present value of the dictator's equilibrium lifetime earnings, $\mathbf{E}D^*$, is the solution, in $\mathbf{E}D$, to

$$\mathbf{E}D = W + \int_{T(C^{-1}(\delta\mathbf{E}D))}^{\infty} \{\delta\mathbf{E}D - C \circ Y^{-1}\left(\frac{\delta\mathbf{E}Dn(1-\delta)}{p[n(1-\delta)+\delta]}\right)\} dF(p) \qquad \text{(A.3)}$$

as required in the theorem. Thus, (X^*, S^*) is a MTHPNE that generates expected equilibrium lifetime earnings $\mathbf{E}D^*$ and $\mathbf{E}K^*$ for the dictator and representative kingmaker respectively.

It remains to show that the solution to equation A.3 is *unique*. To do so, we take the derivative of both sides of equation A.3 with respect to $\mathbf{E}D$. The derivative of the left-hand side is 1. The derivative of the right-hand side can be simplified to yield

$$\int_{T(C^{-1}(\delta\mathbf{E}D))}^{\infty}\left\{\delta - \frac{\delta n(1-\delta)}{p[n(1-\delta)+\delta]}\cdot\left(C\circ Y^{-1}\right)'\left(\frac{\delta\mathbf{E}Dn(1-\delta)}{p[n(1-\delta)+\delta]}\right)\right\}dF(p) \quad \text{(A.4)}$$

since $\delta\mathbf{E}D - C\circ Y^{-1}(\delta\mathbf{E}Dn(1-\delta)/T(C^{-1}(\delta\mathbf{E}D))[n(1-\delta)+\delta]) = 0$ by definition of the trigger price. The integrand in A.4 is less than δ since $(C\circ Y^{-1})'$ is positive. Therefore, the value of the integral in A.4 is less than 1 and the derivative (with respect to $\mathbf{E}D$) of the left-hand side of equation A.3 is larger than that of the right-hand side. Thus, there exists *at most* one solution to equation A.3. That a solution to equation A.3 *always exists* follows from the following two facts. Firstly, the dictator earns less by always running away with the money than by running away with the money only when it's too costly not to. Formally, that is, at $\mathbf{E}D = W$, the left-hand side of equation A.3 is less than its right-hand side. Secondly, earning W each period while exerting zero effort is the highest lifetime payoff that a dictator may expect. At $\mathbf{E}D = W/(1-\delta)$, the left-hand side of equation A.3 is greater than its right-hand side. Thus, $\mathbf{E}D^* \in (W, W/(1-\delta))$ is the *unique* solution to equation A.3 as required in the theorem. ■

Proof. (COROLLARY 5.1): Recall that $Y\circ C^{-1} = \Delta g$ and let $S(\Delta)$ represent the equilibrium trigger price

$$\frac{\kappa\delta\mathbf{E}D^*(\Delta)}{\Delta g(\delta\mathbf{E}D^*(\Delta))}$$

where $\kappa = n(1-\delta)/[n(1-\delta)+\delta]$. If we take the derivative of $S(\Delta)$ with respect to Δ then we find that $S'(\Delta) < 0$ if and only if

$$\frac{\Delta\mathbf{E}D^{*\prime}(\Delta)}{\mathbf{E}D^*(\Delta)} < \frac{g(\delta\mathbf{E}D^*(\Delta))}{g(\delta\mathbf{E}D^*(\Delta)) - \delta\mathbf{E}D^*(\Delta)g'(\delta\mathbf{E}D^*(\Delta))} \quad \text{(A.5)}$$

where the right-hand side of inequality A.5 is greater than one since $g' > 0$. The comparative static result (that $S'(\Delta) < 0$) follows if the left-hand side of inequality A.5 is less than one. We know from equation A.3 that

$$\mathbf{E}D^*(\Delta) = W + \int_{S(\Delta)}^{\infty} \left\{ \delta \mathbf{E}D^*(\Delta) - g^{-1}\left(\frac{\kappa\delta\mathbf{E}D^*(\Delta)}{p\Delta}\right)\right\} dF(p)$$

