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Aging Dictators and Economic Growth

Richard Jong-A-Pin and Jochen O. Mierau

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No Country for Old Men:
Aging Dictators and Economic Growth

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Abstract.

This paper develops a model of the relationship between the age of a dictator and economic growth. In the model a dictator must spread the resources of the economy over his reign but faces mortality and political risk. The model shows that if the time horizon of the dictator decreases, either due to an increase of mortality risk or political risk, the economic growth rate decreases. The model predictions are supported by empirical evidence based on a three-way fixed effects model including country, year and dictator fixed effects for a sample of dictators from 116 countries. These results are robust to sample selection, the tenure of dictators, the definition of dictatorship, and a broad set of economic growth determinants.

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1. Introduction

Why do some dictatorships have higher economic growth rates than others? Since the contributions of Olson (1993) and McGuire and Olson (1996), the answer has been that dictators come in two types: "roving bandits" and "stationary bandits". Roving bandits are dictators with high discount rates that expropriate as much as possible once they enter office, while stationary bandits expect to have long office duration. Since the latter cares about the future, he has an incentive to invest in growth enhancing policies and institutions.

Dictator type is not exogenous. For example, dictators that rule in politically unstable countries are more likely to have shorter time horizons and therefore produce lower economic growth rates (see, for instance, Alesina *et al.*, 1996 and Acemoglu and Robinson, 2000). In this paper we elaborate on the relationship between a dictator's discount factor and his type. We argue that when dictators grow older, they care less about the future, because the probability of natural death increases. A dictator will start off as a stationary bandit but becomes a roving bandit as time passes by, simply because his time-horizon has decreased. Consequently, the age of a dictator partly determines whether he is roving or a stationary bandit and, hence, his age and economic growth are negatively related.

To illustrate and formalize the argument, we develop a model in which a dictator optimizes his own utility by choosing between investments in capital goods and extracting rents. Whereas investments in capital goods will ensure higher national income and higher future utility, extracting rents from the economy increases instantaneous utility but comes at the cost of lower economic growth. Not surprisingly, the dictator will only invest in growth enhancing policies if he is likely to reap the benefits of future economic growth. Older dictators will, therefore, extract more than younger dictators. However, a dictator who cares about his heir apparent will make sure to leave sufficient productive capital even if he faces a substantial mortality risk.

We test our hypotheses using a panel data set of over 300 dictators around the world since the 1950's. More specifically, we employ the ARCHIGOS data set of Goemans *et al.* (2009) to examine marginal and long-run effects of aging taking into account the endogenous nature of political instability and unobserved country, time and dictator heterogeneity. We find compelling evidence for the main hypothesis that growth is negatively affected by the age of dictators. Adding one candle to the birthday cake of the dictator shaves 0.2 to 0.4 percentage points off the yearly economic growth rate. This effect is not driven by endogeneity due to sample selection or omitted variables bias. We also find that political instability has a significant negative impact on economic growth rates. In addition, we find tentative support for the existence of heir effects. That is, we find that the effect of aging on economic growth is smaller in dictatorships where succession of power is regulated within the family (i.e. monarchies) than in other dictatorships.

The empirical results concerning political instability confirm earlier findings that show that political uncertainty harms economic growth rates (see Carmignani (2003) for a survey). The findings regarding the negative association of dictator age and economic growth are, to the best of our knowledge, novel, but add to a growing literature on personal characteristics of leaders and the policies they enact. For example, Jones and Olken (2005) show that the replacement of leaders leads to structural breaks in observed growth patterns. Besley *et al.* (2011) find that better educated leaders cause higher economic growth rates. Regarding defence policy, Horowitz *et al.* (2005) find that older leaders are more likely to initiate and escalate military conflicts. Dreher *et al.* (2009) show that former entrepreneurs are more likely to enact market liberalizing reforms. In addition, our paper adds to the literature dealing with the political survival of authoritarian regimes (see Bueno de Mesquita *et al.*, 2003; Gandhi, 2008).

