Economic growth, political institutions, and leadership transitions

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Abstract:

Leaders matter for growth, but does growth matter for leaders? We introduce a set of strong instruments for growth, based on hill-shaped relationships of agricultural output with temperature and precipitation, to test the causal effect of growth on national leadership turnover, after controlling for educational, demographic, and a range of institutional and policy factors. We find that: (i) growth significantly reduces the probability of leadership transitions, (ii) transitions to democracy robustly accompany leadership transitions after controlling for growth, policies, and institutions, and (iii) during times of major institutional change, growth has a less precise but substantially positive effect on leadership transitions.

Keywords: Political transitions, leaders, economic growth, political economy

JEL codes: C53, H89

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I. Introduction

In a highly influential paper, Jones and Olken (2005) exploit exogenous leadership transitions induced by deaths of national leaders to demonstrate that leaders matter for growth, especially in autocratic settings where leaders face fewer constraints on their power. In addition to growth, they show that such exogenous executive transitions also affect policy outcomes, in particular monetary policy. This celebrated result that "leaders matter" for growth and policy outcomes begs a closely related question: does "growth matter" for leaders, in terms of their short-term probability of remaining in power? We are interested in identifying the principal factors, drawn from the categories of economic growth, political institutions, leader characteristics, and macroeconomic policies, which drive transitions of leadership of the executive branch in countries across the world.

For this purpose, we construct a database of leadership transitions, growth, policies, and political variables for 157 countries during the period 1964-2004. In our study, we find that economic growth significantly reduces the short term probability of a change in the identity of the leader of the executive branch of government in the following year. This result is robust to the inclusion of educational and demographic controls, measures of the type of political regime on the scale of autocracy to democracy, fixed country and year effects, and instrumentation of economic growth with a set of strong, plausibly exogenous instruments. The instrument set for economic growth we introduce in this paper is new to the literature, but builds upon important prior contributions by Burke (2011), Burke and Leigh (2010), Mendelsohn, Nordhaus, and Shaw (1994),

Mendelsohn and Schlesinger (1999), and Mendelsohn et al. (2000). In particular, in their recent paper on the effects of growth on the probability of transitions to democracy, Burke and Leigh (2010) instrument economic growth in a worldwide, panel-data setting with precipitation, temperature, and commodity price indices, the latter of which are similar to those used by Deaton and Miller (1995), Collier and Goderis (2007), and Goderis and Malone (2011). In this paper, we employ the same commodity price indices as instruments, but modify the instruments measuring the impact of temperature and precipitation on output. In particular, we take inspiration from findings in the science of climate response functions by Mendelsohn, Nordhaus, and Shaw (1994), Mendelsohn and Schlesinger (1999), and Mendelsohn et al. (2000), which indicate hill-shaped, or inverse-U relationships between agricultural production and temperature, and agricultural production and rainfall, respectively. To complete our instrument set, we add an export partner growth index constructed and employed by Burke (2011). These innovations, as we demonstrate in the context of both Burke and Leigh's (2010) study of the effect of growth on democratic transitions, as well as in the context of our own exercises, produce a substantially stronger set of instruments for economic growth than those proposed by Burke and Leigh (2010), which will be of independent interest to researchers wishing to instrument growth in applications involving international panel data.

For our core result on the effect of growth on leadership transitions, the point estimates have magnitudes that are economically as well as statistically significant, implying that an increase of the growth rate of real GDP-per-capita by 1 percentage point implies a fall of between 1.5 and 2.5 percent in the probability that the leader of the executive branch will lose his or her job in the following year. Other things equal, therefore, an increase in economic growth of GDP-per-capita by one sample standard deviation implies a reduction in the probability of job loss in the following year of between 9.5 percent and 16 percent, compared to a sample average probability of job loss of 16 percent in a given year in our sample. Growth, in other words, does indeed matter substantially for leaders.

In addition to this fundamental result, we find that leadership transitions in the executive branch often, although not always, accompany transitions to democracy in the same year, and that a high degree of legislative power helps deter leadership transitions at the executive level, while regularly scheduled elections are robustly associated with a higher probability of transition. In particular, transitions to democracy are robustly and significantly associated with leadership transitions in the same year, with a point estimate of the effect falling in the range from 43-46 percent in nearly all our specifications. Given the fact that 54 percent of democratic changes during the period from 1964-2004 were associated with a leadership change event in the same year, it appears that controlling for a range of political, macroeconomic, and development indicators, as well as instrumented growth, can only explain a modest fraction of the contemporaneous conditional relationship between transitions to democracy and national leadership transitions. In contrast to the importance of contemporaneous transitions to democracy for explaining leadership transitions, democratic transitions in years immediately prior to the leadership transition add no additional explanatory power after controlling for transitions to democracy in the same year.

Just as, in the spirit of Weber (1947), Jones and Olken (2005) find that "the degree to which political leaders may affect economic outcomes may depend on the institutional context" (ibid, p. 839), we conclude that the degree to which economic outcomes affect leadership transitions depends on the institutional and political context as well. Estimates of the magnitude of the average effect of growth on the probability of a leadership transition in the following year, before taking into account the interaction of growth with the dummy for democratic transitions, underestimate by 25% the magnitude of the effect of economic growth on the probability of a leadership transition during years without a transition to democracy. However, the overall effect of growth on leadership transitions during times of such major shifts in the institutional structure, while less precisely estimated, is positive and quite large in magnitude when compared to its (negative) effect during times of

institutional stability: the size of the coefficient of economic growth during years of transitions to democracy is approximately nine times that of the coefficient during years in which such transitions do not occur.

Given the somewhat surprising fact that the causal effect of growth on the probability of a leadership transition during times of institutional stasis is negative, whereas it is positive during periods of institutional upheaval, we attempt to rationalize this difference. We suggest, in the spirit of the events that characterized the "Arab spring" of 2011 in countries such as Tunisia, Egypt and Libya, that the rejection of the autocratic form of government is often tantamount to a rejection of the autocrat who runs it, or at the very least, the elite he supports and represents. To support this view, in addition to our finding that transitions to democracy are robustly and significantly associated with leadership transitions in the same year, even after controlling for a range of potentially mitigating factors, we compare the conditional distribution of leader tenure in power during co-transition years (in which both the leader changed and the form of government changed to democracy) to the corresponding distribution across all country-years of leadership transitions. We find that the average tenure of leaders in power during the year of a co-transition is slightly more than the average tenure during democratic transitions overall, and more than twice the average tenure of leaders in power during years of leadership transitions overall. The latter difference is significant at the 1% level, and is exacerbated at higher quantiles of the respective conditional distributions. Taken together, our findings suggest that exogenously driven increases in growth preceding transitions to democracy, especially when the benefits of such growth are widespread, may in fact increase the probability of success by the majority in opposing a long-standing autocrat and the elite he represents. This may account for why the effect of growth on leadership transitions works differently in times of institutional transition as opposed to times of institutional stasis.

The rest of this paper is organized as follows. Section II briefly reviews the relevant literature. Section III describes our dataset on leaders, growth, policies, and institutions. Section IV lays out our instrumentation strategy for economic growth. Section V presents our main results on the effect of economic growth and political institutions on leadership transitions from linear, fixed effects logit, and IV probit probability models. Section VI presents evidence on conditional distributions of leader tenure in order to shed light on the distinct effects of growth on leadership transitions during co-transitions of leadership and institutions. Section VII evaluates the robustness of our main results to use of data from alternative data sources, alternative definitions of growth, and the inclusion of additional control variables. Section VIII concludes.

II. Literature Review

While there is a large election forecasting literature in political science, which has employed a variety of statistical methods to the end of forecasting the outcome of US presidential and legislative elections, knowledge of the drivers of political transitions at the international level is somewhat limited.[1] Existing empirical insights on the causes of international political turnover, which have informed work in political economy, are based primarily on country case studies. Acemoglu and Robinson (2001), for instance, draw inferences from the work of Stephan Haggard and Robert R. Kaufman (1995) on transitions to democracy in Latin America in developing their theory of political transitions. In particular, they emphasize the notion that "…regime changes are more likely during recessionary periods because costs of political turmoil, both to the rich and to the poor, are lower during such episodes" (p. 939). The evidence uncovered in this paper lends qualified support to this idea: there is clearly a causal arrow from higher economic growth to a lower probability of a short term leadership transition, other things (in particular the nature of political institutions) being equal. During transitions from

[1] See e.g. Rosenstone (1983) Lewis-Beck and Rice (1992), Campbell (1992), Sigelman, Batchelor, and Stekler (1999), and Campbell (2008) regarding forecasting models of US elections, as well as Fair's (1978) early paper linking economic events to the US presidential election outcome.

autocracy to democracy, however, simultaneous transitions in national leadership are common but their probability is on average positively related to lagged, instrumented economic growth in such instances, implying that positive exogenous growth shocks make leadership changes more likely. Our results therefore imply that future researchers should pay careful attention to the distinction between transitions in political leadership versus in political systems, as well as the nature of their interaction, when developing new models of the political economy of regime change.

Of the few empirical studies that have inquired into the causes of regime change at the international level in political science, the focus has been primarily on *coups d'êtat* and shifts into and out of democracy. In this vein, Mark J. Gasiorowski (1995) and Adam Przeworski et al. (1996), using different international datasets, demonstrate that recessions significantly increase the probability of a coup. Adam Przeworski et al. (1996), who focus specifically on transitions into and out of democracy in 135 countries around the world, show in addition that growth with moderate inflation, as well as affluence, declining inequality, and parliamentary institutions, increase the probability of a transition to democracy in the following year.

In more recent work whose results contradict somewhat those of Przeworski et al. (1996) regarding the effect of growth on transitions to democracy, Burke and Leigh (2010) show that faster economic growth reduces the short-run likelihood of institutional change towards democracy, using an instrumentation strategy for growth that involves variation in precipitation, temperatures, and commodity prices to estimate the causal effect of lagged economic growth on the probability of transition to democracy in the following year. When our refined instrumentation strategy for growth, which we describe in detail in section IV, is applied to their dataset, we find that the magnitude of the point estimate of the effect of economic growth on the probability of a transition to democracy in the following year rises by approximately 20 percent, thus confirming and strengthening their original findings.

Two additional contributions closely related to our own are those by Leigh (2009) and Malone (2011). Leigh (2009) examines the issue of whether worldwide economic growth swings national elections, and whether luck (world growth) or skill (national growth relative to world growth) plays a more important role. His dataset consists of 268 democratic elections held between the years 1978 and 1999, with the dependent variable set equal to one in the event there was a change in the party of the chief executive (president or prime minister) in a given year, and zero otherwise. He finds that an extra percentage point of world growth boosts incumbents' chances of re-election by 9 percent, while an extra percentage point of national growth relative to world growth only boosts an incumbent's chances of re-election by 4 percent and that voters are more likely to reward competence in countries that are richer and better educated. Our paper differs significantly from the Leigh (2009) contribution, in that his focus is exclusively on a specific set of (potential) determinants of national elections, and is limited to democracies.

Malone (2011), who examines the consequences for the chief executive of economic growth and sovereign default, finds that a sovereign default event has the same adverse effect on the probability of a change in leadership during the same year as a 3.5 standard deviation fall in economic growth. While the paper by Malone (2011) focuses on the same dependent variables as our paper, he tests the effect of a contemporaneous sovereign default on the job prospects of the head-of-state in the same year, controls for a limited number of variables besides default events, one of those being contemporaneous growth, and ignores potential endogeneity issues between contemporaneous default events and growth with executive transitions in the same year. This is understandable, given that the primary goal of that paper is to provide an initial body of evidence on the political incentives of incumbent politicians in the face of debt overhang, to support the theory of political gambling for redemption that is developed therein. Important predecessors of the Malone (2011) paper are the book by Cooper (1971) and the paper by Frankel (2005), which focus on determining the impact of currency

crises on the short-term job prospects of leaders in developing countries. Neither of those contributions, however, goes to great lengths to control for other factors that may affect the probability of job loss.

Papers such as Chang (2010) provide limited evidence for the Latin American context on the probability a left-wing candidate will win an election as a function of external shocks, but again leave important issues of endogeneity aside, as the empirical exercise is meant to be suggestive and to complement theoretical results that are more central to that paper. While the causal impact of financial crises on executive transitions that concerns the above authors is an important issue in its own right, especially in light of recent events, we reserve this topic for future research. The reason for this decision is twofold. First, the techniques required to instrument binary variables (dummies for whether a given type of financial crisis, e.g. a sovereign default, occurred in country *i* in year *t*) in the context of limited dependent variable (e.g. a binary variable for leadership transitions) models are non-standard (see Carrasco, 2001). Second, dealing with the potential endogeneity of financial crises would require a separate instrumentation strategy for financial crises, related to factors that affect the occurrence of a crisis but do not affect leadership transitions, which is quite distinct from the one we use for growth in this paper. We therefore opt to reserve this question as the subject for future research.

Perhaps the paper closest in spirit to ours is the recent manuscript of Burke (2011). Like Burke (2011), we examine the impact of lagged, instrumented economic growth on the probability of job loss by the head of state in a large international panel dataset, and present robust evidence that positive exogenous shocks to economic growth (usually) have a negative effect of the probability of job loss by the head-of-state in the following year. Our paper differs from his, however, in three important ways: we develop and apply a superior set of instruments for economic growth that are new to the literature, we document in detail the important phenomenon of co-transitions of political institutions and leadership and the significant reversal the effect growth has on leadership transitions in such situations, and we evaluate the robustness of our main results to a somewhat different set of control variables, including variables measuring legislative concentration and macroeconomic policy. To our knowledge, while Malone (2011) is the first work to examine the effect of economic growth on leadership transitions in a large international dataset with suitable control variables, both the present paper and that of Burke (2011) are the first to focus carefully on the causal effect of growth on the probability of leadership transitions in such a setting, albeit with the important differences noted above.

As a final point, it is worth saying something about why we focus specifically on shifts in the identity of the leader of the executive branch, rather than shifts in the political system itself or specific (but not necessarily representative) forms of regime change such as *coups d'êtat*. The first reason is the existence of a now ample body of evidence in the economics literature showing that specific measures of government and regime stability, such as the number of changes of the head-of-government or governing group over a specified period, are strongly related to a country's probability of default (Citron and Nickelsburg, 1987; Brewer and Rivoli, 1990; Kohlscheen, 2010), probability of experiencing a currency crisis (Leblang and Satyanath, 2008), rate of economic growth (Jones and Olken, 2005) and probability of experiencing a growth acceleration (Hausmann et al., 2005; Jong-a-Pin and Han, 2010). The second reason we choose to focus on de-facto shifts in personal political control is that, if political institutions affect economic growth, as argued forcefully by Acemoglu et al. (2003), and political leaders or the frequency of regime change are important for economic growth, as shown by Jones and Olken (2005) and Hausmann et al. (2005), then one channel for the effect of institutions on growth may be through differences in the determinants and predictability of executive turnover in countries with different political institutions. Given that Acemoglu et al. (2003) do not consider differences in the frequency of leadership turnover as a potential channel through which institutions may affect growth and volatility, it is useful to establish whether or not political institutions are related to the probability of executive turnover in the first place. As described in section V, we find that the POLITY score measuring the strength of democratic characteristics, as well as the percentage of countries in the region with a democratic form of government, are

both positively and significantly related to the probability of a leadership transition, as are incidences of transitions to a democratic form of government by the country in the same year. These findings suggest that, if democratic institutions are good for economic growth and stability, it is clearly not because they are associated with stability in the identity of the political leader or lower frequencies of leadership transitions. We now turn to a description of the data.