so that

$$\mathbf{E}D^{*\prime}(\Delta) = \frac{\frac{\kappa\delta\mathbf{E}D^*(\Delta)}{\Delta^2}\int_{S(\Delta)}^{\infty}\frac{1}{p}(g^{-1})'\left(\frac{\kappa\delta\mathbf{E}D^*(\Delta)}{p\Delta}\right)dF(p)}{1-\delta[1-F(S(\Delta))] + \frac{\kappa\delta 1}{\Delta}\int_{S(\Delta)}^{\infty}\frac{1}{p}(g^{-1})'\left(\frac{\kappa\delta\mathbf{E}D^*(\Delta)}{p\Delta}\right)dF(p)}$$

implies that

$$\frac{\Delta\mathbf{E}D^{*\prime}(\Delta)}{\mathbf{E}D^*(\Delta)} = \frac{\frac{\kappa\delta}{\Delta}\int_{S(\Delta)}^{\infty}\frac{1}{p}(g^{-1})'\left(\frac{\kappa\delta\mathbf{E}D^*(\Delta)}{p\Delta}\right)dF(p)}{1-\delta[1-F(S(\Delta))] + \frac{\kappa\delta}{\Delta}\int_{S(\Delta)}^{\infty}\frac{1}{p}(g^{-1})'\left(\frac{\kappa\delta\mathbf{E}D^*(\Delta)}{p\Delta}\right)dF(p)}$$

which is less than one and so proves the result.

Proof. (COROLLARY 5.2): Let $I(n)$ denote the trigger

$$\frac{\kappa(n)\delta\mathbf{E}D^*(n)}{Y \circ C^{-1}(\delta\mathbf{E}D^*(n))}$$

where $\kappa(n) = n(1-\delta)/[n(1-\delta)+\delta]$. If we take the derivative of $I(n)$ with respect to n we find that

$$I'(n) = \frac{\kappa'(n)\delta\mathbf{E}D^*(n)}{(Y \circ C^{-1})} + \frac{\kappa(n)\delta\mathbf{E}D^{*\prime}(n)[(Y \circ C^{-1}) - \delta\mathbf{E}D^*(n)(Y \circ C^{-1})']}{(Y \circ C^{-1})^2} \quad \text{(A.6)}$$

where both $Y \circ C^{-1}$ and $(Y \circ C^{-1})'$ are evaluated at $\delta\mathbf{E}D^*(n)$. We know from equation A.3 that

$$\mathbf{E}D^*(n) = W + \int_{I(n)}^{\infty}\left\{\delta\mathbf{E}D^*(n) - C \circ Y^{-1}\left(\frac{\kappa(n)\delta\mathbf{E}D^*(n)}{p}\right)\right\}dF(p)$$

which implies that

$$\mathbf{E}D^{*\prime}(n) = \frac{-\kappa'(n)\delta\mathbf{E}D^*(n)\int_{I(n)}^{\infty}\frac{1}{p}(C \circ Y^{-1})'\left(\frac{\kappa(n)\delta\mathbf{E}D^*(n)}{p}\right)dF(p)}{1-\delta[1-F(I(n)] + \kappa(n)\delta\int_{I(n)}^{\infty}\frac{1}{p}(C \circ Y^{-1})'\left(\frac{\kappa(n)\delta\mathbf{E}D^*(n)}{p}\right)dF(p)}$$

If we substitute for $\mathbf{E}D^{*\prime}(n)$ in A.6 we find that

$$I'(n) = \frac{\kappa'(n)\delta\mathbf{E}D^*(n)}{(Y\circ C^{-1})}\left[1-\frac{\delta\kappa(n)J(n)}{A(n)+\delta\kappa(n)J(n)}\left(1-\frac{\delta\mathbf{E}D^*(n)(Y\circ C^{-1})'}{(Y\circ C^{-1})}\right)\right]$$

where $J(n)=\int_{I(n)}^{\infty}\frac{1}{p}(C\circ Y^{-1})'\left(\frac{\kappa(n)\delta\mathbf{E}D^*(n)}{p}\right)dF(p)$, $A(n)=1-\delta[1-F(I(n)]>0$ and both $Y\circ C^{-1}$ and $(Y\circ C^{-1})'$ are evaluated at $\delta\mathbf{E}D^*(n)$. Since $\kappa'(n)>0$, $(Y\circ C^{-1})'>0$, $1-\frac{\delta\mathbf{E}D^*(n)(Y\circ C^{-1})'}{(Y\circ C^{-1})}<1$ and $\frac{\delta J(n)}{A(n)+\delta J(n)}<1$, it follows that $I'(n)>0$. ■

B. Two types of dictator

We assume that a dictator of type $i=1,2$ faces an increasing, convex cost of effort C^i such that $C^1(x)<C^2(x)$ for all $x\in[0,1]$. After a coup occurs, the new dictator's type is the private information of the newly selected dictator. Ex ante, kingmakers know neither what kind of dictator they are facing nor what type of dictator they would become before they are selected. Kingmakers may learn a dictator's type through the level of effort exerted by the dictator.

