Holding onto Power by Any Means? The Origins of Competitive Elections

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Abstract

We examine conditions under which incumbents hold competitive elections. To prevent defeat, incumbents can avoid holding elections, manipulate the rules, or commit fraud. The conditions for the emergence of competitive elections are narrow, because the prospect of losing coercive power as a consequence of an electoral defeat makes the incumbent rulers less inclined to hold elections, while the prospect of having to leave office induces them to engage in fraud. Elections are competitive when incumbents cannot remain in power by force alone and when they fear to be abandoned by their armed allies if elections were discovered to be fraudulent. Political regimes should be characterized in terms of the relations of physical force rather than of their endogenous consequences.

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"We are not going to give up our country for a mere X on a ballot. How can a ballpoint fight with a gun?" (President Robert Mugabe, cited in time.com/quotes)

"Russia has opened a diplomatic campaign to curtail the activities of election observers in the states of the former Soviet Union, proposing to cut the size of the missions sharply and to prohibit the publication of their reports immediately after an election." ("Russia Takes Aim at Vote Watching," *The New York Times,* October 25, 2007, p. 1.)

1   Introduction

Incumbents rarely leave office because they are defeated in elections. Indeed, our count of national elections in the world since 1788 indicates that only one in about five resulted in a defeat of the incumbent party. The advantage of incumbents is thus enormous.

Consider all the instruments at their disposal. If they fear losing, they may simply abstain from taking the risk, not holding elections at all. Francisco Franco never did during the thirty-six years he ruled as *Generalissimo.* The *Barisan Nasional* (Alliance) Party in Malaysia carelessly held an election in 1969 but when confronted with an unpleasant result, simply rewrote the rules to make it sure that the experience would not be repeated, and thus far it was not. António Salazar was more prudent, making it sure that elections would generate correct results by reverting to fraud, a practice dear to the Mexican *Partido Revolucionario Institucional.* Sheer force, manipulation of rules, and fraud can keep incumbent rulers in power independently of the voice of the people.

Yet these practices are not without risks. Leaders who rule by force are likely to be overthrown by force. Excessive manipulation leaves the potential opposition without an incentive to participate and may result in violent resistance. And fraud can backfire: since the end of

World War II, almost twenty national-level elections were annulled as fraudulent ("List of annulled elections." http://en.wikipedia.org/wiki/List_of_annulled_elections, September 20, 2008). Hence, some incumbents refrain from these practices, hold competitive elections, and leave office quietly if they lose.

We seek to identify the conditions under which incumbents (individuals, parties, or cliques) have no choice but to hold competitive elections, by which we mean elections in which the incumbents do not foreclose the possibility that their opponents could win. Note that incumbents may repeatedly win elections that are "free and fair," simply because they enjoy continued popular support. Elections are "free" when people can exercise their choice regardless of how they would choose. They are "fair" if their outcome is not determined by the rules that organize them and these rules are observed. Our question is not whether elections are free and fair but whether they are competitive, whether the opposition has some chance to win.

We assume that remaining in office is a source of some advantages, material or not, over being an ordinary citizen. The incumbent has some capacity to impose himself by force, which he utilizes when he does not hold elections, if he wins but is caught having committed fraud, or when he loses but does not want to yield. The incumbent can manipulate the rules under which elections occur, but only under exogenously given constraints. In turn, the incumbent can optimally choose the extent of fraud. The effects of fraud on the probability that the incumbent wins reelection and on the probability that fraud is detected are taken as given. This is the environment in which incumbents decide how much fraud they would want to commit if they were to hold elections and, armed with this assessment and the knowledge of the consequences, decide whether or not to hold an election at all.

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True, this is a jaundiced view of politicians. One might hope that some of them are true democrats, willing to expose themselves to competition even if they are not compelled to do so by the circumstances (Hyde 2008). After all, the possibility that President Bush or Prime Minister Aznar would not hold a scheduled election or manipulate the rules to make competition impossible or engage in massive vote buying is inconceivable. But is it because they are true democrats or because they have no choice but?

Hence, in contrast to most of the literature, which takes political regimes ("communism," "electoral authoritarianism," "semi-authoritarianism") as exogenous and then examines the functions of elections in each type of regime,[1] we analyze how regimes emerge as a consequence of decisions of incumbent rulers. Elections are non-competitive not because regimes are authoritarian. No politicians like to lose elections. Regimes are authoritarian when incumbents are able to use all the instruments at their disposal to prevent this unpleasant eventuality.

"The opposition" is not modelled as a strategic actor because it is not something ready-made (Lust-Okar 2005: 27-28). Opposition is different in form and composition when an incumbent tries to rule by force, when he holds an election, when he loses an election and does not yield, or when he wins using fraud. Because incumbents' capacity to rule by force can be threatened by groups within society (Smith 2005, Gandhi and Przeworski 2006) as well as by sectors of the ruling elite (Geddes 1999, Magaloni 2006, Brownlee 2007), opposition can come from anywhere. Indeed, incumbents often fall not due to pressure of opposition

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[1]Students of "electoral authoritarianism" (Schedler 2006) observe that holding elections may be just an instrument of rule: to enhance the legitimacy of the rulers (Hermet 1978), discipline factions within the governing party (Schmitter 1978, Geddes 2005, Magaloni 2006), show an agreeable face to foreign powers (Levitsky and Way 2002), intimidate the potential opponents (Gandhi and Przeworski 2006), or reduce the likelihood of violent removal (Cox 2008).

groups within society but from divisions within the ruling elite (Svolik 2008). Without pluralistic elections, opposition cannot assume an institutional form. Elections, in turn, may divide the opposition (Lust-Okar 2005, Magaloni 2007). The point, then, is that treating "the" opposition as strategic would be a mis-characterization of the environment in which incumbents face different threats to their rule depending on their actions. These threats are endogenous.

We learn that the conditions for elections to be competitive are quite narrow. The prospect of losing coercive power as a consequence of an electoral defeat makes the incumbent rulers less inclined to hold elections, while the prospect of having to leave office induces them to engage in fraud. But incumbents are able to manipulate the rules or to perpetuate fraud only if they enjoy sufficient repressive capacity and if they do not fear losing the support of their armed allies when fraud is discovered. In our view, the instruments used by incumbents to win elections and repression are complements, not substitutes: the capacity to repress is what enables fraud.

The paper is organized as follows. In the next section we present a model and analyze its consequences. We parametrize the model using historical data. We end with a comment concerning the proper understanding of political regimes.

2 The Model

2.1 Assumptions

There is an incumbent, who considers whether or not to hold an election. Ideally, we think, all politicians want to hold office while being admired and adored: the utility of the incumbent

holding office as a result of having won an election is $U(office + ego)$. Holding power by force is second best, $U(office)$. Being in power is better, in turn, than being an ordinary citizen. This utility is denoted by $U(citizen)$, and one may think that the utility of holding office is the utility of being an ordinary citizens plus that of advantages accruing to power, $U(office) = U(citizen + rents)$. Finally, all these utilities are normed in such a way that an incumbent who is thrown out of office by force gets nothing. Hence, using shorthands, we assume that $U(o + e) \geq U(o) \geq U(c) > 0$. The ratio of the value of being an ordinary citizen to the value of office, $U(c)/U(o) \equiv u$, is a parameter of the model: it indicates how extensive are the advantages that accrue to incumbents in a particular polity.