The remainder of the paper is as follows. The next section formalizes our main argument and introduces the empirical hypotheses. We describe the data in Section 3 and provide our empirical strategy in Section 4. The estimation results and various robustness analyses are presented in Section 5. Section 6 concludes.

2. Model and hypotheses

We consider an all powerful dictator who reigns for two periods but transition between the periods is probabilistic. On the one hand, the dictator may die of natural causes; on the other hand, the dictator may be ousted from office. If he dies of natural causes he wants to leave the economy in such a state that his heir apparent, who may be a son but also someone else, inherits a sound economy.

The production sector is characterized by a linear production technology that depends on the aggregate capital stock and the, fixed, level of technology. The production function is given by: $Y_t = AK_t$, where Y_t is aggregate output at time t, A is the state of technology and K_t is the capital stock. From the perspective of a dictator who came into power at time t, K_t is the initial capital endowment.

The dictator must decide how many consumption goods to extract from the economy every period. All productive assets that are not extracted as consumption goods may be used for productive purposes in the next period. The discounted life-time utility function of a dictator who came into power at time t is given by:

$$\Lambda_t = \ln(C_t) + (1 - \tfrac{1}{\theta}\mu)(1-\pi)\ln(C_{t+1}) + (1-\mu)(1-\tfrac{1}{\theta})(1-\pi)^2 \ln(B_{t+2}), \tag{1}$$

where C_t is consumption, $0 < \pi < 1$ is the probability of being ousted from office in each period, $0 < \mu < 1$ is the probability of dying of a natural cause before period 2, $\theta \geq 1$ governs the preference attached to the heir apparent (see below) and B_{t+2} is the bequest the dictator leaves to his heir apparent.[1] In the second period of the dictator's reign the utility function becomes:

$$\Lambda_{t+1} = \ln(C_{t+1}) + (1-\tfrac{1}{\theta})(1-\pi)\ln(B_{t+2}), \tag{2}$$

and he essentially faces the problem of dividing the productive assets in the economy between current consumption and a bequest for his heir apparent. The dictator discounts the bequest by the probability of being ousted from office, π, because he takes into account that upon his certain death someone else besides his heir apparent may seize power.

As the dictator has full power over the economy, his optimization problem essentially is how to spread his initial capital endowment, K_t, over his full reign. However, even though the dictator faces a mortality risk, μ, this does not imply that the country dies with him. Depending on his expectation concerning succession he attaches more or less utility to the capital left for his heir apparent. The more he values his heir apparent the higher is θ.

[1] If $\mu = 1$ Equation (1) collapses to a two period optimal bequest model as in Equation (2). In addition, if the dictator would reign for n periods instead of 2 Equation (1) becomes:
$\Lambda_t = \ln(C_t) + \sum_{i=1}^{n} \prod_{j=1}^{i} (1-\pi_j) \prod_{j=1}^{i-1} (1-\mu_j)(1-\frac{1}{\theta}\mu_i)\ln(C_{t+i}) + \prod_{j=1}^{n}(1-\pi_j)\prod_{j=1}^{n-1}(1-\mu_j)(1-\frac{1}{\theta})\ln(B_{t+n})$, where both μ and π may change over time. For sake of clarity we focus on the 2 period setting in the text. The hypothesis derived below are unchanged if we consider an n period setting. Naturally, if $\mu = 1$ we would not be able to study the relation between growth and mortality.

Effectively θ mitigates time discounting due to mortality. If $\theta = 1$, Equation (1) collapses to the standard 2-period life-cycle model. However, if $\theta > 1$ the standard model is generalized to allow for bequests. In the first period a higher θ leads to less discounting of the mortality factor. That is, if θ is high the dictator will invest more in period 1 because even if he is not around to consume the benefits from the investment his heir will be. In the second period θ acts to give utility value to bequests left for the heir apparent. The heir apparent uses the bequests received from the perished dictator as his initial capital endowment. Therefore, the dictator effectively chooses the level of capital that his heir apparent is endowed with and we can set $B_{t+2} = I_{t+1}$, where I_{t+1} is the amount of productive investments at time t.

