Income, Democracy, and Leader Turnover

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Online Appendix
Calculating cumulative impact of variables in models with lagged dependent variables and interaction terms:

In a model with a lagged dependent variable: \( d_{it} = \alpha d_{it-1} + \gamma y_{it-1} \), the cumulative effect of income is \( \gamma / (1 - \alpha) \). In a model with an interaction term: \( d_{it} = \alpha d_{it-1} + \gamma y_{it-1} + \delta z_{it-1} + \varepsilon z_{it-1} \), the cumulative effect of income is \( (\gamma + \delta z_{it-1}) / (1 - \alpha) \).

In a model with three variables, \( x, y, \) and \( z \), all of which are interacted as follows:

\[
d_{it} = \alpha d_{it-1} + \beta_1 x_{it-1} + \beta_2 y_{it-1} + \beta_3 z_{it-1} + \beta_4 x_{it-1} y_{it-1} + \beta_5 x_{it-1} z_{it-1} + \beta_6 y_{it-1} z_{it-1} + \beta_7 x_{it-1} y_{it-1} z_{it-1}
\]

the cumulative impact of \( x_{it-1} \) is \( \frac{\beta_1 + \beta_2 y_{it-1} + \beta_3 z_{it-1} + \beta_4 y_{it-1} z_{it-1}}{1 - \alpha} \),

the cumulative impact of \( y_{it-1} \) is \( \frac{\beta_2 + \beta_4 x_{it-1} + \beta_5 z_{it-1} + \beta_7 x_{it-1} y_{it-1}}{1 - \alpha} \),

and the cumulative impact of \( z_{it-1} \) is \( \frac{\beta_3 + \beta_5 x_{it-1} + \beta_6 y_{it-1} + \beta_7 x_{it-1} y_{it-1}}{1 - \alpha} \).
Table A1 shows that results are similar to those in Table 2, panel B, if one:

A) drops the interpolated income data.

B) focuses on transitions to democracy by including just upward movements on Polity2 in the dependent variable. The model, as in AJRY (2009), is:

\[ d_{i+1}^+ = \alpha d_{i-1} + \gamma y_{i-1} + \beta x_i + \mu_i + \delta_i + \nu_i \]

where \( d_{i+1}^+ = \max(d_i, d_{i-1}) \). This automatically drops any cases in which the democracy measure falls.

C) focuses on transitions to democracy by using the Boix-Miller-Rosato dichotomous measure of democracy (previously used in Boix and Stokes 2003 and AJRY 2009). This codes countries as democratic if elections are free and competitive, the executive is accountable (i.e. the president is directly elected or the head of government is answerable to parliament), and at least half the male population is enfranchised (Boix, Miller, and Rosato 2013). Coverage ranges from 22 countries in 1800 to 189 in 2007. I focus on just countries that were non-democracies in the previous period and so drop the lagged dependent variable. These regressions thus capture the correlates of transitions from a score of 0 (non-democracy) to 1 (democracy).

D) excludes just perfect democracies (those for which Polity2_{t-1} = 10) rather than all democracies (those for which Polity2_{t-1} ≥ 6).

E) uses the estimator of Alan, Honoré, and Leth-Petersen (2008), which allows for censoring at top and bottom while controlling for unobserved heterogeneity, as in Benhabib et al. (2011).

F) uses Arellano and Bond’s dynamic GMM estimator. The Arellano-Bond procedure is appropriate for panels with few time periods relative to the number of units. This is clearly not the case for the annual data—in this case, including year fixed effects, the number of instruments inevitably far exceeds the number of groups—so I show results for panels of from 5 to 20 years.

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1 The choice of statistical model for a panel with a binary dependent variable and unit and time fixed effects is not straightforward. Probit and (unconditional) logit with fixed effects are inconsistent because of the incidental parameters problem (Greene 2003). The conditional logit fixed effects model (CLFE; Chamberlain 1980), which I use elsewhere in the paper, is consistent. However, it requires dropping all units in which the dependent variable does not change. Here, that creates serious problems. Besides the loss of up to two thirds of the data, eliminating the “dogs that don’t bark” in this case produces estimates of the effect of income that are biased upward: all autocracies that became rich without democratizing are automatically excluded. For instance, running CLFE on 5- and 10-year panels, I find a strong, significant effect of income on democratic transitions even in just the 1960-2000 period. These problems have prompted many researchers to use the linear probability model (estimated by OLS, despite the binary dependent variable) when unit fixed effects are important. For recent uses, see Besley and Reynal-Querol (2011), Boix (2011 Table 1, column 9); Acemoglu et al. (2009, Tables 1 and 2); Bruckner and Ciccone (2011); Pope and Schweitzer (2011). These articles were published in Econometrica, The American Economic Review, The American Political Science Review, and The Journal of Monetary Economics. This model is consistent under relatively weak assumptions (Wooldridge 2002, Chapter 15.2), although it has the disadvantage of sometimes predicting probabilities outside the 0-1 range. I do the same here.
# Table A1: Income and democracy, alternative estimations

| Level of democracy | Transitions to democracy | Transitions to democracy |
|--------------------|--------------------------|--------------------------|
| (A) 1820-2008; Polity2 t-1 < 6 | (B) 1820-2008; Polity2 t-1 < 6 | (C) 1820-2000; dichotomous Boix et al. |
| No interpolated income values | Polity2: just upward movements | Just non-democracies |
| **Type of panel:** | **1-yr** | **5-yr** | **10-yr** | **15-yr** | **20-yr** | **1-yr** | **5-yr** | **10-yr** | **15-yr** | **20-yr** | **1-yr** | **5-yr** | **10-yr** | **15-yr** | **20-yr** |
| Polity2 t-1 | .91*** | .60*** | .26*** | .17** | -.07 | .98*** | .83*** | .38*** | .30** | .04 | .19** | -.17 | -.08 | .00 |
| | (.01) | (.04) | (.06) | (.08) | (.07) | (.01) | (.02) | (.07) | (.07) | (.09) | (.08) | (.11) | (.15) | (.14) |
| Ln GDP per cap. t-1 | -.00 | .03 | .13*** | .16** | .24** | -.00 | .03 | .10*** | .12*** | .13* | .00 | .06** | .20*** | .22** | .28** |
| | (.01) | (.03) | (.05) | (.07) | (.12) | (.00) | (.02) | (.03) | (.04) | (.08) | (.01) | (.03) | (.05) | (.07) | (.12) |
| Cumulative effect of income | -.00 | .06 | .17*** | .19** | .25** | -.00 | .16 | .27*** | .33** | .27* | .00 | .06 | .20*** | .22** | .28** |
| Fisher p level | [.00] | [.00] | [.00] | [.00] | [.30] | [.00] | [.00] | [.00] | [.00] | [.00] | [.00] | [.00] | [.00] | [.02] | [.00] |
| Observations | 6,553 | 1,286 | 617 | 381 | 276 | 8,216 | 1,573 | 730 | 474 | 340 | 7,997 | 1,535 | 714 | 459 | 336 |
| Countries | 140 | 137 | 123 | 123 | 115 | 140 | 137 | 123 | 123 | 116 | 142 | 139 | 128 | 126 | 120 |
| R-squared | .8702 | .6262 | .5926 | .6280 | .7004 | .9208 | .7448 | .6960 | .7185 | .7511 | .0843 | .2339 | .4187 | .5288 | .6298 |

| Level of democracy | Level of democracy | Level of democracy |
|--------------------|--------------------|--------------------|
| (D) 1820-2008; Polity2 t-1 < 10 | (E) 1820-2008; Polity2 t-1 < 6 | (F) 1820-2008; Polity2 t-1 < 6 |
| Honoré Two Side Estimator | Arellano-Bond GMM | |
| **Type of panel:** | **1-yr** | **5-yr** | **10-yr** | **15-yr** | **20-yr** | **1-yr** | **5-yr** | **10-yr** | **15-yr** | **20-yr** | **5-yr** | **10-yr** | **13-yr** | **20-yr** |
| Polity2 t-1 | .91*** | .60*** | .26*** | .17** | -.07 | .98*** | .83*** | .38*** | .30** | .04 | .19** | -.17 | -.08 | .00 |
| | (.01) | (.04) | (.06) | (.08) | (.07) | (.01) | (.02) | (.07) | (.07) | (.09) | (.08) | (.11) | (.15) | (.14) |
| Ln GDP per cap. t-1 | .00 | .03* | .11*** | .13** | .21*** | .014*** | .08*** | .19*** | .22*** | .34*** | .26** | .98*** | .82*** | .86*** |
| | (.00) | (.02) | (.04) | (.05) | (.08) | (.002) | (.01) | (.04) | (.05) | (.09) | (.13) | (.21) | (.25) | (.27) |
| Cumulative effect of income | .04 | .08* | .15*** | .16** | .20*** | .32** | .83*** | .76*** | .86*** |
| Fisher p level | [.00] | [.00] | [.00] | [.00] | [.01] | [.45] | [.87] | [.27] | [.43] |
| Hansen test | AR(2) test | | |
| | [.54] | [.47] | [.19] | [.29] | |
| Observations | 10,048 | 1,877 | 849 | 539 | 394 | 12,054 | 2,232 | 1000 | 631 | 457 | 1,440 | 610 | 355 | 227 |
| Countries | 157 | 153 | 133 | 132 | 128 | 161 | 158 | 134 | 121 | 99 | 135 | 120 | 107 | 84 |
| R-squared | .9345 | .7459 | .6518 | .6608 | .6997 | | | | | | | | | |

**Sources:** (A)-(D) estimated by OLS with country and year fixed effects; “t-1” refers to previous panel period. Robust standard errors, clustered by country, in parentheses; * p < .10, ** p < .05, *** p < .01. “Fisher p level”: probability level at which one can reject H0: residuals are I(1), from Fisher test of residuals. Cumulative effects calculated as on p.l. (E): Year fixed effects included in 10-20 year panels; could not compute with year fixed effects in 1 and 5 year panels. (F): Arellano-Bond regressions, democracy and Ln GDP per capita instrumented with second lags.

**Note:**
Table A2 shows that results are similar to those in Table 2, panel C, if one focuses on transitions to democracy (using the Boix-Miller-Rosato dichotomous measure or just upward movements on the Polity2 scale, as in Table A1) or excludes interpolated income data. On use of linear probability model in (A), see note to Table A1.

### Table A2: Income, leadership change, and democracy—alternative estimations

| Type of panel: | 1-yr (A) 1875-2004: BMR binary measure, only non-democracies | 5-yr (B) 1875-2004: Polity, Polity2 < 6, just upward movements | 10-yr (C) 1875-2004: Polity, Polity2 < 6, no interpolated income values |
|---------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|
|               | 1-yr | 5-yr | 10-yr | 15-yr | 20-yr | 1-yr | 5-yr | 10-yr | 15-yr | 20-yr | 1-yr | 5-yr | 10-yr | 15-yr | 20-yr | 10-yr | 15-yr | 20-yr |
| Democracy t-1 | .98*** | .76*** | .53*** | .56*** | .39*** | .58*** | .90*** | .50*** | .11 | .02 | .09 | .28** |
| Leader replaced in previous period | -.21** | -.77*** | -.84*** | -.198*** | -.206*** | -.06 | -.07** | -.26** | -.63** | -.103*** | -.87 | .03 | -.07* | -.27* | -.59*** | -.108** | -.71 | .05 |
| Ln GDP per capita t-1 | -.00 | .01 | .10 | -.06 | .01 | -.00 | .01 | .02 | -.05 | -.01 | -.00 | .01 | .05 | -.04 | .11 |
| Ln GDP per capita t-1* | .03*** | .11*** | .12** | .28*** | .30*** | .012** | .04** | .10*** | .16*** | .14* | .011* | .04** | .09*** | .17*** | .12 |
| leader replaced prev. per. | (.01) | (.03) | (.05) | (.06) | (.08) | (.005) | (.02) | (.03) | (.05) | (.08) | (.006) | (.02) | (.04) | (.06) | (.10) | (.02) | (.03) | (.05) | (.08) | (.15) |
| Average yrs schooling | .02 | .02 | .02 |
| (age 15 and over) t-1 | (.03) | (.02) | (.03) |
| Average yrs schooling t-1* | .06*** | .03** | .03** |
| leader replaced prev. per. | (.02) | (.02) | (.02) |
| Cumulative effect of income | - | - | - |
| - if leader replaced | .03** | .12*** | .21*** | .22*** | .30** | .42 | .20* | .25** | .26** | .21* | .09 | .11* | .17*** | .13 | .21* |
| - if leader not replaced | -.00 | .01 | .10 | -.06 | .01 | -.13 | .03 | .05 | -.11 | -.02 | -.02 | .03 | .06 | -.04 | .10 |
| Cumulative effect of schooling | - | - | - |
| - if leader replaced | .08** | .14** | .07* |
| - if leader not replaced | .02 | .06 | .02 |
| Fisher p level | [.00] | [.00] | [.00] | [.23] | [.00] | [.00] | [.00] | [.00] | [.00] | [.00] | [.00] | [.00] | [.00] | [.00] | [.00] | [.77] | [.83] | [.00] |
| Observations | 6,221 | 1,191 | 583 | 383 | 287 | 399 | 6,425 | 1,233 | 601 | 396 | 291 | 416 | 5,676 | 1,094 | 547 | 336 | 246 | 416 |
| Countries | 136 | 133 | 122 | 121 | 115 | 64 | 134 | 132 | 119 | 120 | 113 | 65 | 134 | 132 | 119 | 120 | 113 | 65 |
| R-squared | .0968 | .2756 | .4497 | .5751 | .6682 | .4188 | .9128 | .7298 | .7099 | .7537 | .7871 | .6842 | .8644 | .6174 | .6154 | .6920 | .7521 | .5569 |