Not holding elections is a risky choice because it may leave no other choice to the outsiders but to revert to force. Let the probability that the incumbent survives one period in office without holding elections be q. Think of q, therefore, as "the repressive capacity of the incumbent."

Opting for an election does not leave the incumbent without resources. Elections must inextricably follow some rules that regulate who can vote, whether voting is direct or indirect, secret or public, compulsory or voluntary, how votes are aggregated, and so on. And rules affect outcomes. Perhaps the most flagrant example of manipulation is the law introduced by President Putin to prohibit "negative campaigning," by which he meant any criticism of the government. Even minute details, such as the form or the color of ballots, location of the polling places, or the day of the week when voting takes place can affect the result. Hence, elections are inextricably manipulated.

Manipulation, however, can be more or less blatant. Somehow we feel that carving electoral districts in the form of a salamander is excessive, while making districts nicely

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square does not raise anyone's eyebrows. Hence, manipulation is a matter of degree, which is represented here by m. We treat it as exogenous.

Manipulation is not the same as fraud.[2] Manipulation consists of establishing rules while fraud entails breaking rules, whatever they may be. And setting rules and breaking rules are subject to different sanctions even if they have identical consequences. The same physical act – a campaign contribution – has a different meaning and is subject to different reactions when it is permitted by law and when it is illegal: "institutional facts have some autonomy with regard to brute facts" (Sánchez-Cuenca 2003: 81-82). Yet even when the incumbents manipulate openly – in France incumbents changed the electoral system eleven times since 1875 – they do not want to be caught breaking their own rules.

Almost by definition, then, acts of fraud are secretive. Breaking into the office of the opposition party to steal its secrets is fraud because it violates a general prohibition against burglary. Buying votes constitutes fraud when it is prohibited by specific rules. So is casting votes of people whose spirits have passed to a better world. Fraud is best exemplified by a story told about Anastazio Somoza, who is alleged to have informed his defeated opponent, "Indeed, you won the voting, but I won the counting."[3] The technology of fraud is highly varied (Simpser 2006, Lehoucq 2003), but in almost all of its forms, fraudulent activity is clandestine.

Manipulation and fraud are substitutes. Let f stand for the degree of fraud and assume that the probability that the incumbent wins an election is $p = p(m, f)$, increasing both in

[2] On the difficulties of defining fraud, see Annino (1995: 15-18). On corrupt electoral practices in Latin America, see Posada-Carbó (2000).

[3] Cited in Eisenstadt (2004: 1). Originally cited in *The Guardian*, June 17, 1977. The expression "He who counts, wins" is a standar quip of Colombian electoral culture.

m and in f. Clearly, the same probability may be generated by a lot of manipulation with little fraud or by little manipulation with extensive fraud. And fraud may be more or less effective, so that sometimes the incumbent can secure a good chance of being reelected with just a touch of fraud but at other times his victory remains unlikely even if he were to engage in massive fraud.

Before deciding whether to hold the election, the incumbent must decide how much fraud he would want to perpetuate if he is to hold it. Thus if the incumbent decides to hold an election, he wins with the probability $p(m, f^*)$, where f^* stands for the optimal degree of fraud.

The reason incumbents do not simply steal elections is that fraud is a double-edged sword. If it is blatant, it may be detected, by some officially constituted body, by election monitors, by the opposition, or sometimes even by individual voters. We assume that the more extensive the fraud, the more likely it is that it is detected. Let $r = r(f)$, increasing in f, be the probability that fraud is detected. While allegations of fraud are ubiquitous even if there is none, we assume that $r(0) = 0$: fraud can be detected only if fraud there is.[4]

If fraud is detected, the incumbent always denies it and attempts to celebrate the victory. In most cases the defeated parties accept the results of elections after some grumbling: the campaign of mass mobilization by Lopez Obrador in Mexico dwindled after a few months. Yet sometimes the election is invalidated and the incumbent is removed from office: Marcos in the Philippines, Milosevic in Serbia, and Sheverdnadze in Georgia all were forced to flee by the people outraged by "stolen elections" (Thompson and Kuntz 2004, Tucker 2007). We

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[4]Note that in Magaloni's (2007) model, if fraud is unobservable and there is more than one opposition party, one of them may allege fraud even if there was none.

assume that if fraud is detected, revealing that the incumbent had to revert to it in order to win, he is less successful in repressing than if he had not held the election. Specifically, the incumbent survives allegations of fraud with the probability $q - s, 0 < s \leq q$.

Even with all the manipulation and fraud, incumbents sometimes lose elections. What are they to do then? They can accept the defeat and yield. But they can also attempt to prevent the winners from assuming office. The chances that the incumbent would succeed in imposing himself by force, however, are weakened by an electoral defeat. Everyone knows that the incumbent was not able to secure a victory even with his grip over the state apparatus. The probability of success in squelching the opposition after an electoral defeat is again $q - s$. But, in contrast to the situation in which the incumbent is detected to have won because of fraud, the cost of an electoral defeat is permanent. Some sectors within the ruling elite may smell blood: rival factions either see a chance to topple the ruler or sense that the regime is vulnerable to being overthrown. Hence, the elite splits and the incumbent is permanently weakened. We assume, therefore, that if the incumbent survives an electoral defeat, he enters into the next period with his repressive power reduced by s.

These, then, are the ways in which the incumbent can try to hold on to power and the chances he would succeed. The primitives of the model are the probability that an incumbent would successfully suppress the opposition, q; the extent to which the electoral rules are manipulated, m; the effectiveness of fraud; the sensitivity of detection with regard to fraud; the loss of coercive power suffered by the incumbent if he attempts to suppress the opposition having held the election, s; and the relative value of rents accruing to office, u. The induced functions are the optimal degree of fraud, f^*; the probability the incumbent wins the election, $p(m, f^*)$; and the probability that fraud is detected when the incumbent

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had won the election, $r(f^*)$. The timing is as follows: (1) The incumbent chooses the optimal degree of fraud; (2) The incumbent decides whether or not to hold an election with this degree of fraud; (3) Nature decides who wins the election; and, (4a) If the incumbent wins, nature decides whether fraud is detected and if it is detected, whether the incumbent remains in office or (4b) If the incumbent loses, he decides whether to yield or to try an autogolpe, in which case nature moves again. The structure of the stage game is portrayed in Figure 1.

*** Figure 1 here ***

2.2 Analysis

2.2.1 States of the World

The first decision the incumbent must make is what he would do if he happens to lose. This decision places the incumbent in one of two states of the world, which are Y if he must be prepared to yield office and S if he would want to hold onto power by force.

Working backward, suppose that the incumbent is in state Y and let his repressive capacity in this state be q_Y. His expected utility from holding an election in any period is then

$$EU_Y = p_Y[(1 - r_Y)U(o + e) + r_Y(q_Y - s)U(o)] + (1 - p_Y)U(c). \tag{1}$$

The incumbent wins with the probability p_Y. With the probability $1 - r_Y$ fraud is not detected and he gets what he wants most, namely, $U(o + e)$. With the probability r_Y fraud is detected and he survives the protests with the probability $q_Y - s$, getting $U(o)$. Finally,

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with the probability $1 - p_Y$, he suffers an electoral defeat, yields, and becomes an ordinary citizen, getting $U(c)$.