In addition to mortality risk, the dictator faces a probability, π, of being ousted from office by, for instance, a coup. As the dictator attaches no value to the utility of a successor that ousted him from office θ does not affect his time discounting due to uncertain political survival. That is, if the dictator knows that he will be ousted from office within one period (i.e. $\pi = 1$) the dictator will execute a policy of maximal extraction. On the other hand, if the dictator knows that he will perish ($\mu = 1$) tomorrow he would still leave a substantial amount of productive assets to his heir apparent as initial endowment. Thus, political risk, π, and mortality risk, μ, affect the dictator's time horizon in a fundamentally different way.

The dictator's decision problem is constrained by the resource constraint. That is, aggregate output in both periods must be divided between consumption and productive investments:

$$Y_t = C_t + I_t. \tag{3}$$

Assuming full depreciation of productive assets[2] after each period allows us to write the capital accumulation function as $K_{t+1} = I_t$ so that we can write the resource constraint as:

$$AK_t = C_t + K_{t+1}, \tag{4}$$

where we have substituted in the aggregate production function.

A young dictator chooses combinations of C_t, C_{t+1} and B_{t+2} such that (1) is maximized subject to (4). Similarly, an old dictator chooses combinations of C_{t+1} and B_{t+2} such that (2) is maximized subject to (4). From the maximization problems of the individual dictators the growth rate of the economy, $Y_{t+1}/Y_t \equiv 1 + g_t$, arises residually. Comparative statics on $1 + g_t$ lead us to the following hypotheses concerning growth and dictators:[3]

H.1 Growth decreases as the mortality rate of the dictator increases: $\frac{\partial(1+g_t)}{\partial\mu} < 0.$

H.2 Growth decreases as the probability of a coup increases: $\frac{\partial(1+g_t)}{\partial\pi} < 0.$

H.3 Growth is higher if the dictator cares about his heir apparent: $\frac{\partial(1+g_t)}{\partial\theta} > 0.$

In the empirical analysis that follows we seek to determine whether our hypotheses are valid and how different factors affecting the time horizon of dictators affect the economic growth performance of dictatorships.

3. Data

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2 Assuming that both periods cover 10 years and that the annual depreciation rate is 15% gives a compound depreciation rate over the full period of 80% ($1-(1-.15)^{10}$) which is observationally close to full depreciation.

3 See Appendix A for the solution of the model and derivation of the comparative static effects.

Our dependent variable is taken from the Penn World Table (version 6.3) of Heston *et al.* (2009) and measures yearly real GDP growth per capita. Economic growth data for most countries is available from 1950 until 2007.[4]

Our main explanatory variable is the age of a dictator (H.1). Data on the age of political leaders is obtained from the ARCHIGOS data set of Goemans *et al.* (2009). This data set includes information on both autocratic and democratic leaders up till 2004 and this demarcates the boundary of our sample. To identify autocratic leaders, we use the measure of Przeworski *et al.* (2000), who define an autocracy as a political regime where there is no reasonable probability that the incumbent power is replaced after an election (or where elections are absent).[5]

Our sample consists of about 500 political leaders. These leaders have ruled (or still rule) in 118 different countries. The average number of observations per leader is 9.2. That is, on average a dictator rules for 9.2 years (the median is 6.5 years). The youngest autocratic leader in the sample is Hussein Ibn Talal El-Hashim, who came into power at age 17 and remained the leader of Jordan for 46 years. Only Fidel Castro of Cuba has an equally long tenure, although he came into power at age 33. The distribution of age is normal according to a Jarque Bera test (see Appendix B for descriptive statistics and data sources).