Let $\mathbf{E}\mathcal{K}$ and $\mathbf{E}\mathcal{D}^i$, $i=1,2$, represent the present value of the lifetime expected earnings of a kingmaker and a dictator known to be of type $i=1,2$. Let $\mathbf{E}\mathcal{D}^u$ represent the expected lifetime earnings of a dictator whose type is unknown to the kingmakers. The equilibrium strategies are reservation strategies as in the basic model.

Theorem B.1. *If there are two types of dictator the unique (up to a set of measure zero), Markov, trembling-hand perfect Nash equilibrium is the triple of reservation strategies $(\mathcal{X}^{1*},\mathcal{X}^{2*},\mathcal{S}^*)$ in which the present value of each kingmaker's equilibrium lifetime earnings is $\mathbf{E}\mathcal{K}^*=\delta\mathbf{E}\mathcal{D}^{*u}/[n(1-\delta)+\delta]$, the kingmaker's reservation standard is*

$$r_k^*(p)=Y^{-1}\left(\frac{\delta\mathbf{E}\mathcal{D}^{*u}n(1-\delta)}{p[n(1-\delta)+\delta])}\right),$$

the trigger price is

$$\mathcal{T}((C^i)^{-1}(\delta\mathbf{E}\mathcal{D}^{*i}) = \frac{\delta\mathbf{E}\mathcal{D}^{*u}n(1-\delta)}{Y\circ(C^i)^{-1}(\delta\mathbf{E}\mathcal{D}^{*i})[n(1-\delta)+\delta]},$$

the present value of equilibrium lifetime earnings, $\mathbf{E}\mathcal{D}^{*i}$*, of a dictator of type* $i=1,2$ *is the unique solution in* $\mathbf{E}\mathcal{D}^i$ *to*

$$\mathbf{E}\mathcal{D}^i = W + \int_{T(C^{-1}(\mathbf{E}\mathcal{D}^i))}^{\infty}\{\delta\mathbf{E}\mathcal{D}^i - C\circ Y^{-1}\left(\frac{\delta\mathbf{E}\mathcal{D}^i n(1-\delta)}{p[n(1-\delta)+\delta]}\right)\}dF(p);$$

where $\mathbf{E}\mathcal{D}^{*u}$ *is the average of* $\mathbf{E}\mathcal{D}^{*1}$ *and* $\mathbf{E}\mathcal{D}^{*2}$*.*

Proof. As above, we prove the existence of a unique MSPNE in the game between the dictator and representative kingmaker. As in the simpler model, the representative kingmaker's maximization problem is a dynamic programming problem. The difference between the two models lies in the fact that the representative kingmaker may face an unknown type of dictator in one period and face a dictator of known type in the next period. Thus, the kingmaker's Bellman equation 4.1 is transformed into

$$\mathcal{K}^t(p) = \max\{\frac{pY(x)}{n} + \delta\mathbf{E}\mathcal{K}^s, \frac{n-1}{n}\delta\mathbf{E}\mathcal{K}^u + \frac{1}{n}\delta\mathbf{E}\mathcal{D}^u\} \tag{B.1}$$