The incumbent must anticipate consequences beyond the current period. If he yields, he becomes an ordinary citizen, receiving a stream of utility $U(c)$ from then on.[5] Let the value of holding repeated elections in Y be V_Y. If the incumbent wins the election at any period, he survives to the next period with the probability $\pi_Y = p_Y[1 - r_Y + r_Y(q_Y - s)]$ and is in the same situation as before, so that he expects to get V_Y, which he discounts at $\rho < 1$. If he wins the election but fraud is detected and he is overthrown, he gets nothing. In turn, if he loses, he leaves office and receives $U(c)$ from then on, so his continuation value is $\rho U(c)$. Hence, the value of holding elections at all times in Y is

$$V_Y = \max_f \frac{1}{1 - \rho \pi_Y}(EU_Y + \rho(1 - p_Y)U(c)). \tag{2}$$

In turn, suppose that the incumbent is in a state S, in which he would try to "suppress" if he loses, with repressive capacity q_S. The expected utility of any election in S is

$$EU_S = p_S[(1 - r_S)U(o + e) + r_S(q_S - s)U(o)] + (1 - p_S)(q_S - s)U(o). \tag{3}$$

If the incumbent wins in S, he survives in office with probability $\pi_S = p_S(1 - r_S + r_S(q_S - s))$, and is in the same situation as he was. If he loses, he survives with the probability $q_S - s$ and he gets some continuation value discounted at ρ. To narrow the definition of S, suppose that if the incumbent loses an election in S and survives, he enters the state Y in which he

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[5]For simplicity, we assume that incumbents who are defeated in elections never come back. The qualitative results do not depend on this assumption, except that incumbents would more more prone to hold elections if they could return.

would yield if defeated again. Hence, $q_S - s = q_Y$. Under this stipulation, the continuation value upon losing in S is the value he would expect to obtain in Y. This value, in turn, is either V_Y or the value of not holding elections in Y, whichever is larger. If elections are always held in Y, as they are (see below), then

$$V_S(hold\ in\ Y) = \max_f \frac{1}{1 - \rho\pi_S}(EU_S + \rho(1 - p_S)q_Y V_Y). \tag{4}$$

Note the recursive structure of the incumbent's problem in S: he knows that he will maximize in Y, calculates V_Y and takes it as given in S.

To determine which state of the world prevails, compare the utility of the incumbent yielding or fighting to stay in power, given $q_S, s,$ and u. The incumbent knows that he can suppress successfully with probability $(q_S - s)$, to get $U(o) + \rho V_Y$. He also knows that if he decides to fight he would commit fraud that makes the probability of losing $(1 - p_S)$. Finally, he calculates that if he decides to yield he would lose with the probability $(1 - p_Y)$ and that if he does lose he would get a certain stream of income, valued at $\frac{1}{1-\rho}U(c)$. Comparing these expected utilities shows that the incumbent prefers to suppress, that is, he is in a state S if

$$q_S - s > \frac{1}{1 - \rho}\frac{1 - p_Y}{1 - p_S}\frac{U(c)}{U(o) + \rho V_Y} \equiv T(q).$$

This expression defines the threshold separating the two states only implicitly, because $p_Y, p_S,$ and V_Y are all functions of q_S and s. Call the expression on the right-hand side $T(q)$. As long as $dT(q)/dq_S < 1$, for each pair $\{q_S,\ s\}$ there exists a unique threshold, call it q^*, such that the condition is satisfied for all $q_S \geq q^*$.

Hence,

Condition 1 *The incumbent is in state S if $q_S - s > T(q) > q_S - 2s$. If $q_S - s < T(q)$, the state is Y.*

Note, however, that even if this condition is satisfied, the incumbent is not necessarily in state S as defined above. This is because it may be that even if he loses, and his q_S falls to $q_S - s$, it may still be true that $q_S - 2s > T(q)$. If it takes more than one electoral defeat to enter into Y, the incumbent is in state $S - k$, where k counts the number of defeats that would transform the state into Y. We investigate below what happens in such states.

2.2.2 Optimal Fraud

Preliminaries

Before proceeding with further analysis, we need to make some additional assumptions.

Assume that the probability of reelection is linearly decomposable into a part due to manipulation without any fraud and a part due to fraud:

$$p(m, f) = p(m, 0) + p(f).$$

Since this function plays an important role in what follows, consider what it represents. Suppose that having manipulated the rules to the extent m, the incumbent is certain to receive the support of 45 percent of the electorate, while the opposition can certainly count on being supported by 40 percent. If the probability that the undecided would vote for the incumbent is uniformly distributed, then the probability that the incumbent wins without committing any fraud is $p(m, 0) = 2/3$. But if he can buy or falsify 5 percent of the votes plus one, $f = 0.05$, he is certain to win, $p(m, f) = 2/3 + p(0.05) = 1$. Note, however, that $p(m, 0)$

is the same when the incumbent is certain of 40 percent and the opposition of 30 percent, but now the incumbent has to fraudulently obtain 10 percent of the votes to make his victory certain, so that $p(m, f) = 1$ only if $f = 0.10$. Hence, the same degree of fraud may have different effects on the probability of electoral victory in different environments. Technically put, the *curvature of $p(f)$* is an element of the environment in which the incumbent decides. Note, however, that we cannot isolate the effect of manipulation from "genuine" support.

To determine the optimal extent of fraud, note first that it is constrained by $0 \leq f \leq 1$. Moreover, because the part due to manipulation is determined first and $p \in (0, 1)$, the part due to fraud is constrained from above by $p(f) \leq 1 - p(m, 0)$. Either of these constraints may bite first, so that we need to consider all the cases. Formally, the optimal amount of fraud is given by

$$f^*_{\{S,Y\}} = \arg\max_f V_{\{S,Y\}} \ s.t. \ 0 \leq p(f) \leq 1 - p(m, 0) \ and \ 0 \leq f \leq 1.$$

We first solve maximization problems without constraints, check throughout for $f^* \leq \min\{f : p(f) = 1 - p(m, 0), 1\}$, and set f^* at the respective value.

Unless the functions $p(m, f)$ and $r(f)$ are somewhat specialized, however, first-order conditions may identify minima, rather than maxima (see the Appendix). Specifically, we assume that $p(f)$ is concave while $r(f)$ is convex. The possibility that f generates decreasing returns in $p(f)$ seems reasonable: marginal votes are harder to buy or marginal ballots harder to alter. In turn, it is plausible that the magnitude of fraud would increase the probability of detection at the margin.

Assumption 1: $p(f)$ is concave in f, while $r(f)$ is convex in f.