**Sources:** see Table A18.

**Note:** All regressions estimated by OLS with country and year fixed effects; “t-1” refers to previous panel period. Robust standard errors, clustered by country, in parentheses; * p < .10, ** p < .05, *** p < .01. “Fisher p level”: probability level at which one can reject H0: residuals are I(1), from Fisher test of residuals. Cumulative effects calculated as on p.1.
OLS with fixed effects and a lagged dependent variable can yield biased estimates because the lagged dependent variable is mechanically correlated with the error terms for earlier periods. Table A3 shows results are also similar if the lagged dependent variable is dropped (at the cost of autocorrelation and less precise estimates; clustered standard errors, nevertheless, remain consistent).

### Table A3: Income, leadership change, and democracy—without the lagged dependent variable

| Type of panel:                        | 1-yr | 5-yr | 10-yr | 15-yr | 20-yr | 10-yr |
|--------------------------------------|------|------|-------|-------|-------|-------|
|                                      | (1)  | (2)  | (3)   | (4)   | (5)   | (6)   |
| Leader replaced in previous period   | .03  | -.22 | -.62**| -1.05***| -.84 | .08   |
| Ln GDP per capita_{t-1}              | .00  | .03  | .05   | -.03  | .09   |       |
|                                      | (.02)| (.03)| (.05) | (.06) | (.11) |       |
| Ln GDP per capita_{t-1,*} leader replaced previous period | .004 | .04**| .10***| .16***| .13*  |       |
| Average yrs of schooling (age 15 and over)_{t-1} | .011 | (.02)| (.04) | (.05) | (.08) | .02   |
| Average yrs schooling_{t-1,*} leader replaced previous period | .03* |       |       |       |       | .03   |
| Cumulative effect of income          |      |      |       |       |       |       |
| if leader replaced                   | .007 | .07**| .15***| .14** | .22** |       |
| if leader not replaced               | .002 | .03  | .05   | -.03  | .09   |       |
| Cumulative effect of schooling       |      |      |       |       |       | .05   |
| if leader replaced                   |      |      |       |       |       | .02   |
| if leader not replaced               |      |      |       |       |       | .02   |
| Fisher p level                       | [.00] | [.00] | [.00] | [.00] | [.86] | [.00] |
| Observations                         | 6,425| 1,233| 601   | 396   | 291   | 416   |
| Countries                            | 134  | 132  | 119   | 120   | 113   | 65    |
| R-squared                            | .5134| .5368| .5972 | .6719 | .7342 | .5346 |

**Sources:** see Table A18.

**Note:** All regressions estimated by OLS with country and year fixed effects; “t-1” refers to previous panel period. Robust standard errors, clustered by country, in parentheses; * p < .10, ** p < .05, *** p < .01. “Fisher p level”: probability level at which one can reject H0: residuals are I(1), from Fisher test of residuals. Cumulative effects calculated as on p.1.
Figure A1A: Predicted increase in democracy after ten years, with and without prior leader change, non-democracies, 1875-2004

Figure A1B: Difference in predicted increase in democracy after ten years, with prior leader change compared to without, non-democracies, 1875-2004

Source: See Table A18; calculated from Table 2, model 13 (10-year panel); 95 percent confidence intervals
Estimating the relationship with a panel error correction model

I argue that there is an equilibrium relationship between income and democracy, but that re-equilibration occurs only in periods after leader turnover. Thus, the system alternates between two states that depend on whether turnover has recently occurred. One can capture this with the following model, estimated on annual data:

\[
\Delta d_t = l_t (\alpha d_{t-1} + \phi y_{t-1} + \gamma \Delta y_{t-1} + \mu + \delta + 1) + (1 - l_t) (\eta d_{t-1} + \kappa y_{t-1} + \lambda \Delta y_{t-1} + \theta + \psi + u_t) \tag{A1}
\]

where \(l_t\) is a dummy coded 1 in years when the leader exited, 0 otherwise. The first part of the right-hand side models the dynamics in years after leader exit, the second part captures those in other years. If the estimates for \(\alpha\) and \(\phi\) are significant and have opposite signs, that suggests there is a positive equilibrium relationship between income and democracy that is visible in periods after leader turnover. From this, we can derive the speed at which equilibration occurs during the post-turnover period. Note that we do not expect \(\eta\) and \(\kappa\) to both be significant (there is no equilibrium relationship detectable in years when leader exit has not occurred). Nor do we expect the coefficients on the growth terms, \(\gamma\) and \(\lambda\), necessarily to be significant—although they may—because of the opposite effects growth has, simultaneously raising the income level (favoring democracy) and entrenching the incumbent (obstructing change). I allow the fixed effects to differ between the two types of period.

In Table A4, I show results for this model. As expected, lagged income and democracy are significant, with opposite signs, in the case of leader exit. This suggests an equilibrium relationship between the two such that a one ln unit increase in income is associated with around a .26 points increase in the rescaled Polity2 score (or equivalently, a doubling of GDP per capita is associated with a .17 point Polity2 increase).\(^2\) I graph the equilibrium relationship in Figure A2. In the no-exit years, only lagged democracy is significant (with a negative coefficient), suggesting reversion to the mean, but no impact of income. The growth rate is not significant at all if the leader did not exit. If he did exit, it is significant at \(p < .10\), with a positive sign.

\(^2\) The long run multiplier between Ln income and democracy is equal to \(-\phi / \alpha\).
Table A4: Income, leadership change, and democracy—estimated with a panel error correction model

| Dependent variable: Δ Polity2 | Polity2 \(_{t-1} < 6, 1\)-yr panels |
|-----------------------------|---------------------------------|
| Leader exited previous period | -0.096 (0.154) |

*If leader exited previous period*

| | |
| Δ Ln GDP per capita | 0.112* (0.064) |
| Polity2 \(_{t-1}\) | -0.134*** (0.035) |
| Ln GDP per capita \(_{t-1}\) | 0.035* (0.019) |

*If leader did not exit previous period*

| | |
| Δ Ln GDP per capita | -0.012 (0.022) |
| Polity2 \(_{t-1}\) | -0.088*** (0.011) |
| Ln GDP per capita \(_{t-1}\) | -0.002 (0.005) |

Equilibrium relationship if leader exited:

\[ \beta_{\text{Ln GDP per capita } t-1} / \beta_{\text{Polity2 } t-1} = 0.26^* (0.15) \]

Fisher p level [0.00]
Observations 6,425
Countries 134
R-squared 0.1489

**Sources:** see Table A18.

**Note:** Estimated by OLS with full sets of country and year fixed effects, interacted with indicator for leader turnover in previous year. Robust standard errors, clustered by country, in parentheses; * p < .10, ** p < .05, *** p < .01. “Fisher p level”: probability level at which one can reject H0: residuals are I(1), from Fisher test of residuals.

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**Figure A2: Equilibrium relationship between income and regime type in years after leader turnover, estimated from panel error correction model**

Source: See Table A18.

**Note:** Equilibrium equation: \(-0.134\text{Democracy}_{t-1} + 0.035 \text{Ln GDP per capita}_{t-1} - 0.096 - 0.108 = 0\). \((-0.108 = \text{average of fixed effects for countries and years plus constant.})\) No equilibrium relationship in periods without leader change.
Other possible estimation strategies

Another approach would be to use annual data and estimate the effect of income conditional on leader turnover over multiyear periods by including multiple lags of income, leader turnover, and their interaction:

\[ d_{it} = \sum_{j=1}^{k} (\gamma_{it-j} y_{it-j} + \phi_{it-j} l_{it-j} y_{it-j} + \eta_{it-j} l_{it-j}) + \alpha d_{it-k} + \mu_i + \delta_t + u_{it} \]  

(A2)

where \( l_{it} \) is a dummy taking the value 1 if leader turnover occurred in period \( t \). There are two problems with this. Most important, the argument in this paper contrasts the effect of income during \( k \)-year periods in which at least one leader turnover occurred with the effect of income in \( k \)-year periods in which the same leader remained in power throughout. However, A2 does not estimate this. Instead, it estimates the effect of income if leader turnover occurred in precisely \( t-k \) (while controlling for income and leader turnover in the intervening years of the \( k \)-year period). And it is not obvious how one could recover the effect of income given at least one leader turnover from the regression results. The most direct way to estimate the effect of at least one leader turnover is to use a dummy for at least one leader turnover, as in Equation 1 in the paper and adjust so as to avoid attributing increases in Polity2 to leader turnover that did not precede the regime change. The second problem is that, even if one could recover the relevant effect, the high correlation between consecutive lags of \( y_{it} \) and \( l_{it} \) would produce severe multicollinearity, resulting in imprecise estimates.

One might also think of estimating versions of A2 with the intervening lags dropped:

\[ d_{it} = \gamma_{it-k} y_{it-k} + \phi_{it-k} l_{it-k} y_{it-k} + \eta_{it-k} l_{it-k} + \alpha d_{it-k} + \mu_i + \delta_t + u_{it} \]  

(A3)

However, again, this would not estimate the effect of income conditional on at least one leader change. In addition, the estimates of \( \gamma_{it-k} \) and \( \phi_{it-k} \) would suffer from omitted variable bias because of the omission of the intervening lags.

Finally, one might estimate:

\[ d_{it} = \gamma_{it-k} y_{it-k} + \phi_{it-k} \Lambda_{it-k} y_{it-k} + \eta_{it-k} \Lambda_{it-k} l_{it-k} + \alpha d_{it-k} + \mu_i + \delta_t + u_{it} \]  

(A4)

where \( \Lambda_{it-k} = \begin{cases} 1 & \text{if } \sum_{j=1}^{k} l_{it-j} \geq 1 \\ 0 & \text{if } \sum_{j=1}^{k} l_{it-j} = 0 \end{cases} \),

that is using a dummy for whether there was at least one leader turnover in the \( k \)-year period. (One must now adjust to avoid picking up any relationship between increases in Polity2 and simultaneous or subsequent leader turnover.) This is quite close to the Equation 1 model estimated in the paper. Running such regressions, I get significant results for the interaction between income and leader turnover at all values of \( k \), consistent with the paper’s message. The main disadvantage of A4 is that it counts each instance of leader turnover multiple times (for \( k = 20 \), each leader turnover will show up in 20 consecutive values of \( \Lambda_{it-k} \)). Thus, the errors will—
by construction—be strongly autocorrelated since consecutive values of $A_{k-1}$ will contain a lot of
the same information (not to mention the high autocorrelation in income). For $k = 20$, the
correlation between $u_a$ and $u_{a-1}$ resulting from regressing A4 on this paper’s dataset is $r = .92$.
Clustering the standard errors by country adjusts for this. Still, it seems preferable to choose an
estimation strategy in which autocorrelation is less extreme.