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[4] Hanousek *et al.* (2008) and Johnson *et al.* (2009) criticize the use of the Penn World Table for time series cross-country analysis. We acknowledge this criticism and use the economic growth variable provided by the World Development Indicators of the World Bank for robustness (see column 5 of table 6).

[5] This measure has the advantage that it provides a clear dichotomy between democracies and autocracies. However, the strict division between democracies and autocracies comes at the cost that some democracies (e.g. South Africa) are labeled as autocracy, since even though the political process is democratic, the opposition has no reasonable chance to take power (a discussion can be found in Cheibub *et al.*, 2010). To check whether our results depend on the choice of democracy indicator, we also use the Polity index of Marshall and Jaggers (2011) to test for robustness (see column 6 of table 6).

In figure 1a we explore the relation between the age of dictators and economic growth. We show the difference in average economic growth for dictators when they are young and when they are old. That is, we compare the economic growth performance of dictators during the first and second half of their reign. It can be seen that, on average, economic growth is higher in the first half than in the second half. In figure 1b, we show the same relation, but now only for dictators that have been in power for at least 20 years. The figure illustrates that the relation between age and economic growth is even stronger for dictators that have been in power for such a long period. Although the figures give support to H.1, we turn to a more thorough analysis below. That is, whilst in figure 1 we focus on a strict two-period interpretation of the model, in the empirical analysis we focus on its n-period equivalent.

[Insert figure 1a and 1b here]

To examine the impact of political instability on economic growth (H.2), we have to take into account that the political survival rate is likely to be endogenous as political instability may not only a determinant of economic growth, but also a consequence of (the lack of) economic growth. Therefore, we follow earlier work by, e.g., Alesina *et al.* (1996) who estimate a parsimonious limited dependent variable (logit) model to predict the probability of a coup attempt in a given country in a given year.[6] The variables we employ to predict the probability of a coup attempt are GDP per capita, the number of past coup attempts and successful coups d'etat, the level of democracy, the duration of the political regime, and country fixed effects to capture all time invariant observed and unobserved country specific characteristics. It should be noted here that our aim is not to analyze why in some countries more coup d'etats are attempted than in other countries. Instead, our aim is to come up with a solid prediction of

[6] Data on coup attempts are taken from Powell and Thyne (2010).

the probability of a coup attempt on the basis of a small set of predetermined variables. The estimation results can be found in table 1.

[insert table 1 here]

It can be seen that almost all included predictors of coup attempts enter the regression significantly. To further evaluate the predictive power of the model, we calculate the sensitivity measure (the probability of positive prediction given that there has been an attempt) and the specificity measure (the probability of a negative prediction given that there has been no attempt) and find that these measures are 65 percent and 75 percent, respectively. That is, in about 70 percent of all coup attempts, the model rightly predicts the occurrence of a coup attempt. When testing H.2, we always use the exogenously predicted probability of a coup attempt.

To study the relation between having an heir and economic growth (H.3), we encounter the challenge of quantifying the existence of heirs. The problem arises that the heritage of political power can only be observed ex-post. That is, only when the son (or other family member) indeed succeeds the dictator, we are sure that succession occurs within the family. Naturally, such a measure gives an incomplete picture of the extent to which a dictator cares about his heir. Alternatively, one could argue that dictators with children care more about the future than dictators without children. Ludwig (2004) provides accurate data on the number of children of dictators. We updated this data set but conclude that almost all dictators have children, leading to a lack of variation in the data to identify an heir effect. In the analysis below, we therefore use another proxy to study the heir effect using the notion that not every dictatorship is alike. Cheibub *et al.* (2010) provide a typology of dictatorships and differentiate between civilian dictatorships, military dictatorships, and monarchic dictatorships. We expect that especially in monarchic dictatorships rulers will care about the future as it is almost certain that the successor is a child (or another close relative). This is not to say that in other dictatorships succession does not happen within the family. However, monarchic dictatorships are the only type of dictatorships where family succession is institutionalized and therefore we consider it more likely that a ruler will care about his heirs in this type of political system. Table 2 shows that leaders in civilian dictatorships are, on average, not younger or older than those in military or monarchic dictatorships. However, these statistics are unable to capture the dynamics over a life-cycle of a dictator with respect to the economic performance of a dictator. To that end, we now turn to an in-depth empirical analysis.