In the numerical illustrations that follow, we use exponential functions of the form

$$p(m, f) = p(m, 0) + 1 - \exp(-\alpha f),$$

$$r(f) = -1 + \exp(\beta f).$$

These functions are illustrated in Figure 2 for $p(m, f) = 0.6 + 1 - \exp(-0.51f)$, $r(f) = -1 + \exp(0.6f)$.
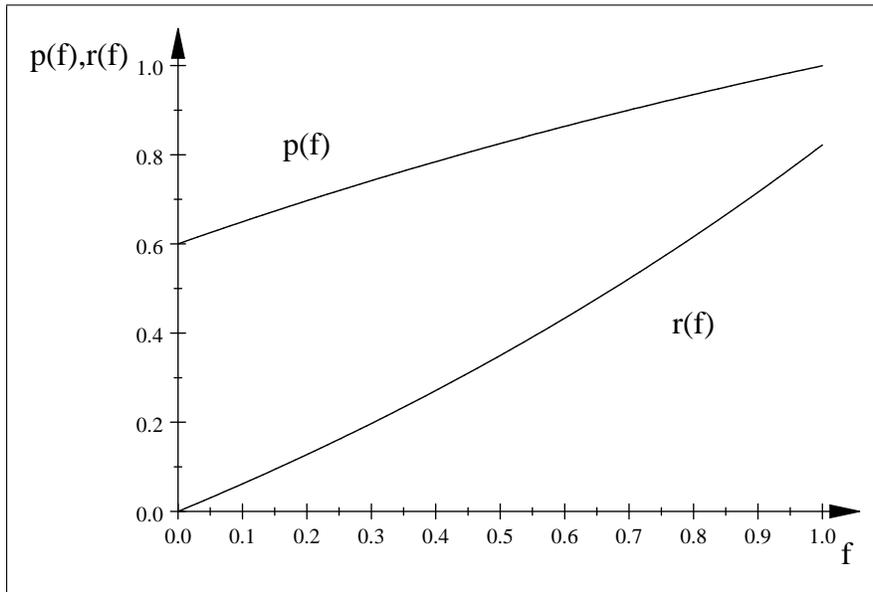

Figure 2: Illustrative functions p(f) and r(f)

The function $p(f)$ was calibrated in such a way that $p(1) = 1$: if the incumbent buys or falsifies all the votes, he will be certain to win. The function $r(f)$ implements the assumption that $r(0) = 0$. But the ease with which fraud is detected may vary across circumstances. Hence, we will study comparative statics with regard to the parameter β, the sensitivity of detection with regard to fraud.

Comparative Statics

With this assumption we can study the optimal degree of fraud. Note that to determine the optimal degree of fraud in S, we need to first find f_Y^*, evaluate $V_Y(f_Y^*)$, solve for f_S^*, and then check Condition 1. Because we cannot get explicit expressions for $f_{\{Y,S\}}^*$, we rely on calibrations, assuming $U(o + e) = 1.25, U(o) = 1, U(c) = u = 0.25$, and using the parametrizations of $p(f)$ and $r(f)$ given above. We take $\rho = 0.66$, assuming that while politicians do look forward, they discount the future much more rapidly than, say, households choosing saving rates.[6]

To get the flavor of comparative statics, examine the following table, to be read as follows. For each q_S, the first value of s is the lower bound that satisfies Condition 1, while the second value of s is the upper bound. Note that these bounds are quite narrow. Given q_S and s, the value of q_Y is determined. Hence, we can calculate f_Y^*, evaluate V_Y, substitute it in V_S, and determine f_S^*. Note that the values of f_Y^* and f_S^* in the last two rows are in parentheses. This is because, as we shall see below, the incumbent does not hold elections in S under these conditions and thus never transits to Y.

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[6]We also experimented, however, with $\rho = 0.95$. All qualitative conclusions are the same.

Table 1: Illustrative values of the extent of fraud in the two states.

q_S	s	$q_Y = q_S - s$	$q_Y - s$	f_Y^*	f_S^*
0.35	0.01	0.34	0.33	**0.2035**	0.1460
0.40	0.04	0.36	**0.32**	**0.1976**	0.1485
	0.05	0.35	0.30	**0.1861**	0.1476
0.50	0.09	**0.41**	**0.32**	**0.1976**	0.1559
	0.13	0.37	0.24	**0.1541**	0.1510
0.60	0.14	0.46	**0.32**	**0.1976**	0.1655
	0.21	0.39	0.18	0.1253	**0.1547**
0.70	0.18	0.52	**0.34**	**0.2096**	0.1845
	0.29	**0.41**	0.12	0.0992	**0.1586**
0.80	0.23	0.57	**0.34**	**0.2096**	0.2013
	0.38	0.42	0.04	0.0680	**0.1610**
0.85	0.25	0.60	0.35	**0.2157**	0.2075
	0.35	0.50	0.15	0.1119	**0.1781**
	0.36	0.49	0.13	(0.1034)	(**0.1757**)
0.90	0.28	0.62	**0.34**	(0.2096)	(**0.2167**)

Note: Only one line is given in the first row because the minimum and maximum values of s that satisfy the Condition 1 differ only in the third digit. Three lines are given for $q_S = 0.85$ to show that the highest s for which the incumbent holds an election in S is 0.35. In turn, only one line is given for $q_S = 0.90$ because the incumbent does hold the election in S even at the minimum value of s, which is the one shown.

Given the values of other parameters, the feasible values of q_Y are in the range $0.34 \leq q_Y \leq 0.6$. If $q_Y < 0.34$, the state is already Y. If $q_Y \geq 0.62$, the incumbent does not hold elections in S. This matters, because it implies that by the time the incumbent enters into Y he never has strong repressive power.

Here are some general results (All proofs are in the Appendix).

Proposition 1 *At least in state Y, when the probability of winning without becomes larger, the extent of fraud increases until the probability of detection becomes dissuasive and then declines. Formallly, $\partial f_Y^*/\partial p(m, 0) \gtrless 0$ if $r(f^*) \lessgtr r^*(q_Y, s, \rho)$.*

In agreement with Simpser (2004), who thinks in terms of margins rather than probability of winning, the incumbent commits fraud even if he has a good chance to win without it.[7] Incumbents want to minimize the chances of losing and only the possibility that fraud would be detected moderates them. In turn, numerical examples show that the likelihood of detection is powerfully dissuasive in preventing fraud.

Proposition 2 *The optimal extent of fraud increases in the repressive capacity of the incumbent, both when he suppresses when defeated in elections and when he yields. Formally, $\partial f_Y^*/\partial q_Y > 0$ and $\partial f_S^*/\partial q_S > 0$.*

One may think that fraud and repression are substitutes in keeping incumbents in power (Schedler 2002: 46). In our view, however, the capacity to repress is what enables fraud: an incumbent who is less afraid to be overthrown if fraud would be detected, engages in more of it. Even if incumbents who have high repressive capacity in state S may not hold elections

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[7]The sign of $\partial f_S^*/\partial p(m, 0)$ is untractable but intuitively the same should be true.

(see below), it is not because repression is a substitute but only because they want to avoid even a slight chance of losing.

Proposition 3 *The optimal degree of fraud is lower when the incumbent faces a larger potential loss of repressive capacity. Formally, $\partial f_S^*/\partial s < 0$ and $\partial f_Y^*/\partial s < 0$.*

Consider first the state Y. If defeated in this state, the incumbent yields, certain to receive a constant stream of positive utility from then on. If he wins, he faces a lottery the value of which declines in s. Hence, as s increases, fraudulent electoral victory becomes relatively less attractive: if the incumbent were to increase f, he would be more likely to win but fraud would be more likely to be detected and the chance that if fraud is detected the incumbent is overthrown and gets nothing increases in s. In state S, in turn, the incumbent faces lotteries whether he wins or loses. But if he survives when he loses, he enters into Y, where he is assured of a constant utility stream if he loses again, while if he wins in S he faces a probability of being getting nothing and this probability increases in s. Hence, the same reasoning holds in S.