Unlike A4, the formulation in Equation 1 does not include overlapping indicators of
leader turnover. Each leader change is counted only once. Regressing Equation 1 on the 20-year
data panel, the correlation between errors for consecutive country periods is only $r = .24$. 
Table A5: Descriptive statistics on leader turnover

|                  | Non-democracies (Polity2 < 6) | Democracies (Polity2 ≥ 6) |
|------------------|-------------------------------|---------------------------|
| **A. Percent of cases with leader turnover within:** |                               |                           |
| -1 year          | 14                            | 28                        |
| -5 years         | 48                            | 77                        |
| -10 years        | 66                            | 92                        |
| -15 years        | 77                            | 96                        |
| -20 years        | 85                            | 97                        |
| **B. Percent with leader turnover in given year** |                               |                           |
| By period        |                               |                           |
| 1875-1900        | 17                            | 39                        |
| 1901-1950        | 21                            | 39                        |
| 1951-2004        | 13                            | 27                        |
| By GDP per capita, 1990 $ |               |                           |
| 0-3,000          | 15                            | 31                        |
| 3,001-6,000      | 14                            | 33                        |
| 6,001-10,000     | 14                            | 26                        |
| > 10,000         | 19                            | 27                        |
| **C. Percent of nondemocracies that had higher Polity2 score** |                               |                           |
| -1 year after leader turnover | 12                            |                           |
| -5 years after leader turnover | 25                            |                           |
| -10 years after leader turnover | 33                            |                           |

**Sources:** See Table A18.

**Notes:** In panel A, proportions for states that remain authoritarian or democratic throughout whole period.
Table A6 shows results are similar if one varies the starting year of the panel.

### Table A6: Effect of changing starting year in panel on estimated effect of income conditional on leader turnover

| Panel of years ending in: | 0 or 5 | 1 or 6 | 2 or 7 | 3 or 8 | 4 or 9 |
|---------------------------|--------|--------|--------|--------|--------|
| Coefficient on Ln GDP per capita, t-1 * leader exit prev. period | .04**  | .04**  | .05*** | .04**  | .04**  |
|                           | (.02)  | (.02)  | (.02)  | (.02)  | (.02)  |
| Cumulative impact of income |
| -if leader replaced        | .12**  | .12**  | .12*** | .10**  | .10**  |
| -if leader not replaced    | .03    | .04    | .02    | .03    | .02    |

| Panel of years ending in: | 0     | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     |
|---------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Coefficient on Ln GDP per capita, t-1 * leader exit prev. period | .10***| .08***| .10***| .09***| .10***| .12***| .08** | .09***| .08***| .07** |
|                           | (.03) | (.03) | (.03) | (.03) | (.03) | (.03) | (.03) | (.03) | (.03) | (.03) |
| Cumulative impact of income |
| -if leader replaced        | .17***| .17***| .15***| .13** | .10*  | .10*  | .09*  | .11** | .10** | .14** |
| -if leader not replaced    | .05   | .07   | .03   | .02   | -.04  | -.06  | -.01  | .00   | .01   | .06   |

**Sources:** see Table A18.

**Notes:** Robust standard errors, clustered by country, in parentheses; * p < .10, ** p < .05, *** p < .01. Estimates from regressions identical to those in Table 2, column 12 (5-Year Panel) and column 13 (10-Year Panel). “t-1” indicates previous panel period.
Miscellaneous issues

*Could it be that the Polity coders simply take leadership change as a sign of democratization? In this case, the association between leader exit and democratization would be trivial.*

In fact, this is clearly not the case. Among the country-years for which the coders recorded an increase in the Polity2 score, more than half (403) occurred with no leader change that year and 43 percent (311) occurred with no leader change either that year or the previous year. Conversely, of all country-years in which leader change occurred, only 15 percent were coded as years in which democracy increased. Evidently, the coders do not equate the two.

*Are there too few cases of democratization without any prior leader change to estimate the relationship between income and democratization in such circumstances?*

The proportion of cases of democratization without any prior leader change naturally falls as the panel interval increases. If the number fell too low, that could make it hard to estimate the effect of income in cases without leader turnover. This might explain why the significance of Ln GDP per capita is not higher in the 20-year panel (Table 2, column 15). Among non-democracies whose Polity2 score rose in a given year, only 11 percent (69 cases) had experienced no leader change in the preceding 20 years.

It is much less of an issue in the lower-interval panels. Among non-democracies whose Polity2 score rose in a given year, 15 percent (98 cases) had experienced no leader change in the previous 15 years, 24 percent (155 cases) in the previous 10 years, 41 percent (262) in the previous 5 years, and 76 percent (552 cases) in the previous year. Without leader turnover, income is not just insignificant in the 20-year panel—it is insignificant in all the others as well (Table 2, columns 11-14).
Robustness checks

Table A7, column 1, repeats the basic model from Table 2, column 11, to facilitate comparison.

Whether a country democratizes may depend on the extent of democracy in other countries, especially those nearby (Gleditsch and Ward 2006, Gleditsch and Choung 2004). Column 2 controls for this using a measure of “foreign democratic capital”—essentially, the average level of democracy in other countries, weighted by their distance—constructed by Persson and Tabellini (2009): \[ f_i = \sum_{j \neq i} (1 - a_j) \sigma(\rho)^{\|ij\|}, \] where \( i \) and \( j \) index countries, \( t \) indexes year, \( a \) equals 1 for autocracies and 0 for democracies, \( \sigma \|ij\| \) measures the distance between \( i \) and \( j \), and \( \rho \) operationalizes a geographical limit beyond which influence falls to zero, which they, in fact, estimate from the data.

Column 3 controls for foreign trade as a share of GDP (Li and Reuveny 2003, Lopez-Cordova and Meissner 2008).

To capture the “resource curse,” column 4 includes the logged income per capita earned from the country’s sales of oil and gas, from Michael Ross’s database.

Autocracies that use pseudo- or partly-democratic institutions such as elected legislatures and executive elections to coopt opposition may be more stable (Gandhi and Przeworski 2007), while non-regime parties may weaken the regime (Wright and Escría-Folch 2012). Column 5 controls for these.

Column 6 includes whether the head of state was a military officer or a monarch, as recorded by Banks (2007). Column 7 uses the more fine-grained classifications of Geddes, Wright, and Frantz (2012: GWF), who distinguish military, monarchical, one-party, and personalistic regimes (but only since WWII). (I use “miscellaneous” for regimes that GWF do not consider non-democracies but which have a Polity2 score less than six; the excluded category is military regime.)

A country’s history of democracy and autocracy may affect its current regime. In column 8, I include Persson and Tabellini’s measure of accumulated democratic experience, which they call “domestic democratic capital.” They assume this accrues at a fixed rate in each year a country is democratic (Polity2 > 0) and depreciates geometrically in years of autocracy: \[ z_i = (1 - \delta) \sum_{t=0}^{t_0} (1 - a_{t+1}) \delta^t, \] where \( i \) indexes countries, \( t \) indexes year, \( t_0 \) is the initial year, \( a \) equals 1 for autocracies and 0 for democracies, and \( \delta \) is a discount rate that they estimate from the data. As a second check, column 9 contains a variable based on that used by Epstein et al. (2006) to capture the legacy of past democratic failures. Epstein et al. used the absolute value of the sum of a country’s total downward movements on the Polity scale since 1960. I use the total since the start of the data, and normalize by the number of years.

To control for political instability, column 10 includes the percentage of previous leader changes in the country (since the start of the data) that were “irregular,” according to the Archigos codings.

Perhaps it is not leader turnover that prompts democratization, but war that overthrows both leaders and regime. Column 11 controls for whether the country had been in a war or civil war the previous year, and whether the government won or lost such wars. (I exclude military defeats that resulted in foreign occupation or imposition of a leader, since obviously occupation by a democratic power could result in democracy.) Democratization was more likely if a civil war had been underway. But this had little effect on the leader turnover and income results.

In the same regressions run on 10-year panels (not shown), the interaction of income with leader change is sometimes less significant (probably due to the large drop in observations due to problems of data availability), but the cumulative impact of income after leader exit is almost always significant.
|                          | (1)      | (2)      | (3)      | (4)      | (5)      | (6)      | (7)      | (8)      |
|--------------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| **Dependent variable:**  |          |          |          |          |          |          |          |          |
| Polity2 t-1              | .91***   | .91***   | .90***   | .89***   | .88***   | .91***   | .90***   | .92***   |
|                          | (.01)    | (.01)    | (.02)    | (.01)    | (.02)    | (.01)    | (.02)    | (.01)    |
| Leader replaced in       | -08**    | -06*     | -08*     | -06      | -09**    | -09**    | -08      | -07*     |
| previous period          | (.04)    | (.04)    | (.05)    | (.04)    | (.04)    | (.05)    | (.05)    | (.04)    |
| Ln GDP per capita t-1    | -.001    | .002     | .01      | -.003    | .002     | .000     | -.002    | .002     |
|                          | (.005)   | (.05)    | (.01)    | (.007)   | (.007)   | (.005)   | (.007)   | (.005)   |
| Ln GDP per capita t-1*   | .012**   | .010**   | .013**   | .011*    | .015**   | .014**   | .014**   | .011**   |
| leader replaced t-1      | (.005)   | (.005)   | (.006)   | (.006)   | (.005)   | (.007)   | (.007)   | (.005)   |
| Foreign democratic       | .10      | .01      |          | .007     |          |          |          |          |
| capital t-1              | (0.07)   | (0.07)   |          | (0.02)   |          |          |          |          |
| Trade/GDP                | -.011*   |          |          |          |          |          |          |          |
| Log income from          | -.001    |          |          |          |          |          |          |          |
| oil and gas              | (0.002)  |          |          |          |          |          |          |          |
| Non-regime parties       |          |          |          |          |          |          |          |          |
|                          | .007     |          |          |          |          |          |          |          |
|                          | (0.005)  |          |          |          |          |          |          |          |
| Elected legislature      | -.014**  |          |          |          |          |          |          |          |
|                          | (0.006)  |          |          |          |          |          |          |          |
| Elected executive        | -.006    |          |          |          |          |          |          |          |
|                          | (0.006)  |          |          |          |          |          |          |          |
| Military regime t-1      | .023**   |          |          |          |          |          |          |          |
|                          | (0.009)  |          |          |          |          |          |          |          |
| Monarchy t-1             | .011     |          |          |          |          |          |          |          |
|                          | (0.009)  |          |          |          |          |          |          |          |
| One-party regime t-1     | -.03***  |          |          |          |          |          |          |          |
|                          | (0.01)   |          |          |          |          |          |          |          |
| Personalistic regime t-1 | -.03***  |          |          |          |          |          |          |          |
|                          | (0.01)   |          |          |          |          |          |          |          |
| Miscellaneous regime t-1 | -.04***  |          |          |          |          |          |          |          |
|                          | (0.01)   |          |          |          |          |          |          |          |
| Domestic democratic      |          |          |          |          | -.05***  | (0.02)   |          |          |
| capital t-1              |          |          |          |          |          |          |          |          |
| Previous transitions     |          |          |          |          |          |          |          |          |
| Percent of previous      |          |          |          |          |          |          |          |          |
| leader changes irregular |          |          |          |          |          |          |          |          |
| Cumulative effect of     | .12      | .14*     | .21**    | .08      | .14*     | .16*     | .12      | .16*     |
| income                   | (0.00)   | (0.02)   | (0.09)   | (0.03)   | (0.02)   | (0.00)   | (0.02)   | (0.03)   |
| -if leader replaced      |          |          |          |          |          |          |          |          |
| -if leader not replaced  |          |          |          |          |          |          |          |          |
| Fisher p level           | [.00]    | [.00]    | [.00]    | [.00]    | [.00]    | [.00]    | [.00]    | [.00]    |
| Observations             | 6,425    | 6,104    | 4,281    | 5,071    | 4,383    | 5,916    | 4,263    | 6,104    |
| Countries                | 134      | 130      | 123      | 127      | 132      | 119      | 130      | 130      |
| R-squared                | .8703    | .8691    | .8613    | .8594    | .8521    | .8718    | .8496    | .8697    |
Table A7: (cont.)

| Dependent variable: Polity2 Level of Democracy, Polity2 t-1 < 6, 1-yr panel | (9)     | (10)     | (11)     |
|----------------------------------------------------------------------------|---------|---------|---------|
| Democracy t-1                                                             | .91***  | .91***  | .91***  |
|                                                                           | (.01)   | (.01)   | (.01)   |
| Leader replaced in previous period                                        | -.07*   | -.08**  | -.08**  |
|                                                                           | (.04)   | (.04)   | (.04)   |
| Ln GDP per Capita t-1                                                     | -.003   | -.001   | .000    |
|                                                                           | (.005)  | (.005)  | (.005)  |
| Ln GDP per Capita t-1 * leader replaced t-1                                | .012**  | .012**  | .012**  |
|                                                                           | (.005)  | (.005)  | (.005)  |
| Previous transitions                                                      | -.07*** | .001    |
|                                                                           | (.01)   |         |
| Percent of previous leader changes irregular                               |         |         |         |
| Interstate war in progress t-1                                             |         | -.002   |
| Won interstate war t-1                                                     |         | .004    |
|                                                                           |         | (.007)  |
| Lost interstate war t-1                                                    |         | .039    |
|                                                                           |         | (.025)  |
| Civil war in progress t-1                                                  |         | .021*** |
|                                                                           |         | (.007)  |
| Government won civil war t-1                                               |         | -.018   |
|                                                                           |         | (.013)  |
| Government lost civil war t-1                                              |         | .013    |
|                                                                           |         | (.017)  |
| Cumulative effect of income                                                |         |         |
| -if leader replaced                                                        | .09     | .12     | .14     |
| -if leader not replaced                                                    | -.03    | -.01    | .00     |
| Fisher p level                                                             | [.00]   | [.00]   | [.00]   |
| Observations                                                               | 6,425   | 6,425   | 6,418   |
| Countries                                                                  | 134     | 134     | 134     |
| R-squared                                                                  | .8731   | .8703   | .8715   |

Sources: see Table A18.