III. Description of the Data

Like Burke (2011), we take data on transitions of national leaders from the Archigos database, which tracks the political fates of heads-of-state, who may be classified as presidents or prime ministers, depending on the political system of the country. Our executive job loss variable, $jobloss_{it}$, is coded as a one if the head-of-state in country *i* loses his or her job in year *t*, and zero otherwise. Years in which job loss by the head-of-state coincided with the natural death of that individual are excluded from the dataset. This convention affects only seventy-one of our observations. The natural death of the national leader is also sourced from Archigos dataset from Goemans et al. (2009). In previous versions of this paper, we sourced our dependent variable from the website www.rulers.org. As the Archigos dataset has slightly better coverage, we leave the results obtained using the rulers.org data as a robustness check, which is available from the authors upon request.

Given that Burke and Leigh (2010) find that democratic change events and individual leadership changes are often a joint process, we use their dependent variable, a binary indicator for democratic change events[2], as well as their time-varying control variables as a baseline for our model specifications. More specifically, the dependent variable used by Burke and Leigh (2010) is a binary variable equal to one in years in which an institutional change towards democracy occurred, and zero otherwise. They use the Polity IV dataset in order to identify such democratic change events. The time-varying control variables used by Burke and Leigh (2010) are the development level (a categorical variable, included with a two year lag), education (the secondary school enrollment rate, included with a two year lag), a variable measuring the demographic structure (equal to the share of people aged 65 years and older, included with a two year lag), the POLITY score (an institution-based measure of regime type, included with a one year lag), the regime tenure in years (included with a one year lag), and the share of countries in the region that are democracies (included with a one year lag). The country-specific development level variable is equal to 0 when a country's per capita gross domestic product (GDP) is within 30 log points of its sample average, equal to +1 (−1) when it is 30–60 log points above (below) its sample average, and equal to +2 (−2) when it is 60 or more log points above (below) its sample average.

In addition the control variables sourced from Burke and Leigh's (2010) work on the drivers of democratic transitions, we control for macroeconomic policies and a range of political and institutional factors. The macro variables, which include the three-year average rate of money supply growth and the three-year average fiscal surplus-to-GDP measure, are drawn from the World Bank, IMF, Euromonitor, and Howard (1992) for Jamaica. The political and institutional factors are drawn from a variety of sources. The year of scheduled presidential elections and the Herfindahl index of legislative concentration are sourced from Keefer (2007). The Herfindahl index of legislative concentration is calculated based on the percentage shares of seats held per political party across the major legislative bodies (e.g. the House and the Senate in the United States),

[2] As noted in Burke and Leigh (2010): "countries experiencing foreign interruption, interregnum, or transition at the start of year *t* (end of year $t-1$) are excluded from the sample. Countries experiencing foreign interruption at the end of year *t* are also excluded from the sample... Years in which regime change coincided with the natural death of the national leader are excluded from the dataset… countries are excluded from estimations for years in which a positive value of the dependent variable is technically infeasible: in years in which the lagged POLITY score was 8 or higher in the case of democratic change regressions…".

and ranges from 0 to 1, where 1 indicates absolute concentration of legislative power in the hands of a single party. Political rights data are sourced from Freedom House. The political rights indicator ranges from 1 to 7, where 1 indicates strong political rights, and 7 indicates the weakest level of political rights. Creditor rights data are sourced from La Porta et al. (1998) and Djankov et al. (2007). The creditor rights variable ranges from 0 to 4, where 4 indicates strong creditor rights and 0 indicates the weakest level of creditor rights. The set of controls also includes the age of leader in power at the beginning of year *t* and the tenure of leader in power at the beginning of year *t*, both of which are drawn from Archigos dataset.

Table 1: Panel A-Summary statistics for control variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Job Loss of chief executive	4918	0.1619	0.3684	0	1
GDP per capita growth (t-1)	4918	1.6338	6.4251	-50.4899	90.0670
Country-specific development level (t-2)	4918	-0.0155	0.6175	-2	2
Secondary school enrollment rate (percent gross) (t-2)	4918	47.8685	33.2975	1	161.6618
Percent of the population aged 65 years and above (percent) (t-2)	4917	5.8665	4.0998	1.0826	18.8825
POLITY score (t-1)	4715	0.8072	7.6219	-10	10
Tenure of regime (t-1) (years)	4888	21.7494	28.9226	0	194
Democracy in region (Percent of countries) (t-1)	4918	46.8214	30.5100	0	100
Demo change event (t)	4888	0.0250	0.1560	0	1
Money supply growth (t-1),3-year Mov. Avg.	3908	18.5842	28.6049	-212.621	404.3781
Fiscal surplus/GDP (t-1),3-year Mov. Avg.	3608	-3.2948	6.8577	-60.79	47.0925
Herfindhal Index Total (t-1)	3165	0.5290	0.3056	0.0020	1
Year of presidential election	4867	0.1075	0.3097	0	1
Political Rights (1:Weak-7:Strong) (t-1)	3921	3.9214	2.1800	1	7
Creditor rights (0: weak cr; 4: strong cr) (t-1)	2891	1.7783	1.1813	0	4
Age of leader in power at start of year t (years)	4918	57.0675	11.1545	19	92
Tenure of leader in power at start of year t (years)	4917	7.1727	7.4271	0	46
Countries	157				
Period	1964-2004				

Table 1: Panel B-Summary statistics for Instrumental Variables (IVs)

Variable	Obs	Mean	Std. Dev.	Min	Max
Instruments from Burke and Leigh (2010)					
Growth rate of prec. (t-1)	4457	9022.1	122001.8	-506507.6	1071345
Conditional Change in temperature (t-1)	4457	0.1615	28.2173	-126.63	164.3399
Commodity price index (t-1)	4457	0.0103	2.9716	-37.2839	42
Refined Set of Instruments					
Change in precipitation (t-1)	4457	-14374.95	1324972	-6835915	9041107
Change in the square of prec. (t-1)	4457	-4.17E+07	5.43E+09	-3.93E+10	4.83E+10
Growth rate of prec. (t-1)	4457	9022.061	122001.8	-506507.6	1071345
Squared Growth rate of prec. (t-1)	4457	32324.64	8.23E+06	-1.24E+08	1.24E+08
Change in temperature (t-1)	4457	0.1911	28.21716	-126.63	164.3399
Change in the square of temp. (t-1)	4457	18.7918	1201.989	-6564.759	9235.904
Growth rate of temp. (t-1)	4455	-7.4698	1175.32	-53200	29800
Squared Growth rate of temp. (t-1)	4453	-14.3451	2298161	-1.06E+08	1.06E+08
Commodity price index (t-1)	4457	0.0103	2.971598	-37.2839	42.0037
Export Partner Growth (t-1)	4451	67.2763	98.05223	-562.5399	1018.573
Labor force in agriculture in 1961 (percent)	4457	57.7639	27.2267	1.6	95.1
Non-irrigated cropland in 1961 (percent)	4457	88.9525	18.4353	0	100

Notes: Precipitation and temperature data are available to 2000. Change, growth and square growth of precipitation are interacted with Labor force in agriculture in 1961 (percent) and Non-irrigated cropland in 1961 (percent). Change, growth and square growth of temperature are interacted with Labor force in agriculture in 1961 (percent). We multiply temperature variation by −1 for countries with an average temperature of less than 11.7ºC during the period 1960–1970.

Whereas summary statistics for the variables used in the primary models of job loss as a function of lagged growth and controls are shown in panel A of Table 1, panel B displays summary statistics for the variables used as instruments for economic growth in the first stage regressions of the linear and probit instrumental variables models. Our instrumental variable strategy for growth is described in more detail in section IV.

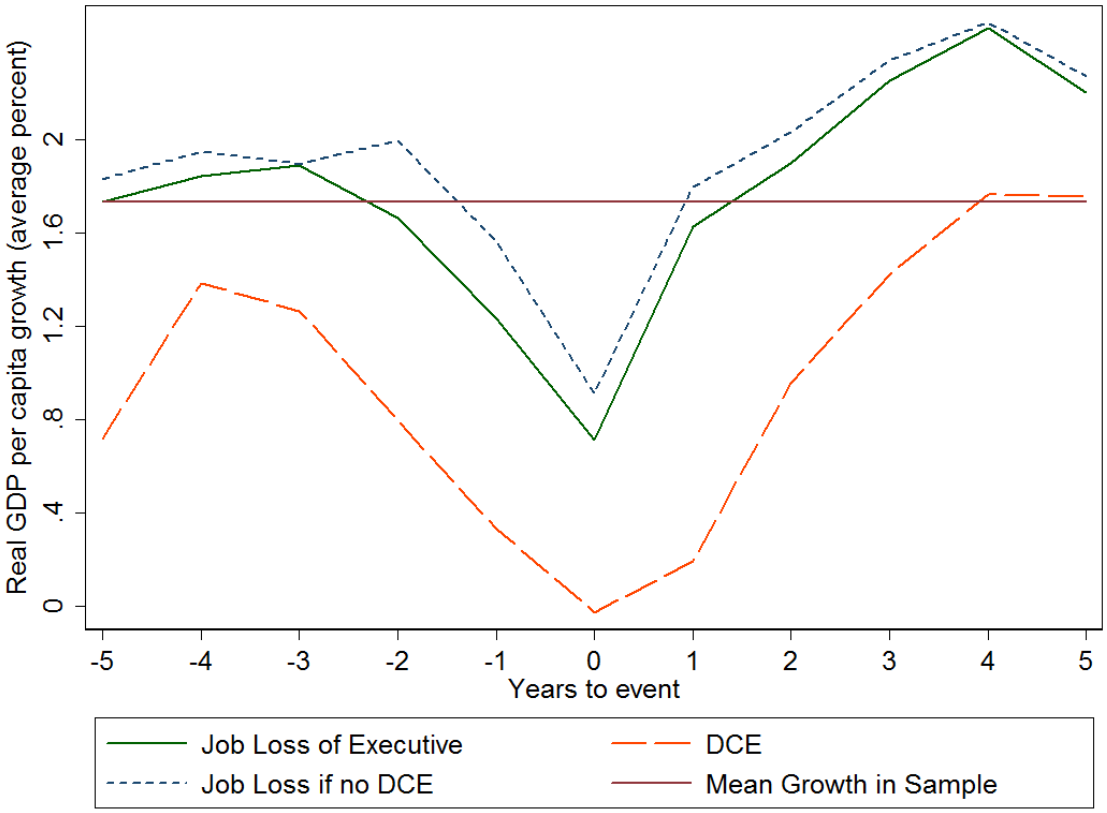

Figure 1. Average annual GDP per capita growth five years prior to and after the job loss of the executive and DCEs, respectively.

Notes: Calculations were done using GDP-per-capita growth taken from the World Development Indicators database, and Archigos for identifying job loss events. Five years of lagged and forward data are not available for all job loss events.

While we will focus on the effect of controlling for the concentration of legislative power, the year of scheduled presidential elections, political rights, and creditor rights in section VI, where we evaluate the robustness of our baseline results, we do not include one potentially interesting category of additional control variables that measure various forms of media penetration, as in the study of Leigh (2009). Leigh (2009) provides some suggestive evidence that media penetration rates affect the returns to luck (world growth) and competence (national growth relative to world growth) when it comes to rewarding national leaders at the party level in a sample limited to democracies during the period 1975-2000. While controlling for the same measures of media penetration Leigh (2009) used in his study[3] is potentially interesting, it is infeasible in our case for two reasons. First, Leigh (2009) employs purely cross-sectional data, which is the averaged over the period 1975-2000, whereas in this paper we are interested in exploiting both cross-sectional and temporal variation in the effects of economic growth on the probability of leadership transitions. Second, the availability of the data on media penetration is modest at best, as we only find around 541 observations available for use in our sample. As this is substantially below the number of observations in most of our models, which range from the 2000's to

[3] Specifically, these measures include the number of newspapers, number of radios and number of televisions per person averaged over the period 1975-2000.

the 4000's depending on which controls are used, we opt not to focus on the role of media penetration in this particular study.

To motivate our findings, Figure 1 plots the average real GDP-per-capita growth rate five years prior to, during, and five years after the job loss of the leader of the executive branch of government, averaged across countries and years during the period 1964-2004. The resulting pattern, in light of the findings of Jones and Olken (2005) on exogenous leadership transitions and growth, and those of the present paper on the causal effect of growth on leadership transitions, is striking. Per-capita economic growth declines steadily prior to the year of a leadership transition, and rises thereafter, to reach a peak four years after the year of the transition, at which point it resumes its decline. The differences in per-capita growth rates are large: average real per-capita growth is around 2 percent four years before and two years after the job loss event, versus just below 0.72 percent during the year in which the leadership transition occurs. While the causal linkages between leadership transitions and growth are impossible to sort out from this visual evidence, it confirms the importance of examining the linkage from both directions. Moreover, it is important to recall that while Jones and Olken's (2005) findings are based upon exogenous variation in leadership induced by natural deaths of leaders during the period since World War II, the scope of Figure 1 is much wider in terms of the number of leadership transitions covered—and unlike in the findings of Jones and Olken (2005), it appears that growth rises on average after leaders lose power. This suggests that importance of the causal linkage from growth to leadership transitions that is the focus of this paper may be much greater, on average, than that of the causal linkage from leadership transitions to growth documented in their study.