where the superscripts, t and s, belong to the set $\{1,2,u\}$. The superscript u indicates that the type of dictator is unknown and the superscript $i \in \{1,2\}$ indicates that the dictator is known to be of type i. Subgame perfection requires that the representative kingmaker chooses to stage a coup whenever the effort is such that $(pY(x)/n) + \delta\mathbf{E}\mathcal{K}^s < [(n-1)\delta\mathbf{E}\mathcal{K}^u + \delta\mathbf{E}\mathcal{D}^u]/n$. The representative kingmaker's reservation standard is $r_k(p)$ such that $(pY(r_k(p))/n)+\delta\mathbf{E}\mathcal{K}^s = [(n-1)\delta\mathbf{E}\mathcal{K}^u + \delta\mathbf{E}D^u]/n$. Thus, when a coup is staged, the representative kingmaker earns $[(n-1)\delta\mathbf{E}\mathcal{K}^u + \frac{1}{n}\delta\mathbf{E}\mathcal{D}^u]/n$. When no coup is staged, the representative kingmaker's earnings are at least as large as $[(n-1)\delta\mathbf{E}\mathcal{K}^u+\delta\mathbf{E}\mathcal{D}^u]/n$ and depend on the effort exerted by the dictator.

Analogous to the argument in the simpler model, the best response of a dictator to a reservation strategy of the representative kingmaker is also a reservation strategy with a reservation value. The dictator exerts $r_k(p)$ when this is small enough and otherwise exerts zero effort so that each kingmaker earns $[(n-1)\delta\mathbf{E}\mathcal{K}^u+\delta\mathbf{E}\mathcal{D}^u]/n$ whether or not a coup is staged. In this case, the representative kingmaker's expected profits, $\mathbf{E}\mathcal{K}^j$, $j \in \{1,2,u\}$ equal $[(n-1)\delta\mathbf{E}\mathcal{K}^u + \frac{1}{n}\delta\mathbf{E}\mathcal{D}^u]/n$ and are independent of the type of dictator the kingmaker is facing. Thus, in equilibrium,

$$\mathbf{E}\mathcal{K} = \frac{\delta\mathbf{E}\mathcal{D}^u}{n(1-\delta)+\delta} \tag{B.2}$$

where $\mathbf{E}\mathcal{D}^u$, represents the expected lifetime payoff of a dictator of unknown type, and $\mathbf{E}\mathcal{K}$ represents the expected lifetime payoff of each kingmaker. Thus, as in the basic model, the kingmakers' equilibrium strategy is to stage a coup whenever $x < Y^{-1}(\delta\mathbf{E}\mathcal{D}^u n(1-\delta)/p[n(1-\delta)+\delta])$. The maximization problem that a dictator of type $i = 1,2$ faces is analogous to the stationary dynamic programming problem faced by a dictator in the basic model. Thus, the unique MTHPNE is $(\mathcal{X}^{1*}, \mathcal{X}^{2*}, \mathcal{S}^*)$ and the expected equilibrium lifetime earnings equal $\mathbf{E}\mathcal{K}^*, \mathbf{E}\mathcal{D}^{*i}, i = 1,2$ as required. ■

Proof. (THEOREM 6.1): Let

$$\mathcal{T}((C^i)^{-1}\delta\mathbf{E}\mathcal{D}^{*i}) = \frac{\delta\mathbf{E}\mathcal{D}^{*u}n(1-\delta)}{Y \circ (C^i)^{-1}(\delta\mathbf{E}\mathcal{D}^{*i})[n(1-\delta)+\delta]}$$

denote the equilibrium trigger price for a dictator of type $i = 1,2$. Let $\mathcal{A}(\mathbf{E}\mathcal{D}^1, \mathbf{E}\mathcal{D}^2)$ be the average of the equilibrium conditional probabilities of a coup $F(\mathcal{T}((C^1)^{-1}(\delta\mathbf{E}\mathcal{D}^1)))$ and $F(\mathcal{T}((C^2)^{-1}(\delta\mathbf{E}\mathcal{D}^2)))$.

A coup occurs whenever the effort required to avert a coup is larger than the maximum effort that the dictator is willing to exert, i.e., $Y^{-1}(\delta[n\mathbf{E}\mathcal{D}^{*u}(1-\delta)]/p[n(1-\delta)+\delta]) > (C^i)^{-1}(\delta\mathbf{E}\mathcal{D}^{*i})$ if i is the type of dictator in power. That is, a coup occurs whenever

$$p < \frac{\delta\mathbf{E}\mathcal{D}^{*u}n(1-\delta)}{Y \circ (C^i)^{-1}(\delta\mathbf{E}\mathcal{D}^{*i})[n(1-\delta)+\delta]}$$