Note: All regressions estimated by OLS with country and year fixed effects. Robust standard errors, clustered by country, in parentheses; * p < .10, ** p < .05, *** p < .01. “Fisher p level”: probability level at which one can reject H0: residuals are I(1), from Fisher test of residuals. I assume that if a country enters the Ross data set with 0 oil and gas income, it also earned 0 income from oil and gas in preceding years. This reduces the loss of data due to fact that Ross data start only in 1930s. “Lost interstate war” excludes cases where foreign power occupied territory within following 10 years or imposed a leader.
Identification in Table 3

While the timing of death by natural causes is unlikely to be affected by democratization, leader deaths in office may be more likely to occur in some settings than in others. We need to check that such contextual factors do not, in fact, account for the income-democracy relationship in the aftermath of a leader’s natural death. Table A8 establishes that, among non-democracies, years in which a leader died of natural causes are distributed similarly to years without any leader death with regard to countries’ income levels, Polity2 scores, and the time period. Such leader exits do occur slightly more often in South Asia and less often in Sub-Saharan Africa and Latin America than elsewhere. And, as one might expect, leaders that die in office tend to be older and to have served for longer. Table A9, therefore, repeats the top line of Table 3, but controlling for region of the world, (previous) leader’s tenure, and (previous) leader’s age.

Table A8: Characteristics of country/years in which leader died of natural causes, non-democracies, 1875-2004

| GDP per capita | < $800 | $800-1,100 | $1,100-1,500 | $1,500-2,200 | $2,200-3,000 | $3,000 or more |
|----------------|--------|------------|--------------|--------------|--------------|----------------|
| -leader death  | 16     | 16         | 14           | 15           | 12           | 29             |
| -no leader death | 18   | 16         | 14           | 15           | 13           | 23             |
| Polity2 score   | -10 to -9 | -8 to -7 | -6 to -4 | -3 to 2 | 3 to 5 | -leader death  | 16 | 27 | 25 | 25 | 7 | 4.72 [.32] |
| -leader death  | 16     | 27         | 25           | 25           | 7            |                 |
| -no leader death | 19   | 25         | 20           | 25           | 12           |                 |
| Time period     | 1875-89 | 1890-1904 | 1905-19 | 1920-34 | 1935-49 | 1950-64 | 1965-79 | -leader death  | 8  | 6  | 14 | 9  | 12 | 12 | 18 |
| -leader death  | 8      | 6          | 14           | 9            | 12           | 18           |
| -no leader death | 8   | 8          | 7            | 9            | 10           | 12           | 19           |
| Region          | East Asia & Pacific | E. Europe & C. Asia | Lat. Americ and Carib. | M. East, N. Africa | South Asia | Sub-Saharan Africa | W. Europe, N. America |
| -leader death  | 15     | 14         | 21           | 17           | 10           | 14           | 9           |
| -no leader death | 12  | 12         | 26           | 15           | 5            | 23           | 9           |
| Leader tenure (previous yr.) | 0-1 | 2-3 | 4-5 | 6-9 | >9 | -leader death | 18     | 18 | 9  | 6  | 50 | 29.33 [.00] |
| -leader death  | 18     | 18         | 9            | 6            | 50           |                 |
| -no leader death | 28  | 18         | 11           | 14           | 29           |                 |
| Leader age (previous yr.) | < 46 | 46-51 | 52-57 | 58-63 | >63 | -leader death | 5      | 18  | 17 | 17 | 44 | 60.70 [.00] |
| -leader death  | 5      | 18         | 17           | 17           | 44           |                 |
| -no leader death | 26  | 19         | 20           | 16           | 19           |                 |

Sources: see Table A18.
### Table A9: Estimated marginal effect of income on increase in Polity2 score in 10 years after dictator exited, with controls

*Figure is coefficient on lagged log GDP per capita in regression of the 10-year change in Polity2 (0 to 1)*

|   | After leader died of natural causes | All 10-year periods in which leader did not die of natural causes | All 10-year periods in which leader did not leave office |
|---|-----------------------------------|-------------------------------------------------|--------------------------------------------------|
|   | (1)                                | (2)                                             | (3)                                              |
| A) | (I)                                | (II)                                            | (III)                                           |
|   | .22***                            | .16***                                          | .03***                                          |
|   | (.07)                              | (.01)                                           | (.01)                                            |
| N | 100                                | 4,746                                           | 1,659                                           |

**Controlling for region, tenure and age of deceased dictator**

| B) | After year of military defeat in which leader exited | After year of military defeat with no leader exit (in the next 10 years) | All 10-year periods containing no year of military defeat in which leader exited (but he may have exited in other years) |
|---|-----------------------------------------------|--------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
|   | (1)                                           | (2)                                                                       | (3)                                                                                                               |
|   | .93**                                         | -.06                                                                      | .09***                                                               |
|   | (.30)                                         | (.05)                                                                     | (.01)                                                                                                             |
| N | 14                                            | 13                                                                        | 4,928                                                                |

**Controlling for military regime, monarchy (Banks 2007)**

| C) | After year of global recession in which leader exited | After year of global recession with no leader exit (in the next 10 years) | All 10-year periods containing no year of global recession in which leader exited (but he may have exited in other years) |
|---|--------------------------------------------------------|--------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
|   | (1)                                                    | (2)                                                                       | (3)                                                                                                               |
|   | .33*                                                   | .07                                                                       | .05***                                                               |
|   | (.16)                                                  | (.06)                                                                     | (.01)                                                                                                             |
| N | 48                                                     | 70                                                                        | 3,384                                                                |

**Source:** See Table A18.

**Notes:** Robust standard errors in parentheses.
Table A10, column 1, repeats the basic model from Table 2, column 11, for comparison. Subsequent columns control for the average rate of leader turnover in the previous 20, 10, and 5 years, and the interactions of this rate with lagged income and leader exit in year \( t - 1 \). The cumulative impact of income conditional on exit in the previous year is hardly changed at all. What activates the link between income and democracy is not leader instability in general but the fact that a leader has actually just exited.

### Table A10: Is what matters a predisposition to leader turnover—or actual leader exit?

| Dependent variable: | Polity2 Level of Democracy, Polity2 \( t-1 < 6 \), 1-yr panels |
|---------------------|---------------------------------------------------------------|
|                     | (1) | (2) | (3) | (4) |
| Polity2 \( t-1 \)    | .91*** | .91*** | .91*** | .91*** |
|                     | (.01) | (.01) | (.01) | (.01) |
| Leader replaced \( t-1 \) | -.08** | -.12* | -.11 | -.11 |
|                     | (.04) | (.07) | (.07) | (.09) |
| Ln GDP per capita \( t-1 \) | -.001 | -.000 | -.001 | .000 |
|                     | (.005) | (.005) | (.005) | (.005) |
| Ln GDP per capita \( t-1 \) * leader replaced \( t-1 \) | .012** | .018** | .017* | .018 |
|                     | (.005) | (.009) | (.010) | (.012) |
| Rate of leader turnover previous 20 years | .01 | (.06) |
| Rate of leader turnover previous 20 years * Ln GDP per capita \( t-1 \) | -.001 | (.009) |
| Rate of leader turnover previous 10 years | .12 | (.10) |
| Rate of leader turnover 10 years * Ln GDP per capita \( t-1 \) * leader replaced \( t-1 \) | -.017 | (.013) |
| Rate of leader turnover previous 5 years | -.01 | (.06) |
| Rate of leader turnover previous 5 years * Ln GDP per capita \( t-1 \) | -.003 | (.008) |
| Rate of leader turnover previous 5 years * leader replaced \( t-1 \) | .08 | (.11) |
| Rate of leader turnover 5 years * Ln GDP per capita \( t-1 \) * leader replaced \( t-1 \) | -.01 | (.01) |
| Cumulative effect of income (at high turnover rate: mean + 1 SD) | .12 (.08) | .10 (.08) | .12 (.08) | .12 (.08) |
| -if leader replaced | -.01 (.05) | -.01 (.07) | .00 (.07) | -.02 (.06) |
| Fisher p level | [.00] | [.00] | [.00] | [.00] |
| Observations | 6,425 | 6,372 | 6,372 | 6,372 |
| Countries | 134 | 134 | 134 | 134 |
| R-squared | .8703 | .8706 | .8706 | .8707 |

**Sources:** see Table A18 in Appendix.
**Note:** All regressions estimated by OLS with country and year fixed effects. Robust standard errors, clustered by country, in parentheses; * p < .10, ** p < .05, *** p < .01. “Fisher p level”: probability level at which one can reject H0: residuals are I(1), from Fisher test of residuals.

The Banks data on opposition mobilization are compiled from newspapers, which raises the concern that reports might be censored in countries with less freedom of the press. In fact, using Freedom House’s index of press freedom, I show that the number of reported mobilizations is usually significantly *higher* in countries with less freedom of the press. It might be that the measures would be higher still if journalists could report more freely, but the variation does not seem to be driven by restrictions on the press. I use the natural log of the number of mobilizations since the distribution for each variable is right-skewed.

### Table A11: Popular mobilizations and press freedom, 1994-2008

| Dependent variable: Ln average number of events per year, 1994-2008 | Antigovernment demonstrations | General strikes | Riots | Attempted revolutions |
|---------------------------------------------------------------|-------------------------------|----------------|-------|------------------------|
| Press freedom, average 1994-2008                              | -.01                          | -.0014**       | -.003** | -.006***               |
|                                                               | (.02)                         | (.0006)        | (.001) | (.002)                 |
| Growth rate, average 1994-2008                                | -.01                          | -.005**        | -.005  | -0.000                 |
|                                                               | (.01)                         | (.002)         | (.004) | (.006)                 |
| Polity2, average 1994-2008                                    | .56***                        | .17***         | .20*** | .33***                 |
|                                                               | (.12)                         | (.04)          | (.07)  | (.12)                  |
| Ln GDP per capita, average 1994-2008                          | -.001                         | -.001          | -.03   | -.04**                 |
|                                                               | (.028)                        | (.010)         | (.02)  | (.02)                  |
| Constant                                                      | .22                           | .04            | .33*   | .56***                 |
|                                                               | (.21)                         | (.08)          | (.13)  | (.15)                  |
| Observations                                                  | 148                           | 148            | 148    | 148                    |
| R-squared                                                     | .1156                         | .0988          | .0736  | .2198                  |

**Sources:** see Table A18.

**Notes:** All variables averages for 1994-2008, the years for which Freedom of Press index available. Natural logs of dependent variables used because distributions of all are right skewed. I have reversed the scale on Freedom House’s index of press freedom so that higher values indicate more freedom. Robust standard errors in parentheses: p < .10, ** p < .05, *** p < .01.
In Table A12, the dependent variable is a dummy for leader exit. Here, but only here, leader exit excludes exit due to death from natural causes, suicide, or retirement due to poor health, because these are not likely to be influenced by economic growth, defeat in wars, or the other factors. Rather than restricting attention to nondemocracies, I include all countries and model the difference in the effects in democracies and non-democracies using interaction terms.