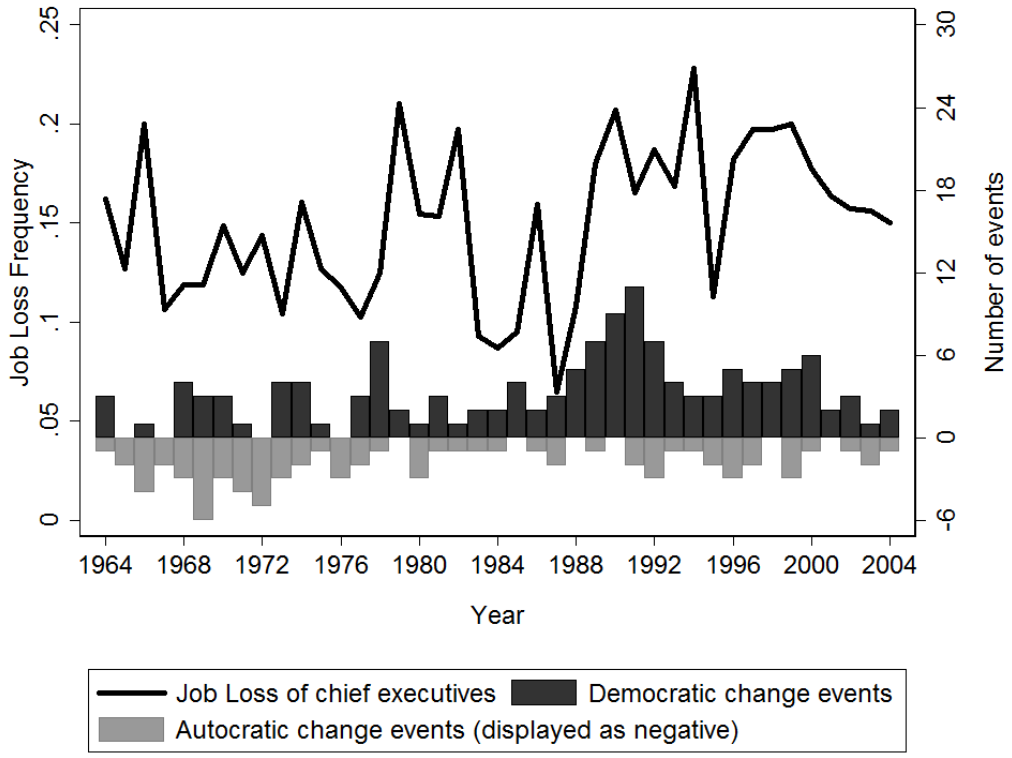

Figure 2. Global Frequency of Executive Job Loss and Democratic Change Events, 1964-2004

To complement the visual evidence of Figure 1, Figure 2 plots the frequency of job loss by leaders, averaged across the 157 countries in our sample, as a function of time during the period 1964-2004, along with the share of countries classified, according to Burke and Leigh (2010), as having experienced a transition to democratic or autocratic political systems, respectively, in a given year. There has been a slight trend upward in

the average frequency of leadership transitions over the period, and there is a clear and positive relationship between waves of democratic transitions and the average frequency of leadership transitions over time. In our dataset, in fact, we find that 54 percent of democratic change events during the period from 1964-2004 were associated with a leadership transition in the same year. We also find that job loss by the chief executive often precedes democratic change events (16 percent of the democratic change events occurred in the year after a job loss of the chief executive), or follow democratic change events (39 percent of the time, democratic change events were followed by a job loss of the chief executive in the two subsequent years). These figures are broadly similar to those reported in Burke and Leigh (2010).

IV. The Instrumental Variable (IV) Strategy for Economic Growth

Just as the solidity of the results on leadership transitions and growth found by Jones and Olken (2005) rests on the plausible exogeneity of the natural deaths of the group of national leaders considered in their study, so must the solidity of our results on growth and leadership transitions rest in large part on the quality of the plausibly exogenous set of instruments for economic growth in ours. It is for this reason that, despite the demonstrable quality of the instruments for growth that Burke and Leigh (2010) introduce in their study, we were compelled to develop and test a substantially improved set of instruments for growth, which are based on the science of agricultural production functions and a careful attention to the functional forms of the terms involving measures of temperature and precipitation.

The instrumentation strategy for economic growth we employ in this paper improves upon the strategy proposed and employed by Burke and Leigh (2010) in two important ways. First, and most importantly, we draw upon the work of Mendelsohn, Nordhaus, and Shaw (1994), Mendelsohn and Schlesinger (1999), Mendelsohn et al. (2000) on agricultural production and climate response functions, which posits and finds evidence for inverse square (hill-shaped) relationships between agricultural production and temperature, and agricultural production and precipitation, respectively. Second, we include temperature and precipitation variables in both differences and growth rates at all lags, including for the quadratic terms, to exploit more fully the set of plausibly exogenous instruments. The superiority of our refinement of Burke and Leigh's (2010) instrumentation strategy for growth is first demonstrated in the context of the empirical exercises from their original paper, and then applied to the question of interest in our own paper, which is the instrumentation of growth to estimate the causal effect of growth on leadership transitions at the national level.

Burke and Leigh (2010) instrument growth using three IV strategies. The first strategy is to instrument growth in year *t-1* with the percentage change in precipitation in years *t-1* and *t-2*, each multiplied by the percentage of the labor force in agriculture in 1961 and the percentage of cropland without irrigation in 1961. The second strategy is to instrument growth in year *t-1* with the change in temperature in years *t-1* and *t-2*, each multiplied by -1 for countries with an average temperature of less than 12°C for the period 1960-1970, as well as by a factor equal to the 1961 share of the labor force in agriculture. The third strategy is to instrument growth in year *t-1* with the year *t-1* log-difference of a country-specific commodity price index, of the kind employed by Deaton and Miller (1995), Collier and Goderis (2007), and Goderis and Malone (2011), multiplied by the value of exports of the 50 commodities as a share of GDP in the base year 1995.

According to Robert Mendelsohn and Michael E. Schlesinger (1999) the net productivity of sensitive economic sectors is a hill-shaped function of temperature, and according to Robert Mendelsohn, Wendy Morrison, Michael E. Schlesinger and Natalia G. Andronova (2000) the Ricardian agricultural model measures a quadratic effect with respect to precipitation with an optimum of 10.8 cm/mo. These findings are consistent with our intuition about global economic productivity: the effect of a higher temperature or precipitation on agricultural productivity is not the same, for example, in a subtropical zone as it is in an equatorial zone.

Based on the finding of quadratic relationships between agricultural production and temperature, and agricultural production and precipitation, respectively, we refined Burke and Leigh's (2010) instrumentation strategy in the following way. First, we infer that changes in agricultural production will involve terms for the changes in temperature and precipitation, as well as changes in the squares of temperature and precipitation. This can be seen in the following way. For a stylized agricultural production function $F_A(t, p)$ that is a quadratic function of temperature *t* and precipitation *p*, we have from first differencing that:

$$F_A(t, p) \cong a + b_1 t + c_1 t^2 + b_2 p + b_2 p^2$$
$$\Rightarrow \Delta F_A = b_1 \Delta t + b_2 \Delta p + c_1 \Delta(p^2) + c_2 \Delta(t^2)$$

This relation motivates the inclusion of the temperature and precipitation variables, appropriately scaled, in first differences and in the first differences of their squared values. Next, to further enrich the set of plausibly exogenous instruments for growth, we recognize that the growth of agricultural production (the change divided by the previous level) may be approximated as a linear combination of growth rates and squared growth rates of temperature and precipitation, respectively. Taking these two considerations together leads us to propose the following set of refined instrumental variables for economic growth: the changes in levels and changes in squared levels of temperature and precipitation,

$$\Delta t, \Delta p, \Delta(p^2), \Delta(t^2)$$

and the growth rates and squared growth rates of temperature and precipitation,

$$g_t, g_p, g_t^2, g_p^2$$

each multiplied by appropriate country-specific, time-invariant weighting factors.

As consistent with Burke and Leigh (2010), we weight temperature variables by agriculture labor share in 1961, and we weight precipitation variables by the product of the agriculture labor share in 1961, multiplied by the percentage of cropland without irrigation in 1961. To adjust for differences between "hot" and "cold" countries, we multiply temperature variation by -1 for countries with an average temperature of less than 11.7°C for the period 1960-1970[4].

Additionally to the weather-related instruments, we use two additional instruments. First, following Burke and Leigh (2010), we instrument growth in year *t-1* with the year *t-1* log-difference of a country-specific commodity price index. Second, following Burke (2011), we instrument growth in year *t-1* with the year *t-1* weighted export partner growth rate[5]. Our complete dataset consists of 4,718 observations for 41 years and 157 countries, after taking into account incomplete coverage for some variables. The data on our instruments for temperature and precipitation, however, are only available until the year 2000, limiting the IV estimation period to 1964-2000. Summary statistics for the instruments are presented in panel B of Table 1.

To verify that our instrumentation strategy represents a clear improvement over that of Burke and Leigh (2010), we compare the performance of our refined instrument set against that of their original instrument set for the preferred empirical model of transitions to democracy presented in their paper. Results from this exercise are displayed is columns 3 and 4 of Table 2, alongside their original results in columns 1 and 2. We

[4] This operation affects 25 percent of country-years. Robert Mendelsohn, Wendy Morrison, Michael E. Schlesinger and Natalia G. Andronova (2000) present estimates of optimum temperature for agriculture of 11.7 °C.

[5] Burke's (2011) definition of the export partner growth instrument is as follows: "Weights are based on the share of each export market in a country's total exports in 1995, using data from the International Monetary Fund's Direction of Trade Statistics. The weighted export partner growth rate is multiplied by the share of exports in GDP in 1995 to allow export partner growth to be of greater importance to economic growth in relatively more export-oriented economies."

Table 2. Instrumental Variable Results for Democratic Change Events using Burke and Leigh (2010) IV instruments and our Refined IV instruments

Estimation	IV (Fuller 1)	IV (Fuller 1)	IV (Fuller 1)	IV (Fuller 1)	IV (Fuller 1)
Excluded instruments	Burke and Leigh (2010), Burke (2011)	Burke and Leigh (2010)	Refined	Refined	Burke (2011)
	All	Temp. (t-1,t-2)	All	Temp. (t-1,t-2)	Exp Partner Growth (t-1)
	(1)	(2)	(3)	(4)	(5)
Panel A- No time-varying country controls					
GDP per capita growth (t-1)	-0.0047*	-0.0154**	-0.0042*	-0.0185**	-0.0013
	(0.0026)	(0.0075)	(0.0025)	(0.0078)	(0.0021)
R-squared	0.0124	-0.1922	0.0166	-0.2964	0.0287
F-statistic on excluded instruments	9.58	16.53	8.02	16	30.75
Panel B- With time-varying country controls					
GDP per capita growth (t-1)	-0.0078**	-0.0173**	-0.0080**	-0.0227***	-0.0043
	(0.0033)	(0.0078)	(0.0034)	(0.0082)	(0.0028)
Country-specific development level (t-2)	-0.0269***	-0.0424***	-0.0285***	-0.0543***	-0.0211**
	(0.0092)	(0.0157)	(0.0098)	(0.0184)	(0.0087)
Secondary school enrollment rate (percent gross) (t-2)	-0.0011*	-0.0015*	-0.0009	-0.0016	-0.0009
	(0.0006)	(0.0009)	(0.0007)	(0.0010)	(0.0006)
Percent of the population aged 65 years and above (t-2)	0.0333**	0.0539**	0.0349**	0.0689***	0.0256**
	(0.0131)	(0.0225)	(0.0138)	(0.0257)	(0.0115)
POLITY score (t-1)	-0.0099***	-0.0100***	-0.0097***	-0.0099***	-0.0098***
	(0.0015)	(0.0017)	(0.0015)	(0.0019)	(0.0015)
Tenure of regime (t-1) (years)	0.0008	0.0006	0.0009	0.0005	0.0009
	(0.0008)	(0.0013)	(0.0008)	(0.0016)	(0.0007)
Democracy in region (% of countries) (t-1)	0.0001	-0.0004	0.0001	-0.0007	0.0003
	(0.0006)	(0.0008)	(0.0006)	(0.0009)	(0.0006)
Observations	2,897	2,897	2,845	2,845	2,897
R-squared	0.0166	-0.1999	0.0134	-0.4001	0.0520
Countries	121	121	121	121	121
F-statistic on excluded instruments	7.66	14.65	5.64	9.59	22.86
Stock-Yogo critical value	3.63/5.61	7.49/13.46	2.18/2.84	3.11/4.58	12.71/24.09
Country and year fixed effects	YES	YES	YES	YES	YES
Years:	1963-2001	1963-2001	1964-2001	1964-2001	1963-2001

Notes: The dependent variable indicates the commencement of democratic change events, which involve a three or more point increase in POLITY score that occurs within three years, flagged by a positive REGTRANS score. Robust standard errors clustered by country are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t− 2 per cap ita GDP is within 30 log points of its sample average t− 2 per capita GDP, +1 (−1) when 30 –60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average. The sample excludes country-years in which the t − 1 POLITY score exceeds 7. Reported Stock -Yogo critical values are the 5 percent significance level critical values for weak instruments tests based on, respectively, 30 percent and 5 percent maximal Fuller relative bias. The null of weak instruments is rejected in the case that the F statistic on the excluded instruments exceeds the Stock-Yogo critical value/s.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

find that our instrument set substantially outperforms Burke and Leigh (2010) instruments with respect to the Stock-Yogo F-test statistic for weak instruments, in particular for their preferred model, which includes only instruments related to temperature (compare column 3 with column 1). In particular, our set of refined instruments achieves much higher significance levels in rejecting the null hypothesis of weak instruments at both the 30 percent and 5 percent maximal Fuller relative bias levels. Having verified the superior strength of our instrument set, we turn to the magnitude of our estimated coefficients for the effect of growth on democracy in their study. The point estimates we obtain for the effect of lagged growth on the probability of a transition to democracy using our refined temperature instrument is approximately 30% larger in magnitude than those obtained in the comparable IV regressions from the original Burke and Leigh (2010) study, thus confirming that

the use of better instruments reveals that the negative effect of growth on democratic transitions is stronger than that originally reported.

We opt to use our proposed set of instruments for economic growth in our study of executive leadership transitions at the national level. As summarized in Table A.1 of Appendix A, we find that our refined temperature and precipitation instruments achieve superior performance in our study as well compared to the original instrument set of Burke and Leigh (2010). While the F-statistic of the excluded (refined) weather instruments generally produces lower p-values than the export partner growth index instrument employed by Burke (2011) in the IV linear model with fixed effects, the export partner growth index instrument on its own achieves somewhat lower standard errors for the coefficient on instrumented growth. Thus, we find that the best instrument set in our model of leadership transitions is achieved by combining our refined temperature and precipitation instruments with the export partner growth index and commodity price index.

Given the strong performance our instrument set for growth in both our and the Burke and Leigh (2010) settings, the construction and testing of the refined instrument set for economic growth constitutes a contribution of independent interest for researchers wishing to instrument growth in order to test its causal effect of other variables of interest in a variety of contexts using international cross-country panel data. We now turn to our primary results on the effect of growth, policies, and institutions on the probability of executive leadership transitions around the world.