Note, however, what happens if s becomes larger while the difference $q_{\{Y,S\}} - s$ remains constant. Obviously, this means that q increases by the same amount as s. But the effect of this change is different in the two states. Examine the rows marked as bold in the column $q_Y - s$ in Table 1. If the value of this difference is the same, then regardless of the absolute values of q_Y and s, the extent of fraud in Y is the same. This is rather obvious, because s has no impact independently of $q_Y - s$. The same is not true, however, when the incumbent is in state S. Even when $q_S - s = q_Y$ is the same (look at the two rows in bold in the column q_Y), the incumbent commits more fraud when s is higher. Although s does not independently

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affect the expected utility of each election, it does have an independent impact on V_Y, which in turn affects the value of V_S. Since V_Y depends on $q_Y - s = q_S - 2s$, it declines in s independently of $q_Y - s$. And since the prospect of transiting to Y is then more foreboding, the incumbent takes the risk of avoiding this possibility by increasing fraud in S.

Proposition 4 *The extent of fraud in Y depends only on the value of the difference $q_Y - s$, but the extent of fraud in S increases in s for a fixed $q_S - s$.*

Note in Table 1 that when q_S is low the incumbent commits more fraud once he falls into Y than he does in S. As q_S increases, however, he commits more fraud in Y when s is low but more in S when s is high, and when q_S is sufficiently high, he always commits more fraud in S. This is just a consequence of Proposition 3 under Condition 1. In the light of Condition 1, when q_S is low, s must be low as well. The incumbent must be careful in S and he loses little power by transiting to Y, so he commits little fraud in S. Given a low s, however, he is relatively strong in Y and commits more fraud. As q_S becomes larger, so does the range of feasible s, and then the incumbent commits less fraud in S under low s and more fraud under high s. Finally, when q_S is large, so is s, so that the incumbent always commits more fraud in S.

In sum, in both states of the world fraud is larger when the incumbent has more power to repress if he is detected to have committed fraud. But the loss of coercive power associated with fraud being detected or with an electoral loss plays a different role in the two states. Once the incumbent is ready to yield when defeated, he cares about his repressive power only in the eventuality that he is detected to have committed fraud. But when he is prepared to repress when he loses an election, he must be concerned that in the future he would have

to yield. Because this prospect is foreboding independently of what happens if he is caught having committed fraud, he tries to avoid the loss of power by engaging in more fraud when this loss is larger.

As one would expect, when the advantages accruing to holding office are smaller, fraud is less extensive.

Proposition 5 *Both in S and Y, the extent of fraud is smaller when $u = U(c)/U(o)$ is larger.*

2.2.3 Elections

Once the incumbent knows how much fraud he would want to commit if he holds an election, he can decide whether or not to hold it.

The incumbent holds elections in S if

$$V_S > \frac{q_S}{1 - \rho q_S} U(o).$$

Note that if he does not hold an election, nothing changes, so he will never hold them. Analogously, in Y elections are held if

$$V_Y > \frac{q_Y}{1 - \rho q_Y} U(o).$$

Since we cannot get an explicit expression for $f^*_{\{S,Y\}}$, we cannot test these conditions analytically. Calibrations show, however, that if the incumbent enjoys high repressive power in S and fears a significant loss of this power if he would lose the election, he prefers to avoid the risk of entering into Y, so he does not hold. Note, again in Table 1, that elections are held

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at $q_S = 0.85$, and $s = 0.35$, but no longer when s is higher. At $q_S = 0.9$, in turn, elections are not held even for the lowest feasible s. Simple algebra shows, in turn, that elections are held in Y when q_Y is lower than some threshold $Q_Y(p(f_Y^*), r(f_Y^*), s)$. This threshold is high for all $f \in (0, 1)$ and thus for all pairs $\{q_Y, s\}$. Using the calibrations from Table 1 shows that $q_Y < Q_Y$ for all feasible values of q_Y. Hence, elections are always held in Y. The reason is that to have arrived in Y, the incumbent must have suffered a loss of coercive power, and this power could not have been very large to begin with because, as we have seen, otherwise he would not have held elections in S.

We offer this result as a summary of numerical calculations:

Summary 1 *Elections are always held in Y. In S, however, they are not held if q_S and s are sufficiently high.*

This result holds for all functions $r(f)$, but if the probability of detection rises faster as fraud increases, the incumbent does not hold elections in S at lower levels of q_S and s.

One final result deserves attention. Suppose that the incumbent is safely entrenched in a state $S - k$, that is, he can lose k elections before he would enter the Y world. Formally, k is defined by

$$q - ks > T(q) > q - (k + 1)s,$$

where $T(q)$ is given by Condition 1. As an example, an incumbent who enters with $q = 0.9, s = 0.15$ is in state $S - 2$. Given his high repressive power, the incumbent does not want to take the risk of being overthrown, which is still non-negligible and does not hold elections. And since nothing changes if he does not hold, he rules by force, expecting to

survive $1/(1-q) = 10$ periods. In turn, an incumbent who takes power with $q = 0.7, s = 0.1$ is also in state $S - 2$ but he does hold elections and if he loses twice enters into state Y.

Now, since elections are held in all states $S - k$ if q is relatively low and since the incumbent loses power each time he is defeated, it is generally true that

Summary 2 *If elections are held in state $S - k$, they are held in states $S - (k - 1), Y$.*

One should not, however, expect to see many incumbents who hold repeated elections not yielding if defeated and who then one day leave when they are defeated. The probability that someone who takes power in $S - 2$ with $q = 0.7, s = 0.1$ survives to Y and is defeated in the first election in which he is prepared to yield is 0.13, about one in eight.

3   Historical Patterns

Here is what we learned:

(1) Incumbents who have a very high power to repress do not hold elections.

(2) Incumbents who have somewhat weaker coercive power are concerned about the potential divisions within the ruling establishment. Even if they are not afraid to engage in extensive fraud, they fear that the regime would be fractured in the unlikely event they would lose. These incumbents either do not hold elections or if they hold them, they use extensive fraud to prevent a defeat.

(3) If they lose, incumbents who have high coercive power and do not suffer a major loss of this power upon defeat disobey the results of the election and attempt to remain in power by force. At some time, however, their loss of coercive power is sufficient to prepare them to yield office if defeated. In turn, facing the prospect of having to yield, they use fraud even

more extensively.

(4) Incumbents who have low coercive power or who lose much of it when caught at fraudulent practices, use less fraud and are willing to yield office once defeated.

Thus, the very prospect of losing power makes incumbents engage in extensive fraud in order to prevent an electoral defeat. And in situations in which incumbents must be prepared to yield, they again desperately attempt to prevent a defeat by engaging in fraud. When they have control over rule-making as well as over the apparatus of repression, they mix manipulation and fraud to assure themselves of electoral victories. Hence, incumbents repeatedly win elections. We would expect elections to be competitive only when incumbents cannot unilaterally manipulate the rules and when they fear they would be abandoned by their allies if fraud is detected.

To estimate the frequencies of relevant events, we use a new data set generated by Przeworski et al (2007). The data cover, although far from completely, all elections in the world since 1788.

To calculate the value of q, we use two kinds of information. Some rulers take power by force. Of 119 such entrants, 65 survived for at least one year without holding an election. In turn, we know that in 442 years in which terms of incumbents expired, elections did not occur during this year or earlier. Survival data are available for 229 cases in which scheduled elections did not take place in time. In 80 cases the incumbent was overthrown during the current or the following year and in 149 he survived. Hence, rulers who entered by force and did not hold an election or elected incumbents who did not hold a scheduled election survived at least one year with the probability $q = (65 + 149)/(119 + 229) = 0.61$.