One concern is that regressions of leader replacement on economic growth might pick up the opposite causal process: more leadership change might, by creating uncertainty for investors, inhibit growth. To address this, column 2 estimates a model instrumenting for the growth rate with the average growth rate in other countries, weighted by their trade shares with the given country in the previous year:

\[ g_{at} = \sum_{b=a}^{} \omega_{abt-1} I_{bt} g_{bt} \left/ \sum_{b=a}^{} \omega_{abt-1} I_{bt} \right. \]

where \( g_{bt} \) is the growth rate of GDP per capita in country \( b \) in \( t \); \( I_{bt} \) is an indicator that equals one if the dataset includes data on growth in country \( b \) in period \( t \), 0 otherwise; and \( \omega_{abt-1} = X_{abt-1} / Y_{at-1} \), where \( X_{abt-1} \) is trade between \( a \) and \( b \) in \( t-1 \), and \( Y_{at-1} \) is country \( a \)’s GDP in \( t-1 \). The trade data come from Russett, Oneal, and Berbaum (2003); since these data end in 1992, I use the trade weights from 1992 for the years 1993-2008. (This instrument is similar to one AJRY (2008) use for per capita income. I tried to instrument for income using an instrument corresponding to theirs, but in the dataset used here the instruments were too weakly correlated with income to serve adequately.)

To satisfy the exclusion restriction, the instrument should be unrelated to leader turnover by any path other than via growth. It is possible that economic performance in other countries affects the incidence of war, which, if it involves the given country, could influence leader change there. I therefore control here for interstate war. I use the test devised by Stock and Yogo (2005) to check that the instrument is not weak. This test consists of comparing the Cragg-Donald statistic to a set of critical values. We can reject the hypothesis of weak instruments with high confidence.

Some papers have analyzed leader turnover using leader-year data with hazard models (e.g., Chiozza and Goemans 2004). These have a number of attractive features. For instance, besides gauging the impact of independent variables, one can calculate a hazard rate at which leaders are replaced on average, other things equal. As in Bueno de Mesquita and Smith (2010), I fit a Weibull hazard model in column 4 for growth and military defeat, which allows the hazard rate to change over time; how it changes depends on an “ancillary parameter,” \( p \), which is estimated from the data. I model this parameter as a function of whether the country is a democracy (Polity2 greater than 5).

The main conclusions from this analysis are that: 1) low growth, military defeat, high and increasing opposition mobilization, civil war, and major government crises are all associated with higher odds of leader exit in nondemocracies, and the effect of low growth may well be causal; 2) in nondemocracies, older leaders are more likely to leave office, but longer tenure reduces the odds; 3) low growth, major government crisis, and maybe the leader’s old age are associated with higher odds of exit in democracies; 4) among nondemocracies, military regimes experience more leader turnover along with personalist regimes; one-party regimes and monarchies experience less.
Table A12: Explaining leader exit, 1875-2004

|                                | Fixed effects conditional logit, year dummies | IV, year and country dummies | Fixed effects conditional logit, year dummies | Weibull hazard model, leader/year data |
|--------------------------------|----------------------------------------------|------------------------------|-----------------------------------------------|----------------------------------------|
|                                 | (1)                                          | (2)                          | (3)                                           | (4)                                    |
| One-year panels                 |                                              |                              |                                               |                                        |
| Growth rate_t                   | -.041*** (.06)                               | -.012** (.06)                | -.027*** (.05)                                |                                        |
| Democracy_t * growth rate_t     | .016 (.11)                                   | .000 (.007)                  | .007 (.008)                                   |                                        |
| Military defeat_t               |                                              |                              |                                               |                                        |
| Democracy_t * military defeat_t |                                              |                              |                                               |                                        |
| Democracy_t_1                   | 3.23*** (.82)                                | .40** (.18)                  | 3.36*** (.82)                                 | 1.65* (.87)                            |
| Ln GDP per capita_t_1           | -.093 (.134)                                 | -.099 (.022)                 | .01 (.13)                                     | -.17 (.060)                            |
| Proportion other countries in region with leader exit_t-1 | .60 (.40) | .032 (.073) | .65 (.41) | 1.52*** (.32) |
| Leader's age_t-1                | .032*** (.004)                               | .004*** (.009)               | .033*** (.004)                                | .021*** (.004)                         |
| Previous times in office_t-1    | -.051 (.079)                                 | -.004 (.013)                 | .057 (.079)                                   | .10** (.05)                            |
| Leader's years in office this time_t-1 | -.053*** (.007) | -.005*** (.001) | -.055*** (.007) | -.029*** (.007) |
| Dem_t * ln GDP per capita_t-1   | -.24** (.10)                                 | -.031 (.019)                 | -.25** (.10)                                  | -.039 (.10)                            |
| Dem_t * proportion other countries in region with leader exit_t-1 | -.48 (.52) | .01 (.11) | -.50 (.52) | -.81* (.42) |
| Dem_t * leader's age_t-1        | -.019*** (.007)                              | -.002 (.002)                 | -.020*** (.007)                               | -.021*** (.006)                        |
| Dem_t * previous times in office_t-1 | .09 (.11) | .015 (.026) | .09 (.11) | .10 (.08) |
| Dem_t * leader's years in office_t-1 | .042*** (.013) | .004 (.005) | .044*** (.013) | -.016 (.027) |
| Interstate war                  | -.04 (.03)                                   |                              |                                               |                                        |
| Constant                        |                                              |                              |                                               | -2.23*** (.46)                         |
| Ancillary parameter (ln(p))     |                                              |                              |                                               |                                        |
| Democracy Dummy                 | .29*** (.08)                                 |                              |                                               |                                        |
| Constant                        | -.40*** (.04)                                |                              |                                               |                                        |
| Effect when non-democracy_t-1   |                                              |                              |                                               |                                        |
| Growth rate_t                   | -.041*** (.06)                               | -.012** (.06)                | 1.43*** (.38)                                 | -.027*** (.05)                         |
| Military defeat_t               | -.093 (.134)                                 | -.009 (.022)                 | .01 (.13)                                     | .70*** (.24)                           |
| Ln GDP per capita_t-1           | -.032*** (.004)                              | .044*** (.009)               | .033*** (.004)                                | .021*** (.004)                         |
| Leader's years in office_t-1    | -.053*** (.007)                              | -.004 (.013)                 | -.055*** (.007)                               | -.029*** (.007)                        |
| Effect when democracy_t-1       |                                              |                              |                                               |                                        |
| Growth rate_t                   | -.025** (.10)                                | -.012 (.008)                 | -.020*** (.007)                               |                                        |
| Military defeat_t               | -.34*** (.12)                                | -.040* (.024)                | -.24** (.12)                                  | -.06 (.08)                             |
| Ln GDP per capita_t-1           | .013** (.005)                                | .002 (.002)                  | .013** (.005)                                 | .000 (.005)                            |
| Leader's years in office_t-1    | -.011 (.011)                                 | -.002 (.005)                 | -.011 (.011)                                  | -.045* (.027)                          |
|                                |                                              |                              |                                               |                                        |
| Cragg-Donald                    | 96.56                                        |                              |                                               |                                        |
| Stock Yogo (size)               | 10%                                          |                              |                                               |                                        |
| Observations                    | 9,268                                        | 7,745                        | 9,255                                         | 11,847                                 |
| Countries                       | 142                                          | 145                          | 142                                           | 155                                    |

Sources: see Table A18.

Note: Standard errors in parentheses (robust and clustered by country in column 2); * p < .10, ** p < .05, *** p < .01.

“Democracy_t-1’’ here indicates that Polity2_t-1 ≥ 6.
### Table A12: Explaining leader exit (cont.)

*Dependent variable is dummy for leader exit (except due to natural death, suicide, or retirement due to poor health)*

|                     | (5)       | (6)       | (7) Banks data | (8) Geddes data |
|---------------------|-----------|-----------|----------------|-----------------|
| Ln AGDs t-2         | .48***    | (.11)     |                |                 |
| Δ AGDs t-1          | .10***    | (.03)     |                |                 |
| Democracy_{i,t} * ln AGDs t-2 | -.35** | (.15) |                |                 |
| Democracy_{i,t} * Δ AGDs t-1 | -.10*** | (.04) |                |                 |
| Assassinations_{t-1} | -0.03     | (.045)   |                |                 |
| Guerilla warfare_{t-1} | -0.021    | (.046)   |                |                 |
| Major government crisis_{t-1} | .52*** | (.07) |                |                 |
| Civil war_{t-1}     | .49**     | (.21)     |                |                 |
| Democracy_{i,t} * assassinations_{t-1} | .006 | (.063) |                |                 |
| Democracy_{i,t} * guerilla warfare_{t-1} | -.12 | (1.11) |                |                 |
| Democracy_{i,t} * crisis_{t-1} | .05 | (.10) |                |                 |
| Democracy_{i,t} * civil war_{t-1} | -.05 | (.34) |                |                 |
| Military regime_{t-1} | .51*** | (.17) | .67*** | (.18) |
| Monarchy_{t-1}      | -.20      | (.16)     | -.06          | (.36)           |
| Personalist regime_{t-1} | .41** | (.19) |                |                 |
| Miscellaneous regime_{t-1} | .90*** | (.19) |                |                 |
| Democracy_{i,t}     | 4.11***   | (1.00)    | 4.43*** | (.99) | 3.30*** | (.85) | 3.29*** | (1.11) |
| Ln GDP per capita_{t-1} | .16      | (.17) | .25      | (.16) | .03     | (.14) | .42**   | (.18) |
| Proportion other countries | .56   | (.48) | .59      | (.49) | .74*    | (.43) | 1.09*   | (.56) |
| in region with leader exit_{t-1} |         |         |           |                 |
| Leader’s age_{t-1} | .040***   | (.006)   | .039***   | (.005) | .035*** | (.005) | .038*** | (.006) |
| Previous times in office_{t-1} | -.044 | (.110) | -.068    | (.111) | -.021   | (.082) | -.19    | (.12) |
| Leader’s years in office_{t-1} | -.049*** | (.009) | -.042*** | (.009) | -.056*** | (.007) | -.029*** | (.010) |
| Democracy_{i,t} * ln GDP per capita_{t-1} | -.21* | (.12) | -.31**   | (.12) | -.23**  | (.11) | -.12    | (.14) |
| Democracy_{i,t} * proportion other_{t-1} | -.13  | (.62) | -.45     | (.62) | -.68    | (.55) | -1.36*  | (.76) |
| in region with leader exit_{t-1} |         |         |           |                 |
| Democracy_{i,t} * leader’s age_{t-1} | -.039*** | (.008) | -.033***  | (.008) | -.021*** | (.007) | -.029*** | (.009) |
| Democracy_{i,t} * previous times in office_{t-1} | .09  | (.14) | .09      | (.14) | .06     | (.11) | .13     | (.16) |
| Democracy_{i,t} * leader’s years in office_{t-1} | .122*** | (.02) | .132***  | (.019) | .050*** | (.013) | .137*** | (.022) |

#### Effect when nondemocracy_{t-1}

|                     | (5)       | (6)       | (7) Banks data | (8) Geddes data |
|---------------------|-----------|-----------|----------------|-----------------|
| Ln AGDs t-2         | .48***    | (.11)     |                |                 |
| Δ AGDs t-1          | .10***    | (.03)     |                |                 |
| Assassinations_{t-1} | -0.03     | (.045)   |                |                 |
| Guerilla warfare_{t-1} | -0.021    | (.046)   |                |                 |
| Major government crisis_{t-1} | .52*** | (.07) |                |                 |
| Civil war_{t-1}     | .49**     | (.21)     |                |                 |
| Ln GDP per capita_{t-1} | .16      | (.17) | .25      | (.16) | .03     | (.14) | .42**   | (.18) |
| Leader’s age_{t-1} | .040***   | (.006)   | .039***   | (.005) | .035*** | (.005) | .038*** | (.006) |
| Leader’s years in office_{t-1} | -.049*** | (.009) | -.042***  | (.009) | -.056*** | (.007) | -.029*** | (.010) |