[Insert table 2 here]

4. Estimation Strategy

To test the theoretical predictions of section 2, we estimate a three-way panel fixed effects regression model, which, in its most general form, is written as:[7]

$$g_{i,j,t} = \alpha_i + \gamma_j + \delta_t + X_{i,j,t}\boldsymbol{\beta} + Z_{i,t}\boldsymbol{\phi} + \varepsilon_{i,j,t} \qquad (5)$$

where $g_{i,j,t}$ is the yearly economic growth rate achieved in country i by dictator j at time t. α, γ, and δ are country fixed effects, dictator fixed effects and year fixed effects, respectively.[8] Z is a vector of country specific control variables, $\boldsymbol{\beta}$ and $\boldsymbol{\phi}$ are vectors of

[7] Our choice for a static fixed effects model and not a dynamic fixed effects model is based on Wald tests for the appropriate lag structure of the model. As shown in the sensitivity analysis, there is no reason to believe that the underlying process is dynamic. Yet, relaxing the restriction of the non-existence of a lagged dependent variable does not change our results (see column 1 of table 6).

[8] We test for the presence of these effects using F-test on the different groups of effects. In all specifications, the null-hypothesis of no effects is rejected at the 1 per cent significance level (results are available upon request).

regression parameters and ε is the error term which is assumed to be random.[9] X is a vector of explanatory variable(s) corresponding to the hypothesis under consideration. In particular, $X\boldsymbol{\beta}$ is equal to:

$\beta_1 \times Age_{j,t}$	for	H.1
$\beta_1 \times P(Coup\ attempt_{i,t})$	for	H.2
$\beta_1 \times Age_{j,t}$ for subsamples with and without monarchies	for	H.3

The fixed effects in our model capture all variance specific to individual countries, dictators and years, respectively. Country fixed effects control for all variables that are specific to a country such as the availability of natural resources or geographical characteristics, whereas year fixed effects control for global economic shocks such as the oil crises in 1973 and 1979. We include dictator fixed effects to control for individual characteristics of dictators. For instance, dictators that enter office at a relatively high age may have better managerial skills than dictators that enter office at a relatively young age. Better managerial skills may affect economic growth, but are unrelated to the effect of age on economic growth due to a shorter time horizon. The dictator fixed effects control for unobserved characteristics of the dictator that do not vary over his term in office (such as the initial level of managerial skills). This implies that for our main analysis we focus on the variation in the data "within" dictators and, hence, that we examine the impact of age when an individual dictator grows older.

Naturally, estimating a reduced form equation involves issues of endogeneity. We find that in our context endogeneity may arise as a consequence either of attrition (selection bias) or omitted variables. The attrition bias may result from the fact that leaders can drop from the sample as a consequence of poor economic performance. So that we may observe low

9 In principle, a vector $W_{j,t}$ exists containing time varying dictator specific variables. For the baseline regression, we assume that this vector is contained in the error term. In section 5.2 we relax this assumption and study the confounding effect of tenure in the relation between the age of the dictator and economic growth.

economic growth rates in the final stage of their term. To address this potential problem, we also provide estimates for our model in which we select the sample of dictators of which their term ended because of exogenous reasons. We follow Besley *et al.* (2011) by focusing on leaders that either died of natural reasons or were incapacitated by illness. By doing so, we are confident that our results are not driven by sample selection. After all, lower economic growth rates do not cause natural deaths or disease.

We include a set of standard control variables in the regressions to control for endogeneity resulting from omitted variables bias. These variables include the ratio of total investments to GDP, the ratio of government expenditures to GDP, economic openness, i.e., total trade relative to GDP and the presence of civil war.[10] With the end of the cold war a lot of countries (especially post-communist countries) experienced a structural break in their economic performance. As this structural break correlates with time (and so does aging), we include a dummy variable that is equal to one in the period up to 1990 and zero afterwards.