Table 2 shows, in turn, what happened when elections did take place, specifically, the

frequencies of sequences of events consisting of outcomes of elections and the subsequent control over the chief executive office. "Incumbent" is not necessarily the same person: he or she may be a member of the same party or an otherwise designated successor. "Winner," as well, may be a person or a party. Note that if the incumbent had won, he is the winner; if the incumbent lost, the winner is someone else. "Assumed indirectly" stands for sequences in which the winner assumed office but only after someone else – the loser or a third party – held it in the immediate aftermath of an election. "Assumed," whether directly or not, indicates that the winner held office for at least one year, but not necessarily that he completed the constitutionally specified term.

Table 2: Events surrounding elections

Incumbent		Winner			Total
	assumed	assumed	did not	unclear	
	directly	indirectly	assume		
won	1999	9	95		2103
lost	473	19	53		545
total ran	2472	28	148		2648
did not run	84	6	22		112
unclear	15	3	8	7	33
Total	2571	37	178	7	2793

As expected, the most striking aspect of these data is the frequency with which incumbents won elections: 2,103 out of 2,648 in which they ran and for which the outcome could

be determined, which gives $p = 0.79$, $4 : 1$ odds of winning, and an expected tenure in office of five electoral terms.

To get an estimate of $q - s$ consider the cases in which incumbents lost and winners were at least temporarily impeded from assuming office. In 19 cases winners ended up assuming office. In 53 cases, however, they were prevented from taking over. In 23 among these cases, defeated incumbents retained office while in the remaining 30 some third party, typically the military, took over. Hence, the probability that the incumbent ends up retaining office when the winner is prevented from assuming it directly is $q - s = 23/(19 + 53) = 0.32$.

The historical record, therefore, enables us to parametrize the values of q, s, and p. We cannot, however, observe $r(f^*)$, f^*, and $p(m, 0)$. We know only that the probability that an incumbent who ran in an election would win and assume office is $p[(1 - r) + r(q - s)] = 2008/2648 = 0.76$. To derive the unobserved values, we solve this equation for $r(f^*) = 0.07$. In turn, making our standard calibration assumptions, $\alpha = 0.51$, $r(0) = 0, \beta = 0.6$, we calculate $f^* = 0.11$, and $p(m, 0) = 0.735$.

Hence, given the observed world, we estimate the probability of holding office for one year by force alone to be $q = 0.61$, the loss of coercive power as a consequence of an electoral defeat to be $s = 0.29$, and the probability of winning to be $p = 0.79$. In turn, under some assumptions, the probability of winning without any fraud turns out to be $p(m, 0) = 0.74$ and the optimal extent of fraud is $f^* = 0.11$. While this extent of fraud may appear high, values of other parameters seem reasonable. All we can say is that the estimate is of average fraud, and it may be miniscule most of the time and massive some of the time.[8]

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[8]For example, in Korea in 1960, "the government reverted to its long-standing practice of cheating in the counting of ballots. The cheating was carried out with such vigor by the local authorities that on election night the Ministry of Interior was confronted with what looked like a 90 percent victory for Lee [the

Note that the odds of incumbents winning without any fraud are 3 : 1, while the odds of winning with the optimal extent of fraud are 4 : 1. Fraud helps but it can help only those incumbents who have good odds of winning even without it, either because they enjoy authentic popular support or because they manipulate electoral rules.

Indeed, for a long time elections were characterized by a blatant use of government power for partisan purposes. This was true, even if unsuccessful, in the United States between 1796 and 1800 (Dunn 2004, Weisberger 2000). The idea of an official government list submitted to voters for a plebiscitary approval was present in France already under the Directorate (Crook 2002), used under Restoration, and perfected under Napoleon III (Zeldin 1958). The Spanish monarchy gained in this way such control over voters that between 1876 and 1917 "The system worked 'from top to bottom': the king named his head of government, who convoked elections, which had, of necessity, to bestow a large majority on his party" (Garrido 1998: 218). The same was true in Portugal between 1851 and 1869 (Birmingham 1993: 132). Promoting government candidates was not a transgression but a duty of public officials: the French Prime Minister, de Vilèlle, issued in 1822 a circular according to which "All those who are members of my ministry must, to keep their jobs, contribute within the limits of their right to the election of M.P.s sincerely attached to the government" (cited in Zeldin 1958: 79). While his sincerity was not generally shared, lists of "government candidates" were a frequent device in Europe as well as Latin America. Incumbent parties did not lose elections in Denmark between 1849 and 1901, in Italy between 1946 and 1994, in Japan between 1949 and 1993, in Luxembourg between 1857 and 1874, and in Norway between 1814 and

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government candidate]. Since this was an obviously absurd figure, orders went out to reduce the majority to 75 percent of the total vote." (*Encarta*, "Korea 1960").

1891. Following Chile after 1831 (about which see Valenzuela 1995), several Latin American countries established stable systems of succession in which incumbent presidents completed their terms, faithfully obeyed term limits, chose their successors, and used governmental power to assure their victory at the polls. The stability of such systems – Chile between 1831 and 1871, Nicaragua between 1856 and 1890, Brazil between 1894 and 1930, Argentina between 1897 and 1916, Uruguay between 1898 and 1932, Mexico between 1934 and 2000 – was remarkable. Among the countries that became independent after the Second World War, the same is true of Botswana between 1965 and the present, Senegal between 1978 and the present, and Malaysia from 1955 to the present.

Since fraud is illicit, only scattered estimates of its frequency are available. Moreover, since self-interested speech – speech that can be predicted from interests – is not credible (Austen-Smith 1993), claims made by defeated opponents must be taken with a grain of salt. As a result, our attention is attracted only by flagrant instances. But there appear to be many. The subtitle of Campbell's (2005) history of fraud in the United States is "A Political Tradition." In Costa Rica, parties used 47 different types of fraud, including the inappropriate exclusion of voters, the purchase of votes, changes in the location of polling places on election day, and alterations of ballots (Lehoucq and Molina 2002). In early 20th century France, voters were given half a banknote prior to election and the other half if the candidate won (Schaffer and Schedler 2007: 24); in Chicago, they were given one shoe before and the second one after: the origins of the expression "when the other shoe drops." In the borough of Stafford, England, parties spent more than 5,000 pounds on 850 voters to buy their support in elections in 1832 (Lehoucq 2007: 35). In Adams County, Ohio, in 1870, 25 percent of voters sold their votes for whiskey (Lehoucq 2003). And even after the

1890 electoral reforms providing for secret ballot in New York State, parties succeeded in paying voters to stay at home (Cox and Kousser 1981). In turn, up to one-third of the electorate in New Jersey commonly accepted money for their votes during the Progressive Era (Argersinger 1985-86: 674). As Posada-Carbó (2000: 629) observes, "This evidence from the USA and Europe serves to confirm... Throughout the nineteenth-century and during the first decades of the twentieth century electoral corruption was not unique to Latin America."

Moreover, fraud is not a phenomenon of the distant past. In Palermo in the 1970s, Christian Democrats distributed public sector jobs along with free pasta and shoes in exchange for support (Baland and Robinson. 2007: 123). In 1993 Taiwan, the Kuomintang bought 14,090 votes for 300 Taiwanese dollars each (Wang and Kurzman. 2007: 66). In the Philippines in 2001, 10.1 percent of voters reported having been offered gifts (Lehoucq 2003); in Argentina in 2001, 12 percent did (Stokes 2005); and in Mexico in 2000 as many as 26.1 percent did (Cornelius 2004). In 2004 eastern Kentucky, a candidate for district judgeship was accused by prosecutors of giving $50 checks to voters, implicitly in return for their support (Stokes 2005). And fraud goes beyond illegal vote-buying (Bassi et al. 2007: 7-8). In sum, electoral fraud continues to be widespread: Simpser (2004) estimates that between 19 and 36 percent of presidential elections were "flawed," "corrupt," or "fraudulent" during the 1975-2000 period.