V. Results

The general specification of our framework for examining the effect of lagged growth on leadership transitions can be written in terms of the model

$$P(\mathit{jobloss}_{it} = 1 | \mathit{growth}_{it-1}, x_{it}) = G(\alpha + \eta_t + \nu_i + \gamma \mathit{growth}_{it-1} + x'_{it}\beta),$$

where growth_{it-1} is lagged real per-capita GDP growth, x_{it} is a vector of control variables, possibly measured at time *t*, *t-1*, or *t-2* depending on the variable in question, η_t are year fixed-effects, and ν_i are country-specific fixed effects. Our primary interest is in the statistical and economic significance of the coefficient γ on growth. For the function *G(.)*, we examine three different specifications: the linear probability model corresponding to $G(x) = x$, the logit model, and the probit model. Each specification has benefits and drawbacks. The linear probability model lends itself to the joint inclusion of fixed effects and IV estimation, but the same linearity that makes it tractable for these purposes also opens the door for counterfactual predictions regarding the conditional probability of executive transitions, which are not limited in this model to the interval (0,1). The logit and probit models have the attractive feature of confining the conditional probability of leadership transitions to the interval (0,1), but suffer from other problems. While the logit model lends itself to fixed effects estimation, implementing IV techniques is not feasible, whereas for the probit model, IV techniques are feasible, but estimation of fixed effects is not. In light of these limitations, we opt to take an agnostic approach to functional form, and report all our main results for linear, logit, and probit models for the conditional probability of leadership transitions.

A. The Effect of Lagged Growth on Leadership Transitions

As a baseline, we begin by reporting results from LPMs, logit, and probit on the determinants of job loss by national leaders, before controlling for fixed country and year effects and before employing our IVs for

economic growth. This first set of results is presented in Table 3. Panel A of Table 3 displays the results of logit, probit, and LPMs of $jobloss_{it}$ on only lagged real GDP per-capita growth. Logit and probit model results are reported as marginal effects for comparability with the coefficient obtained from the linear probability model. The same value of the coefficient, which is negative and significant at either the 10% or 1% level (depending on the model), is obtained for all three models. In panel B of Table 3, we repeat the exercise after controlling for the set of independent control variables from Burke and Leigh's (2010) study of democratic transitions. We find that the coefficient on lagged growth remains significant at either the 10% or 5% level, is negative, and is of nearly the same magnitude for all three models, with the magnitude having increased slightly from the benchmark value obtained in the models of panel A.

Table 3. Logit, Probit and LPM results for the base model

Estimation	LPM	LOGIT (mfx)	PROBIT (mfx)
	(1)	(2)	(3)
Panel A- No time-varying country controls			
GDP per capita growth (t-1)	-0.0022***	-0.0016*	-0.0017*
	(0.0008)	(0.0008)	(0.0008)
Observations	4,918	4,918	4,918
Chi-squared	-	3.726*	3.875**
Panel B- With time-varying country controls			
GDP per capita growth (t-1)	-0.0016*	-0.0020**	-0.0019**
	(0.0009)	(0.0009)	(0.0009)
Country-specific development level (t-2)	0.0156*	0.0188**	0.0179**
	(0.0089)	(0.0086)	(0.0089)
Secondary school enrollment rate (percent gross) (t-2)	-0.0013***	-0.0017***	-0.0016***
	(0.0003)	(0.0003)	(0.0003)
Percent of the population aged 65 years and above (t-2)	0.0097***	0.0091***	0.0094***
	(0.0031)	(0.0020)	(0.0021)
POLITY score (t-1)	0.0064***	0.0080***	0.0079***
	(0.0012)	(0.0009)	(0.0009)
Tenure of regime (t-1) (years)	0.0006*	0.0003**	0.0004**
	(0.0003)	(0.0002)	(0.0002)
Democracy in region (% of countries) (t-1)	0.0006*	0.0007***	0.0008***
	(0.0003)	(0.0002)	(0.0003)
Observations	4,715	4,715	4,715
Chi-squared	-	259.9***	258.8***
Country and year fixed effects	NO	NO	NO
Years: 1964-2004			

Notes: The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t − 2 per capita GDP is within 30 log points of its sample average t − 2 per capita GDP, +1 (−1) when 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Regarding the effect of control variables on the probability of leadership transitions, the results of panel B in Table 3 indicate that the county-specific development level has little discernable impact on the likelihood of executive transitions. On the other hand, countries with higher Polity scores for the strength of democracy, a higher percentage of the population 65 years and older, a regime that has been in power for a longer amount of time, and with a higher share of countries in the region that are democratic, are more likely to experience job loss of the executive in the next year. Other things equal, countries in which there is a higher secondary

education enrollment rate are less likely to witness a leadership transition. The initial evidence from the LPM, logit, and probit model results robustly indicates that job loss by the head-of-state is more likely to occur after an economic contraction.

Table 4. Fixed Effects LPM and Logit results

Estimation	LPM(FE)	LOGIT(FE)
	(1)	(2)
Panel A- No time-varying country controls		
GDP per capita growth (t-1)	-0.0018**	0.9803**
	(0.0008)	(0.0088)
Observations	4,715	4,341
R-squared /Pseudo R-squared	0.0162	0.0255
Chi-squared	-	146.6***
Countries	155	133
Panel B- With time-varying country controls		
GDP per capita growth (t-1)	-0.0015*	0.9836*
	(0.0008)	(0.0091)
Country-specific development level (t-2)	0.0195*	1.2465**
	(0.0110)	(0.1324)
Secondary school enrollment rate (percent gross) (t-2)	-0.0008	0.9924*
	(0.0006)	(0.0045)
Percent of the population aged 65 years and above (t-2)	0.0024	0.9992
	(0.0081)	(0.0653)
POLITY score (t-1)	0.0049**	1.0414**
	(0.0020)	(0.0172)
Tenure of regime (t-1) (years)	0.0005	1.0035
	(0.0007)	(0.0069)
Democracy in region (% of countries) (t-1)	0.0008	1.0026
	(0.0006)	(0.0050)
Observations	4,715	4,341
R-squared /Pseudo R-squared	0.0210	0.0315
Chi-squared	-	196.7***
Countries	155	133
Country and year fixed effects	YES	YES
Years: 1964-2004		

Notes: Fixed Effects logit results (column 2) are reported as odds ratios. The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t− 2 per capita GDP is within 30 log points of its sample av erage t − 2 per capita GDP, +1 (−1) when 30 –60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

B. Fixed Effects LPM and Logit Model Results

Having established the baseline, we will now examine whether the previous results hold after controlling for country and year fixed effects. Fixed effects LPM and logit results are presented in Table 4. We present our fixed effects logit results (column 2) as odds ratios, as in Burke and Leigh (2010)[6]. An odds ratio of 1 indicates that a conditional increase in the independent variable is not associated with any change in the dependent variable, while an odds ratio above (below) 1 indicates that an increase in the independent variable raises (lowers) the dependent variable.

[6] Estimated marginal effects from fixed effects logit models are biased in the presence of substantial heterogeneity across the fixed effect unit, and so are not reported.

Panel A of Table 4 contains results for $jobloss_{it}$ on lagged growth and fixed year and country effects, while panel B contains results for $jobloss_{it}$ on fixed effects and the Burke and Leigh (2010) controls. For the LPM, whose results are reported in column 1, standard errors are robust to heteroscedasticity, and are clustered at the country level to allow for possible serial correlation. The results from both panels and models yield very similar point estimates for the magnitude of the effect of lagged growth on the probability of leadership transitions, which is negative and significant in all cases at either the 5% (in panel A) or 10% (in panel B) level.

The results on the control variables in panel B of Table 4 indicate that the only variables besides GDP per capita growth that have a significant impact on the likelihood of a leadership transition are Polity scores for the strength of democracy, and the country-specific development level. Moreover, the substantial increase in the standard errors of all variables for both the LPM and logit models indicates that the use of fixed effects in this setting can be quite costly in terms of loss of efficiency.

C. Instrumental Variable Results

Even though we have lagged economic growth in all of the foregoing specifications, our estimates of the effect of lagged growth on the probability of leadership transitions may still be biased, even after the inclusion of fixed effects, for a couple of reasons. First, growth performance prior to the departure of a standing leader may reflect the quality of that leader in administering economic policy or administering public goods in a larger sense, and the probability of departure in future years is still likely to be contingent on this unobserved quality. Second, even lagged growth may be correlated with unobserved factors besides the quality of the leader's ability to administer economic affairs that affect both growth and the future probability the leader will be removed from office. For these reasons, we opt to instrument economic growth through the use of the plausibly exogenous set of instrumental variables described in section IV.

In the following tables, we re-estimate the main equation for job loss of the head-of-state using linear IV models and probit IV models. In these tables, the results from the fixed effects logit model are included for comparison. In light of warnings by Joshua D. Angrist and Alan B. Krueger (2001) and Harry H. Kelejian (1971) that the probit IV models can be unreliable under some circumstances, must we interpret the results of that model with caution. Unless otherwise noted, all the following tables present estimates in which the refined weather instruments and commodity price index are included jointly in the first stage regression.

In order to deal with the issue of potentially weak instruments, we use the Fuller 1 estimator for the linear IV model. The Fuller 1 estimator , due to Wayne A. Fuller (1977), is a bias-corrected limited information maximum likelihood estimator, which like Burke and Leigh (2010), we employ in all linear probability panel data models in which we instrument economic growth. This estimator, provides the most unbiased estimates for inference purposes when instruments are potentially weak (see Fuller, 1977; Stock, Wright, and Yogo, 2002; Hahn and Hausman, 2003; Stock and Yogo, 2005).

In Table 5, we present the results for leadership transitions after instrumenting lagged economic growth. Panel A of Table 5 presents the results of models without control variables, and panel B presents the results of the same models after the baseline set of control variables has been included. In panel A, all coefficients on lagged growth are negative and significant at the 1% level, except for the fixed effects logit model, in which it is significant at the 5% level. Comparing the linear probability model without versus with fixed effects (column 1 vs. column 2 in panel A), we see that the magnitude of the point estimate after including fixed effects increases by approximately 50%, indicating a downward bias in the size of the coefficient of lagged growth due to correlation of unobserved country effects and the error term. The point estimate of the growth coefficient in column 4 of panel A, corresponding to the IV probit model, lies between the values obtained in columns 1 and 2.

Table 5. IV and fixed effects logit results

Estimation	IV(Fuller 1)	IV(Fuller 1)	LOGIT (FE)-Odd Ratios	IVPROBIT (mfx)
Panel A- No time-varying country controls	(1)	(2)	(3)	(4)
GDP per capita growth (t-1)	-0.0106***	-0.0153***	0.9768**	-0.0147***
	(0.0034)	(0.0053)	(0.0091)	(0.0033)
F-statistic on excluded instruments	2.53	3.2	-	-
Chi-squared/ Exogeneity test Wald p-value	-	-	143.9***	0.0000
Panel B- With time-varying country controls				
GDP per capita growth (t-1)	-0.0114***	-0.0175***	0.9795**	-0.0163***
	(0.0039)	(0.0063)	(0.0092)	(0.0036)
Country-specific development level (t-2)	0.0031	-0.0104	1.2352**	-0.0029
	(0.0130)	(0.0178)	(0.1259)	(0.0117)
Secondary school enrollment rate (percent gross) (t-2)	-0.0016***	-0.0018***	0.9897**	-0.0018***
	(0.0005)	(0.0007)	(0.0050)	(0.0003)
Percent of the population aged 65 years and above (t-2)	0.0153*	0.0173	1.0255	0.0117***
	(0.0081)	(0.0119)	(0.0821)	(0.0024)
POLITY score (t-1)	0.0047***	0.0041*	1.0426**	0.0082***
	(0.0017)	(0.0023)	(0.0185)	(0.001)
Tenure of regime (t-1) (years)	0.0007	0.0008	1.0084	0.0006***
	(0.0007)	(0.0010)	(0.0072)	(0.0002)
Democracy in region (% of countries) (t-1)	0.0008*	0.0003	1.0009	0.0008***
	(0.0005)	(0.0006)	(0.0051)	(0.0003)
F-statistic on excluded instruments	2.26	3.18	-	-
Chi-squared /Exogeneity test Wald p-value	-	-	198.4***	0.0000
Observations	4,262	4,262	3,919	4,262
Stock-Yogo critical value	2.18/2.84	2.18/2.84	-	-
Country and year fixed effects	NO	YES	YES	NO
Years: 1964-2001				

Notes: Fixed Effects logit results (column 3) are reported as odds ratios. The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t− 2 per capita GDP is within 30 log points of its sample average t − 2 per capita GDP, +1 (−1) wh en 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average. Reported Sto ck-Yogo critical values are the 5 percent significance level critical values for weak instruments tests based on, respectively, 30 percent and 5 percent maximal Fuller relative bias. The null of weak instruments is rejected in the case that the F statistic on the excluded instruments exceeds the Stock-Yogo critical value/s. For the IV probit model we report the Wald test of exogeneity, if the Wald test statistic of the exogeneity of the instrumented variables in the IV-probit model is not significant, there is not sufficient information in the sample to reject the null that there is no endogeneity.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Let us turn to the results in panel B of Table 5. The sign and significance patterns of the coefficient of lagged economic growth are identical across models to those reported for panel A. The magnitude of the coefficients in the linear IV and IV probit models, however, are slightly higher after the additional time-varying control variables are included. The highest magnitude of the (negative) coefficient is obtained in the fixed effects linear IV model (column 2), of a 1.75 percent fall in the probability of a leadership transition for a 1 percent (unit) increase in per-capita GDP growth. In the IV probit model results in column 4 of panel B in Table 5 indicate that an increase in economic growth by 1 percentage point is estimated to reduce the likelihood of job loss by the chief executive in the subsequent year by 1.6 percentage points. This estimated effect in the IV probit model is larger than the point estimate obtained in the linear IV model, although both estimates are within one standard error of one another. The fixed effects logit models with and without time-varying controls (column 3, panels A and B, respectively), although they do not instrument growth, produce results that are generally in line with the other three models.

For both the linear IV probability model with and without fixed effects, the coefficients on the instruments in the first-stage regressions are of the expected signs and are generally significant. These results are not reported, but are available from the authors upon request. In the model without country and year fixed effects and with time-varying controls (column 1, panel B), the instruments pass the Stock-Yogo test for weak instruments for the 30 percent maximal Fuller relative bias at the 5 percent significance level, and in the linear IV probability model with both fixed effects and time-varying controls (column 2, panel B), the instruments pass the Stock-Yogo test for weak instruments for both the 30 percent and 5 percent maximal Fuller relative bias critical values at the 1 percent level. For our IV-probit results, the Wald test statistic for the exogeneity of the instrumented variable rejects the null hypothesis that lagged growth is exogenous at the 1 percent level, thus indicating reasonable evidence that our concerns regarding the potential endogeneity of lagged growth in our study are justified[7].