5. Estimation Results

The predictions of our theoretical model are tested in table 3, where we present the estimation results of the fixed effects model as presented in equation 5. Column 1 contains the results for H.1, i.e., that the economic growth rate declines as dictators grow older. Column 2 presents the results for H.2, i.e., the impact of political instability on economic growth. In column 3, we test H.1 and H.2 simultaneously. Finally, columns 4 and 5 show the estimates of the subsample containing monarchies and the sample without monarchies, thereby testing H.3.

[Insert table 3 here]

[10] Note that due to the inclusion of fixed effects and the focus on yearly economic growth rates, we exclude all variables that are time invariant or are only able to explain long term growth differences (such as the level of human capital or the level of national income at the beginning of the sample period.)

We find strong support for H.1. The point estimate is negative and significant at the 1 percent level with a t-statistic of 8.2. In addition to statistical significance, we also find the effect to be highly economically significant. That is, a one year increase in the age of the dictator reduces economic growth by 0.4 percentage points. Moreover, the variance explained by the model is 0.21 as indicated by the R-squared statistic.

We also find that the probability of a coup attempt has a negative impact on economic growth, thereby lending support for H.2.[11] This effect is also significant at the 1 percent level and is in line with earlier findings in the literature (see, for instance, Alesina *et al.*, 1996). In column 3 we show that H.1 and H.2 are not mutually exclusive. When we enter the age of the dictator as well as political instability into the regression, both estimates remain significant at the 1 per cent level. Hence, we conclude that mortality risk and political risk are not mutually exclusive.

The results in columns 4 and 5 tentatively support the hypothesis that family succession affects the economic growth performance of dictators (i.e. H.3). The impact of aging is significant in both samples. However, when we compare the estimates of aging for the sample with and without monarchies, we find that the impact of aging is smaller in monarchic dictatorships (-0.30 vs. -0.41), while the estimated standard errors are 0.09 and 0.05, respectively.[12]

5.1 Endogeneity

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[11] In going from column 1 to 2 the estimation sample is reduced due to lower data availability for political instability. However, when we test H.1 for the reduced sample our results are unchanged.

[12] As explained in section 3, an alternative way to test this hypothesis is to include the presence of children as explanatory variable in the regression. Whilst examining this alternative, we were confronted with the fact that almost all dictators have children leading to negligible variation in the data. Ignoring this caveat and estimating the regression anyway, we do not find evidence that the presence of children matters.

Our finding that aging of dictators is a determinant of economic growth may suffer from selection bias as pointed out in section 4. That is, dictators may drop from the sample as a consequence of poor economic performance, so that we observe low economic growth rates in the final stage of their term. In order to control for this problem, we estimate our model for the sample of dictators whose term ended because of exogenous reasons. As most dictators leave office for different reasons than natural death or disease, we are left with a relative small sample of 27 dictators and 371 country-year-dictator observations. When we test H.1. and H.2 for this smaller sample, we confirm our earlier findings. This result is reported in column 1 of table 4. Age enters the regression with an estimated parameter of -0.16 and is significant at the 5 percent level. Political instability enters the regression with an estimated parameter of -0.81 and is also significant at the 5 per cent level. Furthermore, the R-squared of the model is 0.19, which close to our baseline specification.[13]

[insert table 4 here]

The other potential endogeneity problem is that variables exist that are correlated with the age of the dictator and are also a determinant of economic growth. This phenomenon is called omitted variables bias. We test the robustness of our results for H.1 and H.2 by including control variables. We include these control variables separately first and in column 8 we include all control variables. In the next sub-section we focus on one confounding variable in particular, namely the tenure of a dictator. In line with earlier studies on the determinants of economic growth, we expect that investments and openness will enter with a positive sign, while we expect the size of government, violence indicators and population growth will enter with a negative sign.