Finally, we learn that detection technology importantly affects the extent of fraud. Fraud is more likely to be detected if elections are administered by a body independent of the current executive or if some third party monitors the manner in which elections are conducted and the ballot are counted. Consider four common arrangements: (1) The executive administers elections and the legislature certifies the results, (2) The executive administers and

a judicial organ, perhaps specialized, certifies, (3) An independent body administers and a judicial organ certifies, and (4) An independent body administers and certifies. According to Lehoucq (2002), when representative institutions were established, the first system was instituted everywhere. Administration of elections by a body independent of the executive was an innovation introduced in Canada 1920, followed by Chile in 1925 and Uruguay in 1932. According to IDEA's 2006 survey of 214 countries and territories, the first system still prevails in 26 percent of countries covered, in 15 percent elections are administered by the executive and an independent judicial body certifies, while electoral management bodies are nominally independent in 55 percent of countries (Wall et al. 2006; In remaining 4 percent, elections are not held). Obviously, as studies of independent central banks have demonstrated, nominal independence does not guarantee an effective one and, as the U.S. 2000 election demonstrated, even judicial bodies can have partisan preferences. But it is clear that the first system allows the incumbent wide latitude: fraudulently elected supporters of the incumbent have no incentives to question results of the election. In turn, the independence of the Mexican Instituto Federal Electoral, established in reaction to the electoral fraud of 1988, was crucial in allowing the victory of the opposition in 2000 (Eisenstadt 2004). Independent observers can also reduce fraud, if they have strong capabilities to detect irregularities and are able to make credible statements regarding the degree of fraud (Carothers 1997, Nevitte and Canton 1997, Hyde 2006). Note, however, that the mode of administration and certification of elections, as well as the presence of independent observers, are subjects of decisions by incumbents: one must ask why they would ever agree to control of elections being taken out of their hands (Mozaffar 2002, Eisenstadt 2004, Magaloni 2007).

4　Understanding Political Regimes

The conditions for elections to be competitive are narrow. When incumbents are not afraid to rule by force alone, they do not hold elections which they may lose. When they decide to take their chances in elections, they have several instruments to make their victory secure. But when the coercive apparatus cannot be instrumentalized for partisan purposes and when the ruling elite splits when fraud is detected or the incumbent suffers an electoral defeat, elections become competitive.

"Civilian control over the military" does not sustain competitive elections when it means simply control by the particular civilians who happen to be the chief executives. When civilian rulers attempt to instrumentalize the armed forces or the police for partisan purposes, the latter face a dilemma, forced to decide whether they should obey. When President Boris Yeltsin called on the Russian army to shell the parliament, the armed forces were obeying their civilian superior. In contrast, General Fidel Ramos in the Philippines circumvented civilian control to support Corazon Aquino's challenge to Ferdinand Marcos and competitive elections were instituted. Partisan use of the police and other state apparatuses to intimidate or spy on the opponents is endemic: just think of President Nixon's instrumentalization of the FBI and the IRS. Competitive elections are possible only when the military and the police are neither willing to serve as an instrument of partisan interests nor eager to replace constitutionally selected rulers at a slightest pretext. While we tend to take it for granted that the military leave the barracks only to defend their countries against legally qualified foreign threats and that the police is neutral with regard to partisan interests, this perception is far too complacent. Somehow, the President of the United States or the Prime Minister

of Sweden cannot mobilize the coercive apparatus to keep themselves in power, while many other rulers could and did. Why it is so, however, is not obvious.

The loss of coercive power in the face of electoral defeats or recognition of fraud may occur because such events unify citizens against the rulers but a more plausible mechanism is that these events induce splits or even defections within the ruling block (Magaloni 2007).[9] When a ruler holds an election and is unable to assure a clean victory, members of the coercive apparatus must envisage the possibility that the ruler may fall and they may be held individually responsible for any acts of repression. Hence, they become hesitant to take this risk (Przeworski 1988): after General Pinochet lost the 1988 plebiscite to extend his term, the other members of the Chilean junta refused to override the result by force (Barros 2002). Even civilian members of the ruling group may be tempted to jump ship, hoping to be rewarded for tipping the scales in favor of the opposition if the latter succeeds in overthrowing the regime. After successive elections in which the incumbent president, Daniel Arap Moi, garnered only a plurality of votes, elites in Kenya defected from the ruling coalition to join the opposition in challenging him in the 2002 elections (Kasara 2005). And when an electoral defeat causes important defections, the incumbent has to choice but to yield to the verdict of the polls.

The coercive capacity of the ruling block and its vulnerability to internal divisions, and perhaps the extent of "genuine" support, are the only exogenous features of the environment in which incumbents make decisions. Everything else – whether elections are held at all,

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[9] Here is *The Economist's* (online, December 6, 2007) interpretation of the 2007 Duma election: "Caught in his own system, Mr. Putin seems to have decided he could not rely on any of the factions.... This is why he turned the parliamentary election into a display of his own power. It is not the Russian people, or the outside world, who needed convincing of his strength, but his own elites."

whether an opposition is given any chance to win, and whether incumbents yield when the opposition does win – is endogenous.

If this perspective is correct, the entire literature concerning the classification of political regimes is misconstrued. When Przeworski et al. (2000) classify regimes in terms of whether the chief executives and legislatures are elected, whether there is more than one party, and whether incumbents ever lost, they take as defining features what are consequences rather than causes. The same is true of Polity as well as of the Freedom House: "constraints on chief executives" or "civil and political freedom" are equally endogenous. The virtue of such classifications is that at least some of them are replicable given the rules of classification and observable facts,[10] so that this may be a reasonable empirical strategy. But conceptually this way of thinking diverts our attention from the essential features of political regimes, namely control over physical force. All politicians want to stay in power; the question is whether they can. Regimes are autocratic when rulers can govern by force alone; they are authoritarian when rulers can afford to hold elections which they are certain to win; they are democratic when the rulers are compelled to tolerate a chance that they may lose and when they are forced to leave when they do lose.

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[10]This is true of Przeworski et al. (2000), less so of Polity, and even less of Freedom House scales.