so that $F(\delta\mathbf{E}\mathcal{D}^{*u}n(1-\delta)/Y \circ (C^i)^{-1}(\delta\mathbf{E}\mathcal{D}^{*i})[n(1-\delta)+\delta])$ is the probability that a coup occurs in any period if the dictator is of type $i = 1, 2$. The probability that a coup occurs is smaller if the dictator is of type 1 rather than of type 2 provided $Y \circ (C^2)^{-1}(\delta\mathbf{E}\mathcal{D}^{*2}) < Y \circ (C^1)^{-1}(\delta\mathbf{E}\mathcal{D}^{*1})$. However, the inequality $(C^2)^{-1}(\delta\mathbf{E}\mathcal{D}^{*2}) < (C^1)^{-1}(\delta\mathbf{E}\mathcal{D}^{*1})$ holds for the following two reasons. The first is that since a dictator of type 1 faces lower costs than those faced by one of type 2, the payoff associated with any particular effort level is higher for a dictator of type 1 than for one of type 2. This implies that a dictator of type 1 does at least as well as one of type 2 when facing the kingmakers' equilibrium strategy so that $\mathbf{E}\mathcal{D}^{*1} \geq \mathbf{E}\mathcal{D}^{*2}$. The second reason is that since $C^i, i = 1, 2$ is increasing and convex such that $C^2(x) > C^1(x)$ it must be that $(C^1)^{-1}(x) > (C^2)^{-1}(x)$. These two facts imply that $(C^2)^{-1}(\delta\mathbf{E}\mathcal{D}^{*2}) < (C^1)^{-1}(\delta\mathbf{E}\mathcal{D}^{*1})$ so that the probability that a coup occurs is smaller if the dictator is of type 1.

Initially, when a dictator is newly installed, the expected time to a coup is $\mathcal{A}(\mathbf{E}\mathcal{D}^{*1}, \mathbf{E}\mathcal{D}^{*2})$. If the price falls below $\mathcal{T}((C^2)^{-1}(\delta\mathbf{E}\mathcal{D}^{*2}))$ in some period, a dictator who exerts the effort required to avoid a coup is revealed to be of type 1. In this case, the probability that a coup occurs in the next period is $F(\mathcal{T}((C^1)^{-1}(\delta\mathbf{E}\mathcal{D}^{*1})))$. That this is greater than $\mathcal{A}(\mathbf{E}\mathcal{D}^{*1}, \mathbf{E}\mathcal{D}^{*2})$ follows from the argument given above. Thus, if the price falls below $\mathcal{T}((C^2)^{-1}(\delta\mathbf{E}\mathcal{D}^{*2}))$ in some period prior to period m, say, the expected time to a coup is lower than in the dictator's first period of power. The conditional probability that the price in each of m periods is above $\mathcal{T}((C^2)^{-1}(\delta\mathbf{E}\mathcal{D}^{*2}))$ given that the price is above $\mathcal{T}((C^1)^{-1}(\delta\mathbf{E}\mathcal{D}^{*1}))$ in each of the m periods is

$$\left(\frac{\int_{\mathcal{T}((C^2)^{-1}(\delta\mathbf{E}\mathcal{D}^{*2}))}^{\infty} p dF(p)}{\int_{\mathcal{T}((C^1)^{-1}(\delta\mathbf{E}\mathcal{D}^{*1}))}^{\infty} p dF(p)}\right)^m .$$

Thus, if a dictator has been in power m periods, the conditional probability that the price is below $\mathcal{T}((C^2)^{-1}(\delta\mathbf{E}\mathcal{D}^{*2}))$ in at least one of the m periods given that the price is above $\mathcal{T}((C^1)^{-1}(\delta\mathbf{E}\mathcal{D}^{*1}))$ in each of the m periods is

$$1 - \left(\frac{\int_{\mathcal{T}((C^2)^{-1}(\delta\mathbf{E}\mathcal{D}^{*2}))}^{\infty} p dF(p)}{\int_{\mathcal{T}((C^1)^{-1}(\delta\mathbf{E}\mathcal{D}^{*1}))}^{\infty} p df(p)}\right)^m .$$

This implies that the longer that a dictator has been in office, the more likely it is that the price in at least one period fell below $\mathcal{T}((C^2)^{-1}(\delta \mathbf{E} D^{*2}))$, and the higher is the conditional probability that the dictator is of type 1. That is, the hazard rate decreases with duration. ■

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