#### Effect when democracy_{i,t}

|                     | (5)       | (6)       | (7) Banks data | (8) Geddes data |
|---------------------|-----------|-----------|----------------|-----------------|
| Ln AGDs t-2         | .13       | (.11)     |                |                 |
| Δ AGDs t-1          | .005      | (.025)    |                |                 |
| Assassinations_{t-1} | .004      | (.044)   |                |                 |
| Guerilla warfare_{t-1} | -.14     | (1.0)    |                |                 |
| Major government crisis_{t-1} | .57*** | (.07) |                |                 |
| Civil war_{t-1}     | .44       | (2.8)     |                |                 |
| Ln GDP per capita_{t-1} | -.04     | (.14) | -.05     | (.14) | -.19    | (.12) | .30*    | (.17) |
| Leader’s age_{t-1} | .001      | (.006)    | .007      | (.006) | .013**  | (.006) | .009    | (.007) |
| Leader’s years in office_{t-1} | .073*** | (.017) | .090***  | (.017) | -.006   | (.011) | .11***  | (.02) |
| Excluded category   | Other non-dem One-party | | | |
| Observations        | 6,942     | 7,123     | 8,578         | 6,163           |
| Countries           | 134       | 135       | 137           | 134             |

**Sources:** see Table A18.

**Note:** Standard errors in parentheses; * p < .10, ** p < .05, *** p < .01. “Democracy_{i,t}” here indicates that Polity2_{i,t} ≥ 6.
| Table A13: Possible confounding factors |
|-----------------------------------------|
| **Dependent variable:**                | Polity2 Level of Democracy, Polity2 \( t+1 \) < 6, 1-yr panels |
|-----------------------------------------|-------------------------------------------------------------|
|                                        | (1)             | (2)             | (3)             | (4)             |
| Polity2 \( t-1 \)                      | .91*** (.01)    | .91*** (.01)    | .90*** (.01)    | .89*** (.01)    |
| Ln GDP per capita \( t-1 \)            | .000 (.005)     | -.001 (.005)    | .001 (.007)     | .001 (.006)     |
| Leader exited \( t-1 \)                | -.08** (.04)    | -.06 (.04)      | -.06 (.04)      | -.07 (.05)      |
| Ln GDP per capita \( t-1 \) * leader exited \( t-1 \) | .013** (.005)  | .009* (.006)    | .011* (.006)    | .011* (.006)    |

**Economic crisis**

- Growth rate \( t+1 \) - .002 (.001)
- Growth rate \( t+1 \) * Ln GDP per capita \( t+1 \) - .0002 (.0002)
- Growth rate \( t+1 \) * leader exited \( t+1 \) - .005 (.005)
- Growth rate \( t+1 \) * Ln GDP p. cap. \( t+1 \) * leader exited \( t+1 \) - .001 (.001)

**Military defeat**

- Country lost war \( t \) * - .04 (.09)
- Lost war \( t \) * Ln GDP per capita \( t+1 \) - .0008 (.014)
- Lost war \( t \) * leader exited \( t+1 \) - .208** (.89)
- Lost war \( t \) * Ln GDP p. cap. \( t+1 \) * leader exited \( t+1 \) - .28** (.12)

**Domestic mobilization**

- Ln number of antigovernment demos (AGDs) \( t-2 \) - .022 (.019)
- Change in number of AGDs \( t-1 \) - .022 (.002)
- Change in AGDs \( t+1 \) * Ln GDP per capita \( t+1 \) - .003 (.002)
- Change in AGDs \( t+1 \) * leader exited \( t+1 \) - .000 (.04)
- Change in AGDs \( t+1 \) * Ln GDP per cap. \( t+1 \) * leader exited \( t+1 \) - .001 (.005)

- Ln number of AGDs \( t+1 \) - .022*** (.005)
- Change in number of AGDs \( t+1 \) - .036*** (.012)
- Change in AGDs \( t+1 \) * Ln GDP per capita \( t+1 \) - .004*** (.001)
- Change in AGDs \( t+1 \) * leader exited \( t+1 \) - .022 (.034)
- Change in AGDs \( t+1 \) * Ln GDP per cap. \( t+1 \) * leader exited \( t+1 \) - .003 (.004)

**Cumulative impact of income if:**

- Growth rate \( t+1 \) = 0%, no leader exit \( t+1 \) - .00 (.06)
- Growth rate \( t+1 \) = -5%, no leader exit \( t+1 \) - .01 (.06)
- Growth rate \( t+1 \) = -10%, no leader exit \( t+1 \) - .02 (.06)
- Growth rate \( t+1 \) = 0%, leader exited \( t+1 \) - .15* (.09)
- Growth rate \( t+1 \) = -5%, leader exited \( t+1 \) - .18* (.10)
- Growth rate \( t+1 \) = -10%, leader exited \( t+1 \) - .21* (.11)

- Country lost war \( t+1 \), no leader exit \( t+1 \) - .09 (.17)
- Country did not lose war \( t+1 \), no leader exit \( t+1 \) - .01 (.06)
- Country lost war \( t+1 \), leader exited \( t+1 \) - 3.46** (1.3)
- Country did not lose war \( t+1 \), leader exited \( t+1 \) - .10 (.09)

- Increase of 2 AGDs \( t+1 \), no leader exit \( t+1 \) - .07 (.08)
- No increase in AGDs \( t+1 \), no leader exit \( t+1 \) - .00 (.06)
- Increase of 2 AGDs \( t+1 \), leader exited \( t+1 \) - .19 (.13)
- No increase in AGDs \( t+1 \), leader exited \( t+1 \) - .11 (.09)

Fisher p level
- [.00] [.00] [.00] [.00]
Observations
- 6403 6418 4770 4867
Countries
- 134 134 126 127
R-squared
- .8715 .8723 .8573 .8548

**Sources:** Table A18.

**Note:** OLS with country and year fixed effects. Robust standard errors, clustered by country, in parentheses; * p < .10, ** p < .05, *** p < .01. “Fisher p level”: probability level at which one can reject H0: residuals are I(1), from Fisher test of residuals. * excluding military defeats followed (within 10 years) by foreign occupation or imposition of leader. If one excludes wars with fewer than 500 battle deaths, the cumulative effect of income if the country lost a war but no leader exited increases to .18 (still not significant), but little else changes.
Table A13: Possible confounding factors (cont.)

| Dependent variable: | Polity2 Level of Democracy, Polity2_t−1 < 6, 1-yr panels |
|---------------------|--------------------------------------------------------|
|                     | (5) | (6) | (7) | (8) |
| Polity2_t−1         | .89*** (.01) | .90*** (.01) | .91*** (.01) | .89*** (.01) |
| Ln GDP per capita_t−1 | .001 (.006) | .001 (.006) | -.000 (.005) | .002 (.006) |
| Leader exited_t−1   | -.10* (.05) | -.09* (.05) | -.08** (.04) | -.05 (.05) |
| Ln GDP per capita_t−1 * leader exit_t−1 | .016** (.007) | .014** (.007) | .012** (.005) | .009 (.006) |
| Assassinations and attempts (ASS)_t−1 | .006 (.030) |
| ASS_t−1 * Ln GDP per capita_t−1 | -.001 (.004) |
| ASS_t−1 * leader exited_t−1 | .081* (.048) |
| ASS_t−1 * Ln GDP p. cap. t−1 * leader exit_t−1 | -.010* (.006) |
| Guerrilla warfare_t−1 | - -.006 (.16) |
| Guerrilla warfare_t−1 * Ln GDP per capita_t−1 | .001 (.002) |
| Guerrilla warfare_t−1 * leader exited_t−1 | .030 (.020) |
| G. war_t−1 * Ln GDP p. cap. t−1 * leader exit_t−1 | -.004 (.003) |
| Civil war_t−1       | -.056 (.053) |
| Civil war_t−1 * Ln GDP per capita_t−1 | .011 (.008) |
| Civil war_t−1 * leader exited_t−1 | .065 (.118) |
| Civil war_t−1 * Ln GDP per cap. t−1 * leader exit_t−1 | -.010 (.016) |
| Major government crisis_t−1 | -.005 (.037) |
| Crisis_t−1 * Ln GDP per capita_t−1 | .001 (.005) |
| Crisis_t−1 * leader exited_t−1 | -.039 (.057) |
| Crisis_t−1 * Ln GDP p. cap. t−1 * leader exit_t−1 | .006 (.008) |
| Cumulative impact of income if: | | | |
| -assassination_t−1, no leader exit_t−1 | .00 (.07) |
| -no assassination_t−1, no leader exit_t−1 | .01 (.06) |
| -assassination_t−1, leader exit_t−1 | .06 (.09) |
| -no assassination_t−1, leader exit_t−1 | -.16* (.10) |
| -guerrilla warfare_t−1, no leader exit_t−1 | .01 (.07) |
| -no guerrilla warfare_t−1, no leader exit_t−1 | .01 (.06) |
| -guerrilla warfare_t−1, leader exit_t−1 | .11 (.09) |
| -no guerrilla warfare_t−1, leader exit_t−1 | .14 (.09) |
| -civil war_t−1, no leader exit_t−1 | .12 (.10) |
| -no civil war_t−1, no leader exit_t−1 | -.00 (.05) |
| -civil war_t−1, leader exit_t−1 | .14 (.18) |
| -no civil war_t−1, leader exit_t−1 | .13 (.08) |
| -major gov. crisis_t−1, no leader exit_t−1 | .03 (.08) |
| -no major gov. crisis_t−1, no leader exit_t−1 | .02 (.06) |
| -major gov. crisis_t−1, leader exit_t−1 | .16 (.10) |
| -no major gov. crisis_t−1, leader exit_t−1 | .10 (.08) |
| Fisher p level       | [.00] | [.00] | [.00] | [.00] |
| Observations         | 4,906 | 4,906 | 6,425 | 4,906 |
| Countries            | 127  | 127  | 134  | 127  |
| R-squared            | .8535 | .8534 | .8706 | .8536 |

Sources: Table A18.

Note: OLS with country and year fixed effects. Robust standard errors, clustered by country, in parentheses: * p < .10, ** p < .05, *** p < .01. “Fisher p level”: probability level at which one can reject H0: residuals are I(1), from Fisher test of residuals.
Table A14.A: Different authoritarian subtypes (Banks data)

| Panel type: | Polity2 Level of Democracy, Polity2 t−1 × 6 |
|-------------|---------------------------------|
|             | (1)    | (2)    | (3)    | (4)    |
| Polity2 t−1 | .91*** | .54*** | .21**  | .19    |
|             | (.01)  | (.06)  | (.09)  | (.16)  |
| Ln GDP per capita t−1 | -.001 | .012  | .024   | -.03   |
|             | (.006) | (.027) | (.051) | (.08)  |
| Leader replaced t−1 | -.14** | -.22   | -.57** | -1.07**|
|             | (.06)  | (.18)  | (.33)  | (.46)  |
| Ln GDP per capita t−1 * Leader replaced t−1 | .020** | .034   | .09*** | .16**  |
|             | (.008) | (.025) | (.04)  | (.06)  |
| Military regime t−1 | -.05   | -.13   | -.91** | -.29   |
|             | (.10)  | (.40)  | (.44)  | (.86)  |
| Military regime t−1 * Ln GDP per capita t−1 | .010   | .013   | .13*** | .06    |
|             | (.013) | (.056) | (.06)  | (.11)  |
| Military regime t−1 * Leader replaced t−1 | .23    | -.34   | -.17   | -.20   |
|             | (.15)  | (.61)  | (.75)  | (1.13) |
| Military regime t−1 * Ln GDP per capita t−1 * Leader replaced t−1 | -.03   | .065   | .01    | .01    |
|             | (.02)  | (.086) | (.10)  | (.14)  |
| Monarchy t−1 | .00    | -.13   | .07    | .19    |
|             | (.06)  | (.25)  | (.47)  | (.70)  |
| Monarchy t−1 * Ln GDP per capita t−1 | .00    | .022   | -.00   | -.02   |
|             | (.01)  | (.037) | (.07)  | (.09)  |
| Monarchy t−1 * Leader replaced t−1 | .09    | -.015  | .13    | .08    |
|             | (.09)  | (.25)  | (.54)  | (.77)  |
| Monarchy t−1 * Ln GDP per capita t−1 * Leader replaced t−1 | -.013  | .002   | -.02   | .00    |
|             | (.013) | (.035) | (.07)  | (.11)  |