Table 6. The effect of democratic change events on leadership transitions

Estimation	LPM	LOGIT (mfx)	PROBIT (mfx)	LPM(FE)	LOGIT (FE)	IV (Fuller 1)	IV (Fuller 1)	IVPROBIT (mfx)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP per capita growth (t-1)	-0.0011	-0.0008	-0.0009	-0.0021**	0.9601***	-0.0107**	-0.0158**	-0.0111***
	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0128)	(0.0042)	(0.0078)	(0.004)
Panel B time-varying country controls	*Included but not shown*	*Included but not shown*	*Included but not shown*	*Included but not shown*	*Included but not shown*	*Included but not shown*	*Included but not shown*	*Included but not shown*
Demo Change Event (t)	0.4324***	0.4635***	0.4594***	0.4324***	15.7833***	0.4136***	0.4164***	0.2479***
	(0.0281)	(0.0489)	(0.0481)	(0.0470)	(4.3246)	(0.0296)	(0.0473)	(0.0218)
Demo Change Event (t-1)	0.0103	0.0167	0.0179	-0.0024	0.9031	-0.0157	-0.0208	0.0092
	(0.0361)	(0.0330)	(0.0357)	(0.0441)	(0.3617)	(0.0379)	(0.0460)	(0.0349)
Demo Change Event (t-2)	0.0065	0.0183	0.0197	-0.0185	0.7194	-0.0295	-0.0362	0.0107
	(0.0341)	(0.0308)	(0.0335)	(0.0433)	(0.2792)	(0.0360)	(0.0423)	(0.0324)
F-statistic on excluded instruments	-	-	-	-	-	1.7	5.84	-
Chi-squared/Exog test Wald p-value	-	235.1***	235.7***	-	322.7***	-	-	0.00345
R-squared	0.0874	-	-	0.1123	-	-	-	-
Pseudo R-squared	-	0.123	0.123	-	0.156	-	-	-
Observations	2,779	2,779	2,779	2,779	2,385	2,779	2,779	2,779
Stock-Yogo critical value	-	-	-	-	-	2.18/2.84	2.18/2.84	-
Country and year fixed effects	NO	NO	NO	YES	YES	NO	YES	NO
Years: 1964-2004								

D. The "Arab Spring" Effect: Testing the Effect of Transitions to Democracy on Leadership Transitions

Up until this point, we have focused on estimating the effect of growth on the probability of a leadership transition for the head-of-state without taking into account the association between institutional transitions to democracy and leadership transitions. To evaluate the effect of a democratic transition on the probability of experiencing a leadership transition, we repeat our main exercises from the B panels of the previous tables after including a binary variable from Burke and Leigh (2010) that measures whether a transition to democracy occurred. We include the value of the variable in year *t*, year *t-1*, and year *t-2*. The results of this exercise are displayed in Table 6. Democratic transitions are robustly and significantly associated with leadership transitions in the same year, and the point estimate of the effect is around 43-46 percent in nearly all

[7] As indicated in the STATA reference manual and other sources, such as Wooldridge (2002, p. 472-477): If the Wald test statistic of the exogeneity of the instrumented variables (in our case lagged economic growth) in the IV-probit model is not significant, there is not sufficient information in the sample to reject the null that there is no endogeneity. In that case, a regular probit regression may be appropriate, as the point estimates from IV-probit will be consistent, although those from the standard probit are likely to have smaller standard errors.

specifications in which point estimates of marginal effects are available, with the sole exception of the IV probit model, in which the point estimate of the marginal effect is close to 25 percent. All estimates of the effect across models are significant at the 1 percent level.

The effect of lagged growth on the probability of a leadership transition across the different specifications falls somewhat in significance, but is still significant at conventional levels in the fixed effects linear and logit probability models, as well as the linear IV probability model with fixed country and year effects. The point estimates of the linear IV model, both with and without fixed effects (columns 6 and 7 of Table 6, respectively), in particular, are quite similar to their values in Table 5, before the dummies for democratic change events were included.

E. Testing the effect of growth on leadership transitions during periods of democratic transition

In the previous section, we proceeded under the assumption that the effect of growth on leadership transitions is the same independently of whether the country is currently undergoing a transition to democracy. However, this assumption deserves further scrutiny, for a couple of reasons. First, we know that democratic change events are often associated with leadership transitions in the same year. This suggests that any neglected interaction between growth and democratic change events may bias our estimates of the effect of growth on the probability of leadership transitions. Second, it is not clear *a priori* that the effect of growth on leadership transitions should operate the same way in normal times as it operates during times of significant institutional change.

During times of major political transitions, for example from autocracy to democracy, the seed of political change may come from a variety of sources. One such source, whether by luck or by design, are shocks to growth. It is not difficult to imagine conditions under which a favorable, exogenous shock to growth could tip the balance in favor of deposing a particularly disliked autocrat, for example by providing a widespread proportion of the population the economic power it needs at the margin to reclaim political power long monopolized by elites. Indeed a distinct, but related story is told by Acemoglu and Robinson (2000) in their discussion of political losers as barriers to economic development, in which they point out how "…the introduction of a new technology, and economic change more generally, may simultaneously affect the distribution of political power" (p. 126).

As our instrumentation strategy captures the effect on the probability of a leadership transition due to the component of growth not attributable to the standing regime, we may test this idea directly by including in our preferred specifications an interaction term between lagged growth and contemporaneous democratic change events. The results of this exercise are shown in Table 7.

The fixed effects, IV linear probability model results presented in Table 7 confirm that transitions to democracy in year *t* robustly induce leadership transitions in the same year. The coefficient of the interaction term between growth and democratic transitions is large and positive, but not very precisely estimated. As indicated in column 3 of Table 7, however, an increase in economic growth of 1 percentage point is estimated to reduce the probability of a leadership transition in the following year by 2.14 percentage points, and this result is significant at the 1 percent level. This point estimate is 25 percent larger than that obtained in the IV linear probability model without the interaction term between democratic transitions and growth, which is reprinted for convenience in column 1 of Table 7. This indicates that, although our estimates of the interaction term somewhat lack precision, the effect of growth on leadership transitions may not work the same way during periods of major institutional transition as it does during periods of institutional stability. In fact, the point estimate of the effect of an increased in the lagged rate of economic growth by one percentage point on the probability of a leadership transition is approximately 18 percent—an economically very significant figure.

Table 7. Interactions between lagged GDP per-capita and Democratic Change Events

Estimation	IV(Fuller 1)	IV(Fuller 1)	IV (Fuller 1)	LOGIT (FE) Odd Ratio
	(1)	(2)	(3)	(4)
GDP per capita growth (t-1)	-0.0171**	-0.0194***	-0.0214***	0.9571***
	(0.0082)	(0.0070)	(0.0083)	(0.0121)
Country-specific development level (t-2)	-0.0132		-0.0345	1.2305
	(0.0209)		(0.0234)	(0.2489)
Secondary school enrollment rate (percent gross) (t-2)	-0.0004		-0.0005	1.0028
	(0.0009)		(0.0010)	(0.0100)
Percent of the population aged 65 years and above (t-2)	0.0603**		0.0601*	1.4071
	(0.0292)		(0.0338)	(0.3455)
POLITY score (t-1)	0.0117***		0.0121***	1.1335***
	(0.0032)		(0.0035)	(0.0330)
Tenure of regime (t-1) (years)	0.0010		0.0022	1.0104
	(0.0010)		(0.0015)	(0.0107)
Democracy in region (% of countries) (t-1)	-0.0004		-0.0004	1.0007
	(0.0009)		(0.0010)	(0.0084)
Democratic change event (t)	0.4246***	0.3541***	0.3704***	15.3864***
	(0.0488)	(0.1138)	(0.1190)	(4.1138)
Interaction between lagged GDP per-capita growth and democratic change events		0.1970*	0.2033	1.0722
		(0.1173)	(0.1290)	(0.0504)
F-statistic on excluded instruments/Chi-squared	5.7	1.94	2.03	300.1***
Country and year fixed effects	YES	YES	YES	YES
Stock-Yogo critical value	2.18/2.84	1.83/2.29	1.83/2.29	-
Observations	2,566	2,566	2,566	2,422
Number of Job Loss of Executive	279	279	279	310
Countries	119	119	119	119
Years: 1964-2001				

Notes: Fixed Effects logit results (column 4) are reported as odds ratios. The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t − 2 per capita GDP is within 30 log points of its sample average t − 2 per capita GDP, +1 (−1) when 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average. Reported Stock -Yogo critical values are the 5 percent significance level critical values for weak instruments tests based on, respectively, 30 percent and 5 percent maximal Fuller relative bias. The null of weak instruments is rejected in the case that the F statistic on the excluded instruments exceeds the Stock-Yogo critical value/s.
*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

VI. Explaining co-transitions of national leadership and political institutions: evidence from leader tenure

The models presented in the foregoing sections reveal that the effect of growth on the probability of a leadership transition is, on average, negative, causal, and economically significant. We find as well, however, that transitions to a democratic form of government in the same year also have a robustly significant and positive effect on the probability of a leadership transition, and that the marginal effect of lagged growth on the probability of a leadership transition turns positive during years of democratic change. The final task of this paper is to rationalize these findings, in particular the apparently conflicting results on the causal effect of growth on leadership transitions during times of institutional stasis versus during times of institutional upheaval.

The recent experience of countries such as Tunisia, Egypt and Libya during the "Arab Spring" of 2011 suggests one possible explanation: at times of transition from autocracy to democracy, the rejection of the autocratic form of government is often closely tied to a rejection of the autocrat who runs it. Transition away

from autocracy and rejection of particular autocrats in their capacity as individual leaders, that is, are sometimes very difficult to distinguish in practice. Two simple hypotheses are suggested by this logic. First, leaders in power at the time of a transition to democracy should have a longer average tenure in power than leaders at other times. Second, we would expect leaders in power at the time of a co-transition in the identity of the leader and an institutional transition to democracy to have a longer average tenure in power than do leaders in power at times of leadership transitions that do not involve transitions to democracy. If these premises are true, then exogenously driven increases in growth preceding transitions to democracy may be viewed as lowering the economic cost of opposition by the discontented majority to an unpopular autocrat, whose ouster often coincides with a transition in the form of government itself. As a simple test of our hypotheses, we present two results on the conditional distribution of the tenure of leaders in power at the time of their leaving office.

The results are as follows. First, during the 122 country-years involving a transition to democracy, the average tenure of the leader at the time of the transition was 8.86 years in power, with a standard error of 0.77 years. In contrast, during the 4795 country-years not involving a transition to democracy, the average tenure of leaders in power was 7.13 years, with a standard error of 0.11 years. The mean tenure in the combined subsamples is 7.17 years, and the 1.73 year difference between these two averages is significant at the 3% level in a two-sided t-test of differences of means across samples of unequal size. This shows that the average tenure of leaders in power is significantly higher during years of democratic transition than otherwise. When we look at the distributions of tenure in power across these two groups, moreover, we see that the median tenure of a leader at the time of a democratic change event is 6 years, versus only 4 for a leader otherwise; at the 90^{th} percentile of these respective distributions, the tenure is 22 years at the time of democratic transitions, versus only 18 years during country-years in which a transition to democracy did not take place.

To refine this result, we restrict our attention to years in which a leadership transition occurred. Within this subset of country-years, there were 66 events involving co-transitions to democracy and leadership transitions in the same year, and 729 events involving leadership transitions in years during which a transition to democracy did not occur. The average tenure of leaders ousted in the first group, during a simultaneous transition to democracy, was 9.15 years, with a standard error of 1.11 years, while the average tenure of leaders ousted in the second group was only 4.51 years, with a standard error of 0.19 years. The mean tenure of leaders in the combined group of 795 observations was 4.89 years, and a two-sided t-test of differences in means between the two groups reveals that the difference of 4.64 years is significant at the 1% level. The pattern of differences in tenures of leaders in the year of job loss at higher quantiles of these distributions is striking: while the median tenure of a leader who lost power during the year of a democratic transition was 6 years, as compared to a median of 3 years for a leader who lost power during times of institutional stasis, the 90^{th} percentile of the distribution of leader tenures at time of job loss during democratic transitions is 24 years, versus a 90^{th} percentile of only 10 years for leaders who lost power during a period of institutional stasis. Of the 122 events of transitions to democracy in our sample, 66 of them involved transitions in the identity of the national leader. Moreover, although the average tenure of leaders at the year of leadership transition was 4.89, which is less than the average tenure of leaders over all country-years of 7.17, the average tenure of leaders during years of co-transition, of 9.15 years, is appreciably higher than the average tenure overall. All of these results lend strong support to our characterization of transitions to democracy as being identified, more often than not, with the ouster of one particularly disliked autocrat, who has been in power significantly longer than is the standard in democratic forms of government, and for whom positive exogenous shocks to economic growth (in what may nevertheless be a relatively poor country) are more likely to represent bad luck than good.

VII. Robustness

A. Robustness to inclusion of structural political and economic policy variables

As additional robustness checks, we include a series of additional control variables, such as a binary variable for the year of scheduled presidential elections, the Herfindahl index of concentration of legislative power, variables to measure monetary and fiscal policy, and variables for political and creditor rights. It is important to note that the inclusion of the economic policy control variables and political and creditor rights control variables reduces the sample size by around 40 to 60 percent. Nonetheless, across a range of alternative specifications involving these variables, we find that our primary result on the effect of lagged growth on leadership transitions remains intact, as does our result on the importance of institutional and leadership co-transitions. The relevant tables can be found in Appendices B and C. The difference between the results contained in these appendices is that the tables in Appendix C control for the interaction between growth and democratic transitions, whereas those in Appendix B do not. We find strong evidence that having a presidential election in year *t*, as well as the age of the leader in power at the beginning of year *t*, both increase the probability of a leadership transition, other things equal. However, after controlling for these and our baseline set of control variables, we find that the degree of concentration of legislative power, monetary and fiscal policy, and the strength of political and creditor rights appear to have little if any effect on the probability of a leadership transition.

B. Robustness to use of alternative data sources and splitting the sample

As an additional set of robustness checks, we test the robustness of our results to use of data from the Penn World table for real GDP per-capita growth, as well as the use of aggregate real economic growth rather than per-capita real GDP growth. These tables are contained in Appendices B and C as well. We find that our results actually strengthen slightly in terms of statistical significance in specifications that use aggregate rather than per-capita growth, but are otherwise unchanged. Finally, we split the sample into subsamples of more vs. less agriculturally intensive economies, and low vs. high GDP per-capita economies, and rerun several of our models on the subsamples. Although splitting the database into subsamples involves loss of statistical power due to a reduced number of observations, we find that the negative effect of lagged growth on the probability of leadership transitions, as well as the importance of co-transitions, hold up across subsample splits, and that these effects are among the most robust effects we uncover in general in our study, compared to the effects of nearly all other control variables.