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6   Appendix: Proofs

6.1   Second-order condition

In the S world, the first order condition $dV_S/df = 0$ is

$$(\frac{dEU_S}{df} - p_f q_Y \rho V_Y)(1 - \rho \pi_S) + \rho \frac{d\pi_S}{df}(EU_S + (1-p)q_Y \rho V_Y) = 0 \tag{5}$$

where,

$$\frac{dEU_S}{df} = [p_f - (p_f r + pr_f)][U(o+e) - q_Y U(o)]$$

$$\frac{d\pi_S}{df} = \frac{d}{df}\{p(1 - r + rq_Y)\} = p_f - (p_f r + pr_f)(1 - q_Y).$$

Making all the substitutions, we can rewrite the first order condition as

$$[p_f - (p_f r + pr_f)]\{[U(o+e) - q_Y U(o)](1 - \rho p r q_Y) + \rho q_Y[U(o) + (1-p)\rho V_Y]\}$$

$$+(p_f r + pr_f)\{\rho q_Y[p(1-r)(U(o+e) - q_Y U(o)) + q_Y(U(o) + (1-p)\rho V_Y)]\}$$

$$-p_f\{\rho q_Y[1 - \rho p(1 - r + rq)]V_Y\} = 0$$

Let the consecutive terms in curly brackets be respectively $A, B,$ and C, and rewrite as

$$p_f[A(f) - C(f)] - (p_f r + p r_f)[A(f) - B(f)] = 0 \tag{6}$$

Assume that $p(f)$ is concave and $r(f)$ convex. Then p_f declines in f, $(p_f r + p r_f)$ increases. Now, it can be shown that $A(f) > B(f)$. Hence, $\frac{dV_S}{df} = 0$ identifies a maximum. This maximum is internal if $A(f) - C(f) > 0$ (which cannot be determined analytically but holds in all calibrations) and $p_f[A(0) - C(0)] > (p_f r + p r_f)[A(0) - B(0)]$ while $p_f[A(1) - C(1)] < (p_f r + p r_f)[A(1) - B(1)]$ but may occur at the corners (although again in never does when the model is calibrated.)

In turn, in state Y,

$$(\frac{dEU_Y}{df} - p_f \rho U(c))(1 - \rho \pi_Y) + \rho \frac{d\pi_Y}{df}(EU_Y + (1 - p)\rho U(c)) = 0 \tag{7}$$

where,

$$\frac{dEU_Y}{df} = [p_f - (p_f r + p r_f)] U(o + e) + (p_f r + p r_f)(q_Y - s)U(o) - p_f U(c)$$

$$\frac{d\pi_Y}{df} = p_f - (p_f r + p r_f)(1 - (q_Y - s)).$$

Let $\frac{U(o+e) - (1+\rho)U(c)}{U(o+e) - (q_Y - s)U(o)} \equiv h < 1$ and $\frac{(1+\rho)U(c)}{U(o+e) - (q_Y - s))U(o)} = u^*$. Making all the substitutions, we can rewrite the first order condition as

$$p_f\{(h-r) + \rho[1 - r(1 - (q_Y - s))]u^*\}$$

$$-pr_f\{1 - \rho p(1 - r(1 - (q_Y - s))) + \rho(1 - (q_Y - s))[p(h - r) + u^*]\} = 0 \qquad (8)$$

Since p_f declines in f, pr_f increases in f, and the expressions in the curly brackets are positive, $\frac{dV_Y}{df} = 0$ identifies a maximum.

6.2 Comparative statics

To apply the implicit function theorem, we need to differentiate the functions $V_{\{S,Y\}}$ evaluated at f^* with regard to $q_{\{S,Y\}}, s$, and u.

Proof of Proposition 1:

$$\frac{\partial V_Y}{\partial p(m,0)}\Big|_{f=f^*} \gtreqless 0 \iff r(f^*) \lesseqgtr r^*(\rho, q_Y, s; U(o+e), U(o), U(c)) \qquad (9)$$

because

$$\frac{\partial V_Y}{\partial p(m,0)} = \frac{(1-r)U(o+e) + r(q_Y - s)U(o) - (1+\rho)(1 - \rho(1 - r + r(q_Y - s))U(c)}{(1 - \rho\pi_Y)^2}.$$

Proof of Proposition 2:

$$\frac{\partial V_Y}{\partial q_Y}\Big|_{f=f^*} > 0 \qquad (10)$$

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because

$$\frac{\partial V_Y}{\partial q_Y} = \frac{pr[1 + \rho p(1 - r)(U(o + e) - U(o)) + \rho(1 - p)U(c)]}{[1 - \rho p(1 - r + (q_Y - s)r)]^2} > 0$$

$$\frac{\partial V_S}{\partial q_S}|_{f=f^*} > 0 \tag{11}$$

It is sufficient to write this derivative out to realize that all the terms are positive (note that $\partial V_Y/\partial q_S = \partial V_Y/\partial q_Y > 0$):

$$\frac{\partial V_S}{\partial q_S} = [(1 - p(1 - r))U(o) + (1 - p)\rho(V_Y + (q_S - s)\frac{\partial V_Y}{\partial q_S})][1 - \rho p(1 - r(1 - (q_S - s)))]$$

$$+\rho pr[p(1 - r)U(o + e) + (1 - p(1 - r))(q_S - s)U(o) + (1 - p)(q_S - s)\rho V_Y] > 0$$

Proof of Proposition 3:

$$\frac{\partial V_Y}{\partial s}|_{f=f^*} < 0, \frac{\partial V_S}{\partial s}|_{f=f^*} < 0 \tag{12}$$

Obvious.

Proof of Proposition 3:

$$\frac{\partial V_Y}{\partial s}|_{f=f^*, q_Y - s} = 0, \frac{\partial V_S}{\partial s}|_{f=f^*, q_S - s} > 0 \tag{13}$$

Note that

$$\frac{\partial V_Y(q_Y, s)}{\partial s}\Big|_{f=f^*, q_Y-s} = \frac{\partial V_Y}{\partial q_Y}\Big|_{f=f^*} \frac{dq_Y}{ds}\Big|_{q_Y-s} + \frac{\partial V_Y}{\partial s}\Big|_{f=f^*}.$$

But given the assumption that $q_Y - s$ is constant, $\frac{dq_Y}{ds} = 1$ and $\frac{\partial V_Y}{\partial q_Y} = -\frac{\partial V_Y}{\partial s}$. In turn,

$$\frac{\partial V_S(q_S, s)}{\partial s}\Big|_{f=f^*, q_Y} = \frac{\partial V_S}{\partial q_S}\Big|_{f=f^*} \frac{dq_S}{ds}\Big|_{q_Y} + \frac{\partial V_S}{\partial s}\Big|_{f=f^*} > 0$$

Note first that $q_S = q_Y + s$, so that $\frac{dq_S}{ds}\Big|_{q_Y} = \frac{d(q_Y+s)}{ds}\Big|_{q_Y} = 2$. Hence, $\frac{\partial V_S(q_S,s)}{\partial s}\Big|_{q_Y} = 2\frac{\partial V_S}{\partial q_S} + \frac{\partial V_S}{\partial s}$. Simple algebra shows in turn that $2\frac{\partial V_S}{\partial q_S} + \frac{\partial V_S}{\partial s} = A + B(2\frac{\partial V_Y}{\partial q_S} + \frac{\partial V_Y}{\partial s})$ where A and B are positive constants. Finally, since $q_Y - s = q_S - 2s$, $\frac{\partial V_Y}{\partial q_S} = -2\frac{\partial V_Y}{\partial s}$. Hence, $2\frac{\partial V_Y}{\partial q_S} + \frac{\partial V_Y}{\partial s} = 0$ and $\frac{\partial V_S(q_S,s)}{\partial s}\Big|_{f=f^*, q_Y} = A > 0$.

Proof of Proposition 5:

$$\frac{\partial V_Y}{\partial u}\Big|_{f=f^*} > 0, \frac{\partial V_Y}{\partial u}\Big|_{f=f^*} > 0 \tag{14}$$

That $\frac{\partial V_Y}{\partial u}\Big|_{f=f^*} > 0$ is obvious. In turn, $\frac{\partial V_S}{\partial u}\Big|_{f=f^*} = \frac{(1-p)q_Y\rho}{1-\rho p(1-r+rq_Y)} \frac{\partial V_Y}{\partial u} > 0$.

By implicit function theorem, these derivatives imply the five propositions.