Marginal short-run effect of income if:

- all types, no leader exit | .000  (.005) | .02  (.03) | .03  (.05) | -.03  (.07) |
- all types, leader exit | .015** (.007) | .06* (.03) | .12** (.05) | .13* (.07) |
- military regime, leader exit | -.001 (.015) | .12** (.06) | .26*** (.08) | .21* (.12) |
- monarchy, leader exit | .008 (.016) | .07 (.05) | .09 (.08) | .12 (.11) |
- other non-democracy, leader exit | .019** (.009) | .05 (.03) | .11** (.06) | .13* (.07) |

Fisher p level | [.00]  [.00]  [.00]  [.00] |
Observations | 5,916  1,099  544  345 |
Countries | 132  130  117  118 |
R-squared | .8719  .6539  .6453  .7291 |

Sources: see Table A18.
Note: All estimations by OLS with country and year fixed effects. Robust standard errors, clustered by country, in parentheses; * p < .10, ** p < .05, *** p < .01. “Fisher p level” is probability level at which one can reject H0: residuals are I(1), from Fisher test of residuals. Margins not estimable for 20-year panels.
### Table A14.B: Different authoritarian subtypes (Geddes et al. data)

| Panel type: | 1-yr | 5-yr | 10-yr |
|-------------|------|------|-------|
| Polity2 t-1 | .90*** (.02) | .48*** (.08) | .02 (.14) |
| Ln GDP per capita t-1 | .003 (.012) | .03 (.08) | -.22 (.13) |
| Leader replaced t-1 | -.09 (.15) | -.34 (.71) | -2.28** (.98) |
| Ln GDP per capita t-1 * leader replaced t-1 | .013 (.020) | .05 (.10) | .31** (.13) |
| Monarchy t-1 | .03 (.08) | .39 (.49) | -.64 (.85) |
| Monarchy t-1* ln GDP per capita t-1 | -.01 (.01) | -.06 (.07) | .09 (.12) |
| Monarchy t-1* leader replaced t-1 | .12 (.16) | .21 (.73) | 1.89* (.11) |
| Mon. t-1* ln GDP per capita t-1 * leader replaced t-1 | -.01 (.02) | -.03 (.10) | -2.5* (.15) |
| Personalist t-1 | .01 (.09) | -.13 (.54) | -1.57 (.04) |
| Personalist t-1* ln GDP per capita t-1 | -.01 (.01) | -.00 (.08) | .20 (.14) |
| Personalist t-1* leader replaced t-1 | -.09 (.18) | -.37 (.82) | 1.01 (1.20) |
| Pers. t-1* ln GDP per capita t-1 * leader replaced t-1 | .02 (.03) | .07 (.11) | -.10 (.16) |
| One Party t-1 | .02 (.08) | .22 (.53) | -1.69* (.00) |
| One Party t-1* ln GDP per capita t-1 | -.01 (.01) | -.04 (.08) | .22 (.14) |
| One Party t-1* leader replaced t-1 | -.06 (.19) | -.29 (.77) | 1.37 (.09) |
| One P. t-1* ln GDP per capita t-1 * leader replaced t-1 | .01 (.03) | .04 (.11) | -.19 (.15) |
| Miscellaneous t-1 | .02 (.11) | -.52 (.65) | 2.51** (.62) |
| Miscellaneous t-1* ln GDP per capita t-1 | -.01 (.01) | -.07 (.09) | .30* (.17) |
| Miscellaneous t-1* leader replaced t-1 | -.00 (.26) | .94 (.98) | 2.69 (1.67) |
| Misc. t-1* ln GDP per capita t-1 * leader replaced t-1 | .00 (.04) | -.13 (.13) | -.32 (.22) |

**Cumulative effect of income if:**

|                      | 1-yr | 5-yr | 10-yr |
|----------------------|------|------|-------|
| -all types, leader exit | .017 (.011) | .070 (.044) | .104 (.077) |
| -all types, no leader exit | -.003 (.007) | .006 (.040) | -.039 (.078) |
| -monarchy, leader exit | -.004 (.009) | -.012 (.042) | -.071 (.092) |
| -personalist, leader exit | .028 (.017) | 144** (.072) | .188 (.020) |
| -one party, leader exit | .019 (.017) | .069 (.056) | .126 (.094) |
| -military regime, leader exit | .016 (.021) | .075 (.075) | .090 (.097) |
| -misc., leader exit | .011 (.019) | .010 (.074) | .071 (.015) |

Fisher p level | [.00] | [.00] | [.00] |
Observations | 4,263 | 749 | 358 |
Countries | 119 | 117 | 104 |
R-squared | .8500 | .6446 | .7161 |

**Sources:** see Table A18.

**Note:** All estimations by OLS with country and year fixed effects. Robust standard errors, clustered by country, in parentheses; *p < .10, **p < .05, ***p < .01. “Fisher p level” is probability level at which one can reject H0: residuals are I(1), from Fisher test of residuals. Too few remaining observations to calculate for 15 and 20-year panels without serious stationarity problems. Military is excluded category.
Table A15 analyzes whether the mode of exit affects the impact of income on democratization.

Archigos distinguishes several ways leaders leave office. Besides dying from natural causes, committing suicide, retiring due to poor health, or being deposed by a foreign force, they may be replaced in a “regular” or an “irregular” manner. “Regular” replacements occur “according to the prevailing rules, provisions, conventions, and norms of the country” (Goemans et al. 2009, p.272). Although such turnovers are the rule in democracies, they also occur in authoritarian regimes, as, for instance, when a new leader takes over in a faked election or a monarch abdicates in favor of his son. “Irregular” replacements occur amid abnormal events such as military coups or popular revolts.

I show regressions in which each type of leader exit is interacted with income. In models 1-5, the dependent variable is the level of Polity2. Models 6-10 use the Boix-Miller-Rosato binary measure of democracy, and include only non-democracies, so the regressions measure the probability of transition to democracy. For why it is necessary to estimate models 6-10 with a linear probability model, see footnote on p.2.

In the multiyear panels, when more than one change of leader occurs within the period, I focus on the final mode of leader exit. (If a regular turnover is followed by a revolution that sweeps away the old leader, one would expect the revolution to affect the type of regime at the end of the period more than the earlier turnover.) As before, I also adjust so that a leader exit is coded zero if it comes in a period when there was net increase in Polity2 but none of the net increase in Polity2 came after the leader change. This is to avoid attributing liberalization to leader change that did not precede the liberalization.

Note that these panel regressions are a far less efficient way of estimating the impact of death by natural causes than the comparison of means in Table 3. There, I examine all 10-year periods after a leader’s natural death. Here, I examine each 10 year panel-period that contains a leader’s natural death—whether the death occurred in the first, the last, or some other year of the panel. If the effect is actually felt 5 years after the leader’s death, the regressions will not capture this for the cases where the leader died less than 5 years before the end of the panel.
Table A15: Democratization given different modes of leader exit

| Dependent variable | Levels: Polity2, Polity2 > 6, 1875-2004 | Transitions: BMR binary measure, only non-democracies, 1875-2000 |
|--------------------|------------------------------------------|---------------------------------------------------------------|
|                    | (1) 1-yr | 5-yr | 10-yr | 15-yr | 20-yr | 1-yr | 5-yr | 10-yr | 15-yr | 20-yr |
| Panel type         |          |      |       |       |       |      |      |       |       |       |
| Polity2 t-1        | .91***   | .55*** | .21** | .23   | .16   | .01  | .07  | .10   | .14   | .10   |
| Ln GDP per capita  | -.001    | .04   | .09*  | .14** | .19   | -.00 | .03  | .15** | .18*  | .19   |
| Leader exit regular t-1 | -.19** | -.28  | -.74* | -.61  | -.81  | -.37**| -.93**| -.133**| -.103| -.141 |
| Leader exit irregular t-1 | -.05   | .11   | .06   | .65   | .40   | -.27*| -.19  | .24   | .55   | .40   |
| Leader died in office of natural causes t-1 | -.03   | -.01  | -.02  | .58   | -.02  | -.09 | .10  | .27   | .39   | -.71  |
| Leader deposed t-1 | -.10    | -.02  | 1.12* | .44   | .53   | -.44 | -.62 | .84   | -.57  | -.209*|
| Leader retired due to poor health t-1 | .31     | -.03  | .14   | 1.60**| -.92  | -.23**| -.37  | .80   | 1.06  | 2.08  |
| Regular leader exit t-1 * | .03**  | .04   | .10*  | .08   | .10   | .05**| .13**| .17*  | .13   | .16   |
| Irregular leader exit t-1 * | .01   | -.02  | -.01  | -.10  | -.07  | .04**| .02  | -.05  | -.10  | -.09  |
| Death from natural causes t-1 * | .00   | -.00  | -.01  | -.09  | -.01  | .01  | -.02  | -.05  | -.07  | -.09  |
| Deposited by foreign force t-1 * | .02   | -.01  | -.16**| -.08  | -.11  | .06  | .07  | -.12  | .05   | .22   |
| Leader retired t-1 * | -.05   | -.00  | -.04  | -.23**| .02   | .03* | .04  | -.09  | -.17  | -.31* |
| Ln GDP per Capita t-1 | (.06)  | (.05) | (.08) | (.08) | (.19) | (.01) | (.04) | (.22) | (.18) | (.17) |

Cumulative effect of income if leader exited
- if regular: 29** 17* 24*** 28** 35*** 05** 17*** 32*** 30** 36**
- if irregular: 11 04 09 05 14 04* 06 11 08 10
- if died of natural causes: 03 08 11* 06 21 01 02 10* 10 29
- if was deposited: 16 09 09 08 09 06 11 03 22 41*
- if retired due to health: -55 -10 -07 -06 -12 -25* 02 -07 -07 -01 -11

Fisher p level: [00] [00] [00] [00] [00] [00] [00] [00] [05] [00]
Observations: 6,370 1,205 586 384 276 6,161 1,160 569 373 271
Countries: 134 132 118 118 112 136 133 121 121 115
R-squared: .8712 .6202 .6027 .6563 .7428 .1040 .2761 .4783 .5738 .7112

Sources: See Table A18.
Note: All estimations by OLS with country and year fixed effects. Robust standard errors, clustered by country, in parentheses; * p<.10, ** p<.05, *** p<.01. “Fisher p level” is probability level at which one can reject H0: residuals are i.i.d. from Fisher test of residuals. “BMR”: Boix-Miller-Rosato dichotomous measure. Too few cases of leader suicide to estimate effects. If more than one leader turnover during the panel interval, type of turnover refers to last one. Data adjusted so leader turnover not coded 1 if Polity2 increased during panel period but there was no net increase after the leader exit.
Figure A3.A  Estimated frequency of popular mobilizations around turnover of the top leader, non-democracies, 1920-2000

Source: Banks (2007), Archigos.
Note: From regressions controlling for country and year fixed effects. Antigovernment demonstration: "Any peaceful public gathering of at least 100 people for the primary purpose of displaying or voicing their opposition to government policies or authority, excluding demonstrations of a distinctly anti-foreign nature." General strike: "Any strike of 1,000 or more industrial or service workers that involves more than one employer and that is aimed at national government policies or authority." Attempted revolution: "Any illegal or forced change in the top government elite, any attempt at such a change, or any successful or unsuccessful armed rebellion whose aim is independence from the central government." Riot: "Any violent demonstration or clash of more than 100 citizens involving the use of physical force."