[13] H.3 cannot be tested since only 10 monarchic dictators were randomly replaced. These are: Isa Ibn Al-Khalifa of Bahrein, Wangchuk of Bhutan, Hussein of Jordan, As-Sabah of Kuwait, Mohammed V and Hassan II of Morocco, Tribhuvan and Mahendra of Nepal, Khalid and Fahd of Saudi Arabia and Subhuza II of Swaziland.

The variables we have included as controls are all of the expected sign. However, only the ratio of government expenditures to GDP and the presence of civil war enter the regression significantly. In our view, this can largely be explained by the inclusion of country fixed effects that takes away the cross-sectional variation in the data. Yet, such a saturated model confirms our earlier findings that the age of the dictator and political instability are determinants of economic growth. Finally, in column 9 we consider both sources of endogeneity simultaneously by estimating the saturated model of column 8 for the sample of leaders that left office for exogenous reasons. The column highlights that the results remain largely unchanged.

5.2 The effect of tenure

With every year that the dictator grows older, he also gains an additional year of tenure. Clague *et al.* (1996) claim that there is a positive relation between tenure of a dictator and economic growth. Their argument relates to Olson's theory that there are roving and stationary dictators (Olson, 1993). While the former have a short time horizon, the latter have a much longer time horizon. Hence, a dictator that is observed to have a long tenure is more likely to be a stationary bandit, and, therefore, more likely to have a positive growth performance. The argument of Clague *et al.* (1996) contrasts the predictions of our model.

The inclusion of dictator fixed effects in the empirical model comes at the cost that it is not innocuous to differentiate between age and tenure of the dictator. Conditional on the dictator fixed effect, these variables are perfectly collinear. In order to examine this issue, we can still make use of the cross-sectional variation between leaders within countries. In other words, we can exploit the fact that dictators come to power at a different age. For example, King Hussein of Jordan entered office at age 17, whereas his son Abdullah entered office at age 37. Put differently, at age 40 Hussein's tenure was 23 years, while Abdullah's was 3. In terms of our empirical strategy focusing on variation between dictators implies that we have to drop dictator fixed effects.

Table 5 shows the effect of age and tenure on economic growth. In column 1, we re-estimate specification 7 of table "controls" without dictator fixed effects. We find that the age parameter is -0.08 and still significant. It is important to note that the omission of dictator fixed effects changes the interpretation of the estimated coefficient. While the baseline regression gives a marginal effect (i.e, the effect of becoming one year older), the current specification gives an absolute effect (i.e., the effect of a given age on economic growth). In column 2 we estimate the same specification as in column 1, but replace age by tenure. The results indicate that tenure by itself does not affect economic growth. Thus, refuting the prediction of Clague *et al.* (1996) that tenure is positively related to economic growth.[14] In column 3 we include both age and tenure in the regression and find that only age is estimated significantly. However, we observe that tenure is now estimated, as predicted by Clague *et al.* (1996) with a positive coefficient albeit not significant. The exercise in table 5 allows to conclude that while there are theoretical grounds for tenure to have an impact on economic growth, this relationship does not confound the relation between aging dictators and economic growth.

[Insert table 5 here]

5.3 Further robustness analyses

[14] Note that the specification in column 2 contains one additional observation. This is due to the fact that in 1969 Brazil was ruled by a military junta with no specific head of government.

In table 6 we provide additional tests for robustness. In column 1, we include a lagged dependent variable in the regression to check whether economic growth follows an autoregressive process. It can be seen that there is no evidence for such a dynamic process and, more importantly, that the sign and significance of the age coefficient is unaffected by the inclusion of a lagged dependent variable. In column 2 we examine whether our results for H.1 are driven by outliers. We exclude observations for which the economic growth is higher than 30 percent per year and lower than -30 percent per year. Our results do not change when we exclude outliers from the sample.[15] In column 3