VIII. Conclusion

Using data drawn from 157 countries during the period 1964-2004, we find that faster real economic growth is associated with a lower probability of observing a leadership transition by the head-of-state in the following year. This result is robust to alternative probability model specifications and the inclusion of a range of additional control variables. We introduce a novel and strong set of instruments for economic growth in the international panel data context, which we arrive at by applying the findings on agricultural production functions due to Mendelsohn, Nordhaus, and Shaw (1994), Mendelsohn and Schlesinger (1999), Mendelsohn et al. (2000), coupled with a careful attention to functional form, to the instrument set introduced by Burke and Leigh (2010). After instrumenting for growth, we find that our estimates of the effect of growth on leadership transitions increases in magnitude compared to the non-instrumented case, and we find that the point estimates

increase yet more when we take into account the interaction between economic growth and transitions to democracy.

Overall, our evidence suggests that economic growth matters substantially for the short term political fates of individual leaders of nation states, and that this effect represents a causal force from growth to leadership transitions. Simple evidence on the patterns of growth surrounding leadership transitions in our fairly large sample of events indicates that such transitions tend to occur at the trough of a U-shaped growth trajectory. This fact, coupled with our findings that poor growth contributes significantly and in a causal fashion to the ouster of incumbent leaders, pushes in favor of the view of history entertained by Tolstoy (as noted by Berlin, 1978) and Marx (1852), and somewhat against the "Great Man" view of history advanced by Carlyle (1837, 1859). On balance our results, like those of Jones and Olken (2005), come down somewhere in the middle ground occupied by Weber (1947): while the institutional and economic context surrounding national leaders clearly and significantly affects their prospects of remaining in power, there are specific situations involving regime change and loss of power by long standing autocrats in which the effect of economic forces (in particular growth) on the individuals in question is reversed from its role during times of institutional stasis. This latter fact points, curiously, to the importance and power such autocrats hold. Nonetheless, our findings suggest on balance that economic outcomes, which are usually largely outside leaders' individual control, frequently have more of a role in deciding leader's political fates than leaders have in affecting economic outcomes.

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APPENDIX A

Table A.1. Comparison of different IV strategies in the IV linear probability model with fixed effects

Estimation	IV(Fuller 1)	IV(Fuller 1)	IV(Fuller 1)	IV(Fuller 1)	IV(Fuller 1)
Excluded instruments	Refined All	Refined Precip (t-1,t-2)	Refined Temp (t-1,t-2)	Burke and Leigh (2010) Cmdty Price (t-1)	Burke (2011) Export Partner (t-1)
Panel A- No time-varying country controls	(1)	(2)	(3)	(4)	(5)
GDP per capita growth (t-1)	-0.0153***	-0.0116	-0.0198	-0.0093	-0.0141**
	(0.0053)	(0.0087)	(0.0164)	(0.0138)	(0.0059)
F-statistic on excluded instruments	3.2	2.03	10.52	4.6	39.17
Panel B- With time-varying country controls					
GDP per capita growth (t-1)	-0.0175***	-0.0133	-0.0231	-0.0118	-0.0158**
	(0.0063)	(0.0097)	(0.0183)	(0.0144)	(0.0070)
Country-specific development level (t-2)	-0.0104	-0.0028	-0.0202	-0.0001	-0.0073
	(0.0178)	(0.0220)	(0.0364)	(0.0284)	(0.0181)
Secondary school enrollment rate (percent gross) (t-2)	-0.0018***	-0.0016**	-0.0020**	-0.0016*	-0.0017**
	(0.0007)	(0.0007)	(0.0009)	(0.0009)	(0.0007)
Percent of the population aged 65 years and above (t-2)	0.0173	0.0147	0.0205	0.0139	0.0162
	(0.0119)	(0.0124)	(0.0162)	(0.0131)	(0.0120)
POLITY score (t-1)	0.0041*	0.0044*	0.0038	0.0044*	0.0042*
	(0.0023)	(0.0023)	(0.0026)	(0.0024)	(0.0023)
Tenure of regime (t-1) (years)	0.0008	0.0008	0.0007	0.0008	0.0008
	(0.0010)	(0.0009)	(0.0012)	(0.0009)	(0.0009)
Democracy in region (% of countries) (t-1)	0.0003	0.0003	0.0002	0.0004	0.0003
	(0.0006)	(0.0006)	(0.0007)	(0.0007)	(0.0006)
F-statistic on excluded instruments	3.18	1.76	7.52	4.7	31.62
Observations	4,262	4,262	4,262	4,262	4,262
Stock-Yogo critical value	2.18/2.84	3.11/4.58	3.11/4.58	12.71/24.09	12.71/24.09
Country and year fixed effects	YES	YES	YES	YES	YES
Years: 1964-2001					

Notes: The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t− 2 per capita GDP is within 30 log points of its sample average t − 2 per capita GDP, +1 (−1) when 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average. Reported Stock-Yogo critical values are the 5 percent significance level critical values for weak instruments tests based on, respectively, 30 percent and 5 percent maximal Fuller relative bias. The null of weak instruments is rejected in the case that the F statistic on the excluded instruments exceeds the Stock-Yogo critical value/s.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

APPENDIX B

Table B.1. IV Fuller 1 Results with country and year fixed effects: Additional control variables

Estimation	IV (Fuller 1)	IV (Fuller 1)	IV (Fuller 1)	IV (Fuller 1)	IV (Fuller 1)	IV (Fuller 1)	IV (Fuller 1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GDP per capita growth (t-1)	-0.0173**	-0.0166*	-0.0175**	-0.0102	-0.0111	-0.0249	0.0083
	(0.0085)	(0.0085)	(0.0088)	(0.0140)	(0.0495)	(0.0702)	(0.0334)
Burke and Leigh (2010) time varying controls	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*
Democratic change event (t)	0.4221***	0.3680***	0.3653***	0.4133***	0.4145***	0.3968***	0.4258***
	(0.0468)	(0.0470)	(0.0474)	(0.0569)	(0.0965)	(0.1127)	(0.0987)
Year of presidential election (t)		0.1788***	0.1766***	0.1348***	0.1842***	0.1826***	0.1919***
		(0.0362)	(0.0358)	(0.0412)	(0.0526)	(0.0587)	(0.0562)
Year of presidential election (t-1)		0.0219	0.0205	0.0446	0.0910*	0.0851*	0.1032**
		(0.0245)	(0.0239)	(0.0345)	(0.0483)	(0.0494)	(0.0476)
Age of leader in power at start of year t (years)			0.0045***	0.0056**	0.0079**	0.0084**	0.0088***
			(0.0015)	(0.0024)	(0.0032)	(0.0035)	(0.0032)
Tenure of leader in power at start of year t (years)			-0.0007	0.0002	-0.0008	-0.0004	0.0011
			(0.0018)	(0.0024)	(0.0029)	(0.0031)	(0.0033)
Herfindhal Index Total (t-1)				0.0426	0.1010	0.0864	0.1315
				(0.0726)	(0.1138)	(0.1533)	(0.1065)
Money supply growth (t-1),3-year Mov. Avg.					0.0003	0.0003	0.0002
					(0.0005)	(0.0007)	(0.0005)
Fiscal surplus/GDP (t-1),3-year Mov. Avg.					0.0004	0.0006	0.0032
					(0.0020)	(0.0024)	(0.0035)
Political Rights (1:Weak-7:Strong) (t-1)						0.0184	
						(0.0255)	
Creditor rights (0: weak cr; 4: strong cr) (t-1)							-0.3652
							(0.3379)
F-statistic on excluded instruments	5,4	5,31	5,09	3,6	2,11	2,36	2,26
Country and year fixed effects	YES	YES	YES	YES	YES	YES	YES
Stock-Yogo critical value	2.18/2.84	2.18/2.84	2.18/2.84	2.18/2.84	2.18/2.84	2.18/2.84	2.18/2.84
Observations	2,808	2,796	2,796	1,576	1,047	998	830
R-squared	0.0165	0.0543	0.0557	0.1619	0.2028	0.0971	0.2190
Countries	121	121	121	110	88	86	72
Years: 1964-2001							

Notes: The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t − 2 per capita GDP is within 30 log points of its sample aver age t − 2 per capita GDP, +1 (−1) when 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average. Reported Stock-Yogo critical values are the 5 percent significance level critical values for weak instruments tests based on, respectively, 30 percent and 5 percent maximal Fuller relative bias. The null of weak instruments is rejected in the case that the F statistic on the excluded instruments exceeds the Stock-Yogo critical value/s.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table B.2. Fixed effects Logit results: Additional control variables

Estimation	LOGIT (FE) Odd Ratios	LOGIT(FE) Odd Ratios	LOGIT (FE) Odd Ratios	LOGIT (FE) Odd Ratios	LOGIT (FE) Odd Ratios	LOGIT (FE) Odd Ratios	LOGIT (FE) Odd Ratios
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GDP per capita growth (t-1)	0.9626***	0.9611***	0.9545***	0.9364***	0.9447*	0.9451	0.9408
	(0.0124)	(0.0137)	(0.0135)	(0.0222)	(0.0310)	(0.0338)	(0.0373)
Burke and Leigh (2010) time varying controls	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*
Democratic change event (t)	15.6429***	11.3560***	11.4820***	25.3993***	20.8850***	20.5877***	24.0906***
	(4.1458)	(3.1589)	(3.2916)	(11.8730)	(10.8463)	(10.8494)	(14.7065)
Year of presidential election (t)		5.4348***	5.3095***	5.3711***	7.8727***	7.3077***	7.7997***
		(1.4234)	(1.3780)	(1.9682)	(3.4776)	(3.3617)	(3.4283)
Year of presidential election (t-1)		1.3074	1.2742	2.1763	3.7072**	3.2242**	3.7000**
		(0.4193)	(0.4046)	(1.0665)	(1.9100)	(1.6808)	(2.0805)
Age of leader in power at start of yeart (years)			1.0447***	1.0561***	1.0832***	1.0797***	1.0894***
			(0.0142)	(0.0200)	(0.0236)	(0.0244)	(0.0286)
Tenure of leader in power at start of yeart (years)			1.0066	1.0621**	1.0638	1.0710	1.1606***
			(0.0207)	(0.0325)	(0.0448)	(0.0454)	(0.0660)
Herfindhal Index Total (t-1)				1.2049	3.7558	3.5094	2.2856
				(0.9929)	(4.1644)	(3.9082)	(2.9153)
Money supply growth (t-1),3-year Mov. Avg.					1.0082	1.0092	1.0058
					(0.0060)	(0.0063)	(0.0064)
Fiscal surplus/GDP (t-1),3-year Mov. Avg.					1.0360	1.0544	1.1031
					(0.0465)	(0.0528)	(0.0725)
Political Rights (1:Weak-7:Strong) (t-1)						1.1092	
						(0.2687)	
Creditor rights (0: weak cr; 4: strong cr) (t-1)							0.1073
							(0.2055)
Country and year fixed effects	YES	YES	YES	YES	YES	YES	YES
Observations	2,422	2,413	2,413	1,179	784	742	617
Pseudo R-squared	0.155	0.205	0.225	0.323	0.390	0.386	0.424
Chi-squared	296.2***	299.6***	334.4***	270.6***	9914***	8205***	8879***
Years: 1964-2001							

Notes: Fixed Effects logit results are reported as odds ratios. The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t − 2 per capita GDP is within 30 log points of its sample average t − 2 per capita GDP, +1 (−1) when 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table B.3. IV Probit Results without country and year fixed effects: Additional control variables

Estimation	IVPROBIT (mfx)	IVPROBIT (mfx)	IVPROBIT (mfx)	IVPROBIT (mfx)	IVPROBIT (mfx)	IVPROBIT (mfx)	IVPROBIT (mfx)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GDP per capita growth (t-1)	-0.0115***	-0.0102***	-0.0087**	-0.0021	-0.0233*	-0.0307**	-0.0299*
	(0.0038)	(0.0039)	(0.004)	(0.0048)	(0.0124)	(0.013)	(0.0155)
Burke and Leigh (2010) time varying controls	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*
Democratic change event (t)	0.2501***	0.2186***	0.2158***	0.223***	0.2126***	0.1865***	0.1941***
	(0.0218)	(0.0219)	(0.0213)	(0.0245)	(0.0454)	(0.06)	(0.0677)
Year of presidential election (t)		0.0985***	0.0998***	0.0786***	0.091***	0.0873***	0.0915***
		(0.0158)	(0.0155)	(0.0188)	(0.0284)	(0.0327)	(0.0356)
Year of presidential election (t-1)		-0.0111	-0.0122	0.0185	0.0295	0.0179	0.0218
		(0.0192)	(0.0189)	(0.0217)	(0.0334)	(0.0366)	(0.0405)
Age of leader in power at start of yeart (years)			0.0018***	0.0016**	0.0026**	0.0029***	0.0045***
			(0.0006)	(0.0007)	(0.0011)	(0.0011)	(0.0013)
Tenure of leader in power at start of yeart (years)			-0.0039***	-0.0023**	-0.0031*	-0.0033**	-0.0021
			(0.001)	(0.0011)	(0.0016)	(0.0017)	(0.0019)
Herfindhal Index Total (t-1)				-0.0209	-0.0601	-0.0597	-0.0225
				(0.0312)	(0.0438)	(0.0454)	(0.057)
Money supply growth (t-1),3-year Mov. Avg.					-0.0003	-0.0004	-0.0005
					(0.0003)	(0.0004)	(0.0004)
Fiscal surplus/GDP (t-1),3-year Mov. Avg.					0.0048***	0.0053***	0.0029
					(0.0018)	(0.0018)	(0.0027)
Political Rights (1:Weak-7:Strong) (t-1)						-0.012	
						(0.0121)	
Creditor rights (0: weak cr; 4: strong cr) (t-1)							0.0032
							(0.0107)
Country and year fixed effects	NO	NO	NO	NO	NO	NO	NO
Exogeneity test Wald p-value	0.00189	0.00605	0.0277	0.855	0.0593	0.0244	0.0600
Observations	2,808	2,796	2,796	1,579	1,052	1,004	835
Years: 1964-2001							

Notes: The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t − 2 per capita GDP is within 30 log points of its sample average t − 2 per capita GDP, +1 (−1) when 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average. For the IV probit model we report the Wald test of exogeneity, if the Wald test statistic of the exogeneity of the instrumented variables in the IV-probit model is not significant, there is not sufficient information in the sample to reject the null that there is no endogeneity.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table B.4. Using Penn World Tables