Figure A3.B: Estimated frequency of antigovernment demonstrations around different types of leader turnover, nondemocracies 1920-2000

Source: Banks (2007), Archigos.
Note: From regressions controlling for country and year fixed effects. Antigovernment demonstration: "Any peaceful public gathering of at least 100 people for the primary purpose of displaying or voicing their opposition to government policies or authority, excluding demonstrations of a distinctly anti-foreign nature."
The following graphs present marginal (short run) effects from estimation of an OLS regression of the country’s Polity2 score on its lagged Polity2 score and all elements and interactions of: the leader’s total term, a set of dummies for the leader’s current year in office, Ln GDP per capita in the previous year. The regression is run on non-democracies (Polity2 in previous year < 6) and includes full sets of country and year fixed effects; standard errors are robust and clustered by country. Since the many interactions are cumbersome to list, I summarize the results graphically.

Figure A4.A: Change over time: Marginal effect of Ln GDP per capita on Polity2 for a leader who exited after 5 years, non-democracies, 1875-2004

Figure A4B: Change over time: Marginal effect of Ln GDP per capita on Polity2 for a leader who exited after 8 years, non-democracies, 1875-2004

Figure A4.C: Change over time: Marginal effect of Ln GDP per capita on Polity2 for a leader who exited after 15 years, non-democracies, 1875-2004
The goal of Table A16 is to test whether certain fixed characteristics of leaders and regimes, on which selection might operate, do in fact catalyze the effect of income on liberalization. Column 1 shows that leaders who have graduated from college tend to liberalize more when in countries with relatively high income. Column 2 shows that when the country’s current income is high, those leaders who grew up at a time when the country was relatively developed tend to liberalize much more than those who grew up when it was still poor. This is consistent with the argument that those who came of age in more modern periods were socialized into values more favorable towards democracy and are therefore more likely to reform in response to the pressures for liberalization generated by development. Column 3 shows that military regimes tend to democratize more than other subtypes of nondemocracy, and that the estimated effect is higher in more developed countries. Thus, these characteristics are associated with greater liberalization in more developed countries.

**Table A16: Selection effects**

| Dependent variable: |  | Polity2. Polity2<6, annual data |
|---------------------|---|------------------------------|
|                     | (1) | (2) | (3) |
| Polity2, t-1        | .91*** | .90*** | .90*** |
|                     | (.01) | (.02) | (.02) |
| Ln GDP per capita, t-1 | -.06* | -.001 | -.001 |
|                     | (.006) | (.006) | (.007) |
| Leader has college degree, t | -.06* | (.03) |
| Leader has college degree, t * Ln GDP per capita, t-1 | .009* | (.005) |
| Ln GDP per capita when leader was 20 | -.08* | (.04) |
| Ln GDP per capita when leader was 20 * Ln GDP per capita, t-1 | .012** | (.005) |
| Military regime, t-1 | -0.35 | (.069) |
| Military regime, t-1 * Ln GDP per capita, t-1 | .009 | (.009) |
| Cumulative effect of leader’s college degree when income is: | | | |
| -$1,000 | .02 | (.05) |
| -$5,000 | .18** | (.08) |
| -$10,000 | .25** | (.12) |
| Cumulative effect of prodemocratic values (proxied by Ln GDP p.c. when leader was 20), when current income is: | | | |
| -$1,000 | .06 | (.10) |
| -$5,000 | .27** | (.11) |
| -$10,000 | .35*** | (.13) |
| Cumulative effect of military regime, when income is: | | | |
| -$1,000 | .30** | (.13) |
| -$5,000 | .45*** | (.14) |
| -$10,000 | .57*** | (.18) |
| Fisher p level | [.00] | [.00] | [.00] |
| Observations | 6,266 | 4,866 | 4,295 |
| Countries | 134 | 119 | 121 |
| R-squared | .8686 | .8722 | .8488 |

**Sources:** see Table A18.

**Note:** All estimations by OLS with country and year fixed effects. Robust standard errors, clustered by country, in parentheses; * p < .10, ** p < .05, *** p < .01. “Fisher p level” is probability level at which one can reject H0: residuals are I(1), from Fisher test of residuals. Geddes et al. (2012) classification of military regimes used.
Table 5 estimated the relationships between leaders’ tenure in office and likelihood of taking various risky actions, using a conditional logit fixed effects model. This requires dropping all countries which do not contain variation over time in the dependent variable, which sometimes means excluding a large proportion of the data. Below, I present identical estimations using the linear probability model to show that results are not dependent on the exclusion of data.

Table A17: Does activism decrease with leader tenure? Re-estimating with linear probability model

| Dependent variable: Dummy for Polity2 moved up | Polity2 moved down | Major change to constitution | State initiated a militarized interstate dispute $^a$ |
|----------------------------------------------|-------------------|-----------------------------|---------------------------------------------------|
| Cases: Polity2$_{t-1}$ < 10                  | Polity2$_{t-1}$ > -10 | All                         | All                                               |
| (1)                                          | (2)               | (3)                         | (4)                                               |
| Leader’s years in office                     | -0.004***        | -0.003***                   | -0.006***                                         | -0.003*                                           |
|                                              | (.001)            | (.000)                      | (.001)                                            | (.001)                                            |
| Leader’s years in office * democracy dummy $_{t-1}$ | 0.008***       | 0.002**                     | 0.004***                                          | 0.005                                            |
|                                              | (.002)            | (.001)                      | (.001)                                            | (.003)                                            |
| Democracy dummy (Polity2 $\geq$ 6)$_{t-1}$ | -1.16***         | 0.13                        | -0.082***                                         | -0.088**                                         |
|                                              | (.02)             | (.014)                      | (.014)                                            | (.038)                                            |
| Leader’s age                                 | -0.00            | -0.00                       | 0.00                                              | 0.00                                             |
|                                              | (.000)            | (.000)                      | (.000)                                            | (.001)                                            |
| Ln GDP per capita $_{t-1}$                   | -0.068**         | -0.026**                    | -0.048***                                         | -0.063                                           |
|                                              | (.026)            | (.011)                      | (.012)                                            | (.038)                                            |
| Growth rate $_{t-1}$                         | -0.002***        | -0.002***                   | -0.003***                                         | -0.003**                                         |
|                                              | (.001)            | (.001)                      | (.001)                                            | (.001)                                            |
| Ln antigovernment demonstrations $_{t-1}$    | 0.05***           | .005                        | .036***                                           | .002                                             |
|                                              | (.01)             | (.006)                      | (.009)                                            | (.013)                                            |
| Country’s past rate of initiating MIDs       |                  |                             | .088                                              | (1.71)                                           |
| State’s military capability $_{t-1}$         |                  |                             | -.26                                              | (1.92)                                           |
| Trade as share of GDP $_{t-1}$               |                  |                             | .033                                              | (.051)                                           |
| Head of state a military officer             |                  |                             | .044                                              | (.034)                                           |
| Fisher p level                               | [.00]             | [.00]                       | [.00]                                             | [.00]                                            |
| Observations                                 | 6,098             | 7,357                       | 7,559                                             | 5,400                                            |
| Countries                                    | 141               | 150                         | 152                                               | 148                                              |
| R squared                                    | .1252             | .0822                       | .1088                                             | .2651                                            |

Sources: Table A18.

Note: All estimations by OLS, with full sets of country and year dummies. Annual data. Standard errors in parentheses; * $p < .10$, ** $p < .05$, *** $p < .01$. $^a$ years in which state does not initiate a MID but continues one it previously initiated are excluded. Cases where lagged Polity2 score equals 10 (-10) excluded in column 1 (2) to adjust for fact that countries cannot move beyond the limit of the scale.
| Variable | Notes | Source |
|----------|-------|--------|
| Democracy: close to continuous measure | Polity2, rescaled to take values from 0 to 1. | Polity IV Dataset, Version 2009, [http://www.systemicpeace.org/inscr/inscr.htm](http://www.systemicpeace.org/inscr/inscr.htm) |
| Democracy: binary measure | Dummy: 1 = democracy; 0 = non-democracy. | Constructed by Boix, Miller and Rosato (2013), for 1800-2007. |
| GDP, GDP per capita, GDP per capita growth | In 1990 international Geary-Khamis dollars. | Maddison (2010), downloaded from [http://www.ggdc.net/MADDISON/origindex.htm](http://www.ggdc.net/MADDISON/origindex.htm) |
| Trade | Trade between dyads of countries, in 1990 dollars. | Dataset for Russett, Oneal, and Berbaum (2003), downloaded from Bruce Russett’s website at: [http://pantheon.yale.edu/~brusset/](http://pantheon.yale.edu/~brusset/) |
| Domestic democratic capital, foreign democratic capital | Definitions in Persson and Tabellini (2009) | Dataset for Persson and Tabellini (2009), downloaded from Guido Tabellini’s website at [http://didattica.uniboecconi.it/mypage/index.php?IdUtente=48805&idr=7569&lingua=ita](http://didattica.uniboecconi.it/mypage/index.php?IdUtente=48805&idr=7569&lingua=ita) |
| Average schooling | Average years of schooling in population aged 15 and over | Morrission and Murtin (2009), downloaded [www.pse.ens.fr/data/index.html](http://www.pse.ens.fr/data/index.html) |
| Leader turnover, timing and type; leaders’ ages, other characteristics | Archigos, downloaded from Henk Goemans’ website [http://www.rochester.edu/college/faculty/hgoemans/data.htm](http://www.rochester.edu/college/faculty/hgoemans/data.htm) |
| War, civil war, initiators of war, militarized interstate disputes, military capacity | Correlates of War intrastate and interstate wars datasets, v.4.0, Militarized interstate disputes v.3.10, National material capabilities, v.4.0, downloaded from [http://www.correlatesofwar.org/datasets.htm](http://www.correlatesofwar.org/datasets.htm) |
| Military regime | Head of State coded as “military” in Banks dataset. | Arthur Banks’ "Cross- National Time-Series Data Archive". |
| Monarchy | Head of State coded as “monarch” in Banks dataset. | Banks (see above) |
| Oil and gas income per capita | Michael L. Ross, 2011-04, "Replication data for: Oil and Gas Production and Value, 1932-2009", [http://thedata.harvard.edu/dvn/dv/mlross](http://thedata.harvard.edu/dvn/dv/mlross) |
| Military, personalist, one-party, monarchical autocracies | Geddes, Barbara, Joseph Wright and Erica Frantz. 2012. “Authoritarian Regimes: A New Data Set,” Manuscript. Data at [http://dictators.la.psu.edu/](http://dictators.la.psu.edu/) |
| Antigovernment protests | Any peaceful public gathering of at least 100 people for the primary purpose of displaying or voicing their opposition to government policies or authority, excluding demonstrations of a distinctly anti-foreign nature. | Banks (see above) |
| Riots | Any violent demonstration or clash of more than 100 citizens involving the use of physical force. | Banks (see above) |
| General strikes | Any strike of 1,000 or more industrial or service workers that involves more than one employer and that is aimed at national government policies or authority. | Banks (see above) |
| Attempted revolutions | Any illegal or forced change in the top government elite, any attempt at such a change, or any successful or unsuccessful armed rebellion whose aim is independence from the central government. | Banks (see above) |
| Assassinations | Any politically motivated murder or attempted murder of a high government official or politician. | Banks (see above) |
| Guerrilla warfare | Any armed activity, sabotage, or bombings carried on by independent bands of citizens or irregular forces and aimed at the overthrow of the present regime. | Banks (see above) |
| Major government crisis | Any rapidly developing situation that threatens to bring the downfall of the present regime - excluding situations of revolt aimed at such overthrow. | Banks (see above) |
| Major constitutional changes | The number of basic alterations in a state’s constitutional structure, the extreme case being the | Banks (see above) |
The adoption of a new constitution that significantly alters the prerogatives of the various branches of government. Examples of the latter might be the substitution of presidential for parliamentary government or the replacement of monarchical by republican rule. Constitutional amendments which do not have significant impact on the political system are not counted.

| Elected parliament | Legislative selection = “elective” in Banks dataset. | Banks (see above) |
|-------------------|------------------------------------------------------|-----------------|
| Elected executive | Executive elected directly or by elected legislature | Banks (see above) |
| Non-regime parties | “defacto 2”: existence of parties outside of regime front | Democracy and Dictatorship Revisited dataset, José Cheibub, Jennifer Gandhi, James Vreeland (Georgetown University), September 2009 (v.1) |
| Press freedom index | Freedom House | Downloaded from www.freedomhouse.org |
| Education of leaders | Besley and Reynal-Querol (2011) | Provided by Marta Reynal-Querol. |
| Mass resistance campaigns | | Chenoweth and Stephan (2011) |