	(1)	(2)	(3)	(4)	(5)
Estimation	LPM	IV (Fuller 1)	IV (Fuller 1)	LOGIT (FE)	IVPROBIT (mfx)
Excluded instruments	None	All	All	None	All
Panel A: GDP per capita growth, WDI					
GDP per capita growth (t-1)	-0.0020**	-0.0128***	-0.0203***	0.9765**	-0.0226***
	(0.0009)	(0.0047)	(0.0073)	(0.0102)	(0.0046)
Burke and Leigh (2010) time varying controls	*Included, but not shown*				
F-statistic on excluded instruments	-	2,71	5,05	-	-
Chi-squared/Exogeneity test Wald p-value	-	-	-	185.6***	0,0000
R-squared/Pseudo R-squared	0.0231	-0.0234	-0.0547	0.0351	-
Panel B: GDP per capita growth, Penn World Table					
GDP per capita growth (t-1)	-0.0014**	-0.0098**	-0.0163***	0.9806**	-0.0182***
	(0.0006)	(0.0040)	(0.0063)	(0.0087)	(0.0041)
Burke and Leigh (2010) time varying controls	*Included, but not shown*				
F-statistic on excluded instruments	-	2,2	12,3	-	-
Chi-squared/Exogeneity test Wald p-value	-	-	-	183.4***	0,0000
R-squared/Pseudo R-squared	0.0224	-0.0248	-0.0700	0.0340	-
Panel C: Real GDI per capita Growth, Penn World Table					
GDP per capita growth (t-1)	-0.0010*	-0.0029	-0.0036**	0.9864	-0.0065***
	(0.0005)	(0.0019)	(0.0018)	(0.0084)	(0.0024)
Burke and Leigh (2010) time varying controls	*Included, but not shown*				
F-statistic on excluded instruments	-	2,05	4,56	-	-
Chi-squared/Exogeneity test Wald p-value	-	-	-	186.6***	0,0171
R-squared/Pseudo R-squared	0.0225	0.0046	0.0188	0.0340	-
Stock-Yogo critical value	-	2.18/2.84	2.18/2.84	-	-
Observations	4,140	4,128	4,128	3,730	4,128
Countries	151	-	150	124	-
Country and year fixed effects	YES	NO	YES	YES	NO
Years: 1964-2001					

Notes: Fixed Effects logit results (column 4) are reported as odds ratios. The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t + 2 per capita GDP is within 30 log points of its sample average t − 2 per capita GDP, +1 (−1) when 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average. Reported Stock-Yogo critical values are the 5 percent significance level critical values for weak instruments tests based on, respectively, 30 percent and 5 percent maximal Fuller relative bias. The null of weak instruments is rejected in the case that the F statistic on the excluded instruments exceeds the Stock-Yogo critical value/s. For the IV probit model we report the Wald test of exogeneity, if the Wald test statistic of the exogeneity of the instrumented variables in the IV-probit model is not significant, there is not sufficient information in the sample to reject the null that there is no endogeneity.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table B.5. Using aggregate rather than per capita GDP growth

	(1)	(2)	(3)	(4)	(5)
Estimates	LPM	IV (Fuller 1)	IV (Fuller 1)	LOGIT (FE)	IVPROBIT (mfx)
Excluded instruments	None	All	All	None	All
Panel A: GDP growth, World Development Indicators					
GDP growth (t-1)	-0.0019**	-0.0115***	-0.0175***	0.9772**	-0.0155***
	(0.0008)	(0.0039)	(0.0062)	(0.0090)	(0.0034)
Country-specific development level (t-2)	0.0174	0.0045	-0.0078	1.2312**	-0.0001
	(0.0105)	(0.0127)	(0.0168)	(0.1253)	(0.0114)
Secondary school enrollment rate (percent gross) (t-2)	-0.0012*	-0.0017***	-0.0020***	0.9896**	-0.0019***
	(0.0006)	(0.0005)	(0.0007)	(0.0050)	(0.0003)
Percent of the population aged 65 years and above (t-2)	0.0079	0.0156*	0.0174	1.0248	0.0085***
	(0.0111)	(0.0082)	(0.0118)	(0.0816)	(0.0023)
POLITY score (t-1)	0.0050**	0.0046***	0.0040*	1.0427**	0.0083***
	(0.0022)	(0.0017)	(0.0023)	(0.0185)	(0.001)
Tenure of regime (t-1) (years)	0.0009	0.0005	0.0005	1.0085	0.0006***
	(0.0007)	(0.0007)	(0.0011)	(0.0072)	(0.0002)
Democracy in region (% of countries) (t-1)	0.0005	0.0008	0.0001	1.0006	0.0006**
	(0.0006)	(0.0005)	(0.0006)	(0.0050)	(0.0003)
F-statistic on excluded instruments	-	2,37	3,08	-	-
Chi-squared/Exogeneity test Wald p-value	-	-	-	199.5***	0,0000
R-squared/Pseudo R-squared	0.0236	-0.0200	-0.0440	0.0359	-
Stock-Yogo critical value	-	2.18/2.84	2.18/2.84	-	-
Observations	4,274	4,262	4,262	3,919	4,262
Countries	153	-	152		-
Country and year fixed effects	YES	NO	YES	YES	NO
Years: 1964-2001					

Notes: Fixed Effects logit results (column 4) are reported as odds ratios. The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t− 2 per capita GDP is within 30 log points of its sample average t− 2 per capita GDP, +1 (−1) when 30 –60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average. Reported Stock-Yogo critical values are the 5 percent significance level critical values for weak instruments tests based on, respectively, 30 percent and 5 percent maximal Fuller relative bias. The null of weak instruments is rejected in the case that the F statistic on the excluded instruments exceeds the Stock-Yogo critical value/s. For the IV probit model we report the Wald test of exogeneity, if the Wald test statistic of the exogeneity of the instrumented variables in the IV-probit model is not significant, there is not sufficient information in the sample to reject the null that there is no endogeneity.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table B.6(a) . IV Fuller 1 (Linear Model) Results with All Refined Instruments, without FE: Sub-samples

Estimation	Fuller (1)	Fuller (1)	Fuller (1)	Fuller (1)	Fuller (1)
Sample	Full	More agricultural	Less agricultural	Low mean GDP pc	High mean GDP pc
	(1)	(2)	(3)	(4)	(5)
GDP per capita growth (t-1)	-0.0114***	-0.0199**	-0.0100**	-0.0115**	-0.0127**
	(0.0039)	(0.0098)	(0.0042)	(0.0048)	(0.0064)
Country-specific development level (t-2)	0.0031	-0.0184	0.0109	-0.0003	-0.0049
	(0.0130)	(0.0203)	(0.0189)	(0.0180)	(0.0195)
Secondary school enrollment rate (percent gross) (t-2)	-0.0016***	-0.0012	-0.0012	-0.0015*	-0.0015**
	(0.0005)	(0.0009)	(0.0007)	(0.0009)	(0.0007)
Percent of the population aged 65 years and above (t-2)	0.0153*	0.1272***	0.0046	0.1017***	0.0137
	(0.0081)	(0.0297)	(0.0103)	(0.0253)	(0.0100)
POLITY score (t-1)	0.0047***	0.0086***	0.0001	0.0062***	0.0021
	(0.0017)	(0.0021)	(0.0027)	(0.0020)	(0.0029)
Tenure of regime (t-1) (years)	0.0007	0.0000	0.0009	0.0011	0.0005
	(0.0007)	(0.0011)	(0.0010)	(0.0009)	(0.0011)
Democracy in region (% of countries) (t-1)	0.0008*	0.0001	0.0008	0.0009	0.0005
	(0.0005)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
F-statistic on excluded instruments	2,26	1,37	1,86	1,7	1,04
Country and year fixed effects	NO	NO	NO	NO	NO
Stock-Yogo critical value	2.18/2.84	2.18/2.84	2.18/2.84	2.18/2.84	2.18/2.84
Observations	4,262	2,142	2,120	2,109	2,153
Years: 1964-2001					

Notes: The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t − 2 per capita GDP is within 30 log points of its sample average t − 2 per capita GDP, +1 (−1) when 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average. Reported Stock-Yogo critical values are the 5 percent significance level critical values for weak instruments tests based on, respectively, 30 percent and 5 percent maximal Fuller relative bias. The null of weak instruments is rejected in the case that the F statistic on the excluded instruments exceeds the Stock-Yogo critical value/s.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table B.6(b). IV Fuller 1 (Linear Model) Results with All Refined Instruments, with FE: Sub-samples

Estimation	Fuller (1)	Fuller (1)	Fuller (1)	Fuller (1)	Fuller (1)
Sample	Full	More agricultural	Less agricultural	Low mean GDP pc	High mean GDP pc
	(1)	(2)	(3)	(4)	(5)
GDP per capita growth (t-1)	-0.0175***	-0.0333	-0.0123**	-0.0147**	-0.0234*
	(0.0063)	(0.0235)	(0.0062)	(0.0068)	(0.0124)
Country-specific development level (t-2)	-0.0104	-0.0389	0.0029	-0.0083	-0.0308
	(0.0178)	(0.0417)	(0.0224)	(0.0213)	(0.0306)
Secondary school enrollment rate (percent gross) (t-2)	-0.0018***	-0.0012	-0.0014	-0.0010	-0.0018**
	(0.0007)	(0.0015)	(0.0009)	(0.0014)	(0.0009)
Percent of the population aged 65 years and above (t-2)	0.0173	0.1542***	0.0030	0.1057***	0.0177
	(0.0119)	(0.0526)	(0.0131)	(0.0356)	(0.0129)
POLITY score (t-1)	0.0041*	0.0078**	0.0001	0.0063*	0.0020
	(0.0023)	(0.0036)	(0.0027)	(0.0032)	(0.0028)
Tenure of regime (t-1) (years)	0.0008	-0.0006	0.0010	0.0012	0.0009
	(0.0010)	(0.0029)	(0.0011)	(0.0017)	(0.0011)
Democracy in region (% of countries) (t-1)	0.0003	-0.0013	0.0005	0.0008	0.0002
	(0.0006)	(0.0015)	(0.0008)	(0.0015)	(0.0007)
F-statistic on excluded instruments	3,18	1,55	2,87	3,08	5,27
Country and year fixed effects	YES	YES	YES	YES	YES
Stock-Yogo critical value	2.18/2.84	2.18/2.84	2.18/2.84	2.18/2.84	2.18/2.84
Observations	4,262	2,142	2,120	2,109	2,153
Years: 1970-2001					

Notes: The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t − 2 per capita GDP is within 30 log points of its sample average t − 2 per capita GDP, +1 (−1) when 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average. Reported Stock-Yogo critical values are the 5 percent significance level critical values for weak instruments tests based on, respectively, 30 percent and 5 percent maximal Fuller relative bias. The null of weak instruments is rejected in the case that the F statistic on the excluded instruments exceeds the Stock-Yogo critical value/s.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table B.6(c). Logit FE Results: Sub-samples

Estimation	LOGIT (FE) Odd Ratios	LOGIT(FE) Odd Ratios	LOGIT (FE) Odd Ratios	LOGIT (FE) Odd Ratios	LOGIT (FE) Odd Ratios
Sample	Full	More agricultural	Less agricultural	Low mean GDP pc	High mean GDP pc
	(1)	(2)	(3)	(4)	(5)
GDP per capita growth (t-1)	0.9795**	0.9552***	0.9981	0.9530***	0.9981
	(0.0092)	(0.0150)	(0.0124)	(0.0129)	(0.0136)
Country-specific development level (t-2)	1.2352**	0.9658	1.3429**	1.1072	1.1949
	(0.1259)	(0.1627)	(0.1887)	(0.2123)	(0.1597)
Secondary school enrollment rate (percent gross) (t-2)	0.9897**	0.9957	0.9932	0.9894	0.9898*
	(0.0050)	(0.0111)	(0.0064)	(0.0123)	(0.0061)
Percent of the population aged 65 years and above (t-2)	1.0255	2.2055***	0.9859	2.0716**	1.0219
	(0.0821)	(0.5590)	(0.0845)	(0.5863)	(0.0785)
POLITY score (t-1)	1.0426**	1.0915***	1.0052	1.0662**	1.0259
	(0.0185)	(0.0287)	(0.0199)	(0.0304)	(0.0222)
Tenure of regime (t-1) (years)	1.0084	1.0209*	1.0053	1.0230*	1.0038
	(0.0072)	(0.0117)	(0.0088)	(0.0138)	(0.0084)
Democracy in region (% of countries) (t-1)	1.0009	0.9929	1.0054	1.0050	0.9998
	(0.0051)	(0.0095)	(0.0071)	(0.0150)	(0.0055)
Country and year fixed effects	YES	YES	YES	YES	YES
Observations	3,919	1,943	1,976	1,890	2,029
Pseudo R-squared	0.0354	0.0842	0.0455	0.0810	0.0432
Chi-squared	198.4***	423.7***	315.4***	275.9***	333.7***
Years: 1964-2001					

Notes: Fixed Effects logit results are reported as odds ratios. The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t − 2 per capita GDP is within 30 log points of its sample average t − 2 per capita GDP, +1 (−1) when 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table B.6(d). IV Probit Results: Sub-samples

Estimation	IVPROBIT (mfx)	IVPROBIT (mfx)	IVPROBIT (mfx)	IVPROBIT (mfx)	IVPROBIT (mfx)
Sample	Full	More agricultural	Less agricultural	Low mean GDP pc	High mean GDP pc
	(1)	(2)	(3)	(4)	(5)
GDP per capita growth (t-1)	-0.0163***	-0.0194**	-0.0177***	-0.0068	-0.0278***
	(0.0036)	(0.0077)	(0.0042)	(0.0042)	(0.0052)
Country-specific development level (t-2)	-0.0029	-0.0173	0.0152	0.0183	-0.0193
	(0.0117)	(0.0203)	(0.0172)	(0.0154)	(0.0174)
Secondary school enrollment rate (percent gross) (t-2)	-0.0018***	-0.0009*	-0.0036***	-0.0013***	-0.003***
	(0.0003)	(0.0005)	(0.0005)	(0.0004)	(0.0004)
Percent of the population aged 65 years and above (t-2)	0.0117***	0.013**	0.0209***	0.0036	0.0208***
	(0.0024)	(0.0055)	(0.0031)	(0.0058)	(0.0031)
POLITY score (t-1)	0.0082***	0.0087***	0.006***	0.0068***	0.0079***
	(0.001)	(0.0013)	(0.0016)	(0.0013)	(0.0016)
Tenure of regime (t-1) (years)	0.0006***	0.001*	0.0009***	0.0007	0.0005**
	(0.0002)	(0.0006)	(0.0002)	(0.0005)	(0.0002)
Democracy in region (% of countries) (t-1)	0.0008***	0.0015***	0.0002	0.0019***	0,0000
	(0.0003)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Country and year fixed effects	NO	NO	NO	NO	NO
Exogeneity test Wald p-value	0,0000	0,0192	0,0001	0,2080	0,0000
Observations	4,262	2,142	2,120	2,109	2,153
Years: 1970-2001					

Notes: The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t − 2 per capita GDP is within 30 log points of its sample average t − 2 per capita GDP, +1 (−1) when 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average. For the IV probit model we report the Wald test of exogeneity, if the Wald test statistic of the exogeneity of the instrumented variables in the IV-probit model is not significant, there is not sufficient information in the sample to reject the null that there is no endogeneity.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

APPENDIX C

Table C.1. IV Fuller 1 Results with country and year fixed effects: Additional control variables

Estimation	IV (Fuller 1)	IV (Fuller 1)	IV (Fuller 1)	IV (Fuller 1)	IV (Fuller 1)	IV (Fuller 1)
	(1)	(2)	(3)	(4)	(5)	(6)
GDP per capita growth (t-1)	-0.0214***	-0.0239**	-0.0227**	-0.0127	-0.0213	-0.0264
	(0.0083)	(0.0095)	(0.0092)	(0.0102)	(0.0747)	(0.0981)
Burke and Leigh (2010) time varying controls	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*
Year of presidential election (t)		0.1481***	0.1468***	0.0784	0.2506	0.2805
		(0.0444)	(0.0428)	(0.0622)	(0.1885)	(0.3855)
Year of presidential election (t-1)		0.0061	0.0061	0.0412	0.0931	0.1018
		(0.0259)	(0.0251)	(0.0330)	(0.0697)	(0.1106)
Age of leader in power at start of year t (years)			0.0045**	0.0067**	0.0075	0.0071
			(0.0018)	(0.0027)	(0.0061)	(0.0096)
Tenure of leader in power at start of year t (years)			0.0001	0.0005	-0.0008	0.0003
			(0.0025)	(0.0031)	(0.0039)	(0.0054)
Herfindhal Index Total (t-1)				0.0550	0.1542	0.1777
				(0.0913)	(0.2868)	(0.5142)
Money supply growth (t-1),3-year Mov. Avg.					0.0013	0.0016
					(0.0013)	(0.0022)
Fiscal surplus/GDP (t-1),3-year Mov. Avg.					-0.0005	-0.0005
					(0.0042)	(0.0049)
Political Rights (1:Weak-7:Strong) (t-1)						0.0671
						(0.1854)
Democratic change event (t)	0.3704***	0.3235***	0.3275***	0.4029***	0.3709*	0.3545
	(0.1190)	(0.1225)	(0.1138)	(0.1462)	(0.2054)	(0.2811)
Interaction between lagged GDP per-capita growth and democratic change events	0.2033	0.2056	0.1899	0.2551	-0.2966	-0.3915
	(0.1290)	(0.1683)	(0.1475)	(0.2318)	(0.6924)	(1.3844)
F-statistic on excluded instruments	2,03	2,00	1,87	5,7	2,75	2,75
Country and year fixed effects	YES	YES	YES	YES	YES	YES
Stock-Yogo critical value	1.83/2.29	1.83/2.29	1.83/2.29	1.83/2.29	1.83/2.29	1.83/2.29
Observations	2,566	2,563	2,563	1,455	986	945
R-squared	-0.3981	-0.4118	-0.3177	-0.4555	-1.0578	-1.9502
Countries	119	119	119	107	85	84
Years: 1964-2001						

Notes: The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t − 2 per capita GDP is within 30 log points of its sample average t − 2 per capita GDP, +1 (−1) when 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average. Reported Stock-Yogo critical values are the 5 percent significance level critical values for weak instruments tests based on, respectively, 30 percent and 5 percent maximal Fuller relative bias. The null of weak instruments is rejected in the case that the F statistic on the excluded instruments exceeds the Stock-Yogo critical value/s.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table C.2. Fixed effects Logit results: Additional control variables

Estimation	LOGIT (FE)-Odd Ratios	LOGIT (FE)-Odd Ratios	LOGIT (FE)-Odd Ratios	LOGIT (FE)-Odd Ratios	LOGIT (FE)-Odd Ratios	LOGIT (FE)-Odd Ratios
	(1)	(2)	(3)	(4)	(5)	(6)
GDP per capita growth (t-1)	0.9571***	0.9560***	0.9488***	0.9266***	0.9411*	0.9404*
	(0.0121)	(0.0132)	(0.0134)	(0.0220)	(0.0300)	(0.0320)
Burke and Leigh (2010) time varying controls	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*	*Included, but not shown*
Year of presidential election (t)		5.3633***	5.2191***	5.0536***	7.6627***	7.0799***
		(1.4042)	(1.3536)	(1.8951)	(3.4292)	(3.2664)
Year of presidential election (t-1)		1.2871	1.2517	2.1218	3.6481**	3.1660**
		(0.4110)	(0.3979)	(1.0326)	(1.8997)	(1.6660)
Age of leader in power at start of yeart (years)			1.0444***	1.0579***	1.0837***	1.0802***
			(0.0144)	(0.0204)	(0.0238)	(0.0245)
Tenure of leader in power at start of yeart (years)			1.0084	1.0654**	1.0640	1.0715
			(0.0213)	(0.0338)	(0.0450)	(0.0459)
Herfindhal Index Total (t-1)				1.1708	3.7011	3.4509
				(0.9670)	(4.0825)	(3.8283)
Money supply growth (t-1),3-year Mov. Avg.					1.0080	1.0090
					(0.0061)	(0.0064)
Fiscal surplus/GDP (t-1),3-year Mov. Avg.					1.0358	1.0540
					(0.0466)	(0.0528)
Political Rights (1:Weak-7:Strong) (t-1)						1.1010
						(0.2638)
Democratic change event (t)	15.3864***	10.9768***	11.1409***	25.0640***	20.9140***	20.6673***
	(4.1138)	(3.1451)	(3.2788)	(11.8921)	(10.9716)	(11.0160)
Interaction between lagged GDP per-capita	1.0722	1.0699	1.0712	1.0991	1.0297	1.0326
growth and democratic change events	(0.0504)	(0.0556)	(0.0554)	(0.0960)	(0.0985)	(0.0997)
Country and year fixed effects	YES	YES	YES	YES	YES	YES
Observations	2,422	2,413	2,413	1,179	784	742
Pseudo R-squared	0.157	0.207	0.226	0.325	0.390	0.386
Chi-squared	300.1***	306.7***	333.8***	269.7***	10700***	9452***
Years: 1964-2001						

Notes: Fixed Effects logit results are reported as odds ratios. The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t − 2 per capita GDP is within 30 log points of its sample average t − 2 per capita GDP, +1 (−1) when 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table C.3. Results with country and year fixed effects: Interaction between Democracy in region and Democratic change event

Estimation	IV (Fuller 1)	LOGIT (FE) Odd Ratio
	(1)	(2)
GDP per capita growth (t-1)	-0.0216***	0.9564***
	(0.0084)	(0.0121)
Country-specific development level (t-2)	-0.0351	1.2270
	(0.0247)	(0.2495)
Secondary school enrollment rate (percent gross) (t-2)	-0.0005	1.0035
	(0.0010)	(0.0100)
Percent of the population aged 65 years and above (t-2)	0.0607*	1.3951
	(0.0334)	(0.3430)
POLITY score (t-1)	0.0120***	1.1367***
	(0.0034)	(0.0327)
Tenure of regime (t-1) (years)	0.0022	1.0116
	(0.0015)	(0.0107)
Democracy in region (% of countries) (t-1)	-0.0002	0.9978
	(0.0013)	(0.0086)
Democratic change event (t)	0.4312	8.1095***
	(0.2703)	(4.3543)
Interaction between lag GDP pc Growth and	0.2118	1.0693
Democratic change event	(0.1617)	(0.0507)
Interaction between Democracy in region and	-0.0017	1.0168*
Democratic change event	(0.0083)	(0.0103)
F-statistic on excluded instruments/Chi-squared	1,55	367.0***
Country and year fixed effects	YES	YES
Stock-Yogo critical value	1.83/2.29	-
Observations	2,566	2,422
Number of Job Loss of Executive	279	310
Countries	119	98
Years: 1964-2001		

Notes: Fixed Effects logit results (column 2) are reported as odds ratios. The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t− 2 per capita GDP is within 30 log points of its sa mple average t− 2 per capita GDP, +1 (−1) when 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average. Reported Stock-Yogo critical values are the 5 percent significance level critical values for weak instruments tests based on, respectively, 30 percent and 5 percent maximal Fuller relative bias. The null of weak instruments is rejected in the case that the F statistic on the excluded instruments exceeds the Stock-Yogo critical value/s.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table C.4. Using Penn World Tables

	(1)	(2)	(3)	(4)
Estimation	LPM	IV (Fuller 1)	IV (Fuller 1)	LOGIT (FE)
Excluded instruments	None	All	All	None
Panel A: GDP per capita growth, WDI				
GDP per capita growth (t-1)	-0.0027***	-0.0208***	-0.0274**	0.9534***
	(0.0008)	(0.0067)	(0.0116)	(0.0130)
Burke and Leigh (2010) time varying controls		*Included, but not shown*		
Interaction between lag GDP pc Growth and	0.0177*	0.1566**	0.1381	1.0926
Democratic change event	(0.0094)	(0.0686)	(0.1119)	(0.0611)
F-statistic on excluded instruments/Chi-squared	-	0,6	2,88	340.7***
R-squared/Pseudo R-squared	0.1094	-0.1955	-0.1926	0.149
Panel B: GDP per capita growth, Penn World Table				
GDP per capita growth (t-1)	-0.0018***	-0.0029	0.0025	0.9639***
	(0.0005)	(0.0107)	(0.0562)	(0.0103)
Burke and Leigh (2010) time varying controls		*Included, but not shown*		
Interaction between lag GDP pc Growth and	0.0113	0.4590	0.3688	1.0795**
Democratic change event	(0.0071)	(0.2907)	(1.4686)	(0.0372)
F-statistic on excluded instruments/Chi-squared	-	0,38	2,87	338.4***
R-squared/Pseudo R-squared	0.1082	-4.0461	-2.5621	0.149
Panel C: Real GDI per capita Growth, Penn World Table				
GDP per capita growth (t-1)	-0.0015***	-0.0053	-0.0040	0.9704***
	(0.0005)	(0.0067)	(0.0100)	(0.0099)
Burke and Leigh (2010) time varying controls		*Included, but not shown*		
Interaction between lag GDP pc Growth and	0.0023	0.3263	0.3227	1.0417**
Democratic change event	(0.0037)	(0.2287)	(0.6712)	(0.0194)
F-statistic on excluded instruments/Chi-squared	-	0,16	2,18	331.4***
R-squared/Pseudo R-squared	0.1062	-9.6928	-9.4068	0.147
Stock-Yogo critical value	-	1.83/2.29	1.83/2.29	-
Observations	2,703	2,497	2,497	2,282
Countries	120	-	118	91
Country and year fixed effects	YES	NO	YES	YES
Years: 1964-2001				

Notes: Fixed Effects logit results (column 4) are reported as odds ratios. The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t − 2 per capita GDP is within 30 log points of its sa mple average t − 2 per capita GDP, +1 (−1) when 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average. Reported Stock-Yogo critical values are the 5 percent significance level critical values for weak instruments tests based on, respectively, 30 percent and 5 percent maximal Fuller relative bias. The null of weak instruments is rejected in the case that the F statistic on the excluded instruments exceeds the Stock-Yogo critical value/s.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table C.5. Using aggregate rather than per capita GDP growth

	(1)	(2)	(3)	(4)
Estimates	LPM	IV (Fuller 1)	IV (Fuller 1)	LOGIT (FE)
Excluded instruments	None	All	All	None
Panel A: GDP growth, World Development Indicators				
GDP growth (t-1)	-0.0024***	-0.0181***	-0.0224***	0.9570***
	(0.0008)	(0.0070)	(0.0083)	(0.0119)
Country-specific development level (t-2)	0.0119	-0.0237	-0.0249	1.2377
	(0.0133)	(0.0241)	(0.0204)	(0.2490)
Secondary school enrollment rate (percent gross) (t-2)	0.0008	-0.0020**	-0.0012	1.0022
	(0.0007)	(0.0009)	(0.0012)	(0.0099)
Percent of the population aged 65 years and above (t-2)	0.0267	0.0656**	0.0654**	1.3986
	(0.0231)	(0.0324)	(0.0323)	(0.3372)
POLITY score (t-1)	0.0120***	0.0107***	0.0116***	1.1337***
	(0.0029)	(0.0035)	(0.0035)	(0.0330)
Tenure of regime (t-1) (years)	0.0009	0.0012	0.0016	1.0102
	(0.0009)	(0.0014)	(0.0014)	(0.0107)
Democracy in region (% of countries) (t-1)	0.0005	-0.0007	-0.0003	1.0005
	(0.0008)	(0.0008)	(0.0011)	(0.0085)
Democratic change event (t)	0.4219***	-0.1747	-0.0843	13.9389***
	(0.0537)	(0.5176)	(0.3586)	(4.0354)
Interaction between lag GDP pc Growth and	0.0060	0.2489	0.2108*	1.0498
Democratic change event	(0.0097)	(0.1880)	(0.1266)	(0.0470)
F-statistic on excluded instruments/Chi-squared	-	0,59	1,99	306***
R-squared/Pseudo R-squared	0.1134	-0.6754	-0.4815	0.157
Stock-Yogo critical value	-	2.18/2.84	2.18/2.84	-
Observations	2,808	2,566	2,566	2,422
Countries	121	-	119	98
Country and year fixed effects	YES	NO	YES	YES
Years: 1964-2001				

Notes: Fixed Effects logit results (column 4) are reported as odds ratios. The dependent variable indicates the transitions of the head-of-state, which is coded as a one if in that year the head-of-state loses his/her job, and zero otherwise. Robust standard errors are in parentheses. GDP per capita growth is scaled so that one percentage point of additional growth is 1, not 0.01. The country-specific development level variable equals 0 when a country's t− 2 per capita GDP is within 30 log points of its sample average t − 2 per capita GDP, +1 (−1) when 30–60 log points above (below) its sample average, and +2 (−2) when 60 or more log points above (below) its sample average. Reported Stock-Yogo critical values are the 5 percent significance level critical values for weak instruments tests based on, respectively, 30 percent and 5 percent maximal Fuller relative bias. The null of weak instruments is rejected in the case that the F statistic on the excluded instruments exceeds the Stock-Yogo critical value/s.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

* Significant at the 10 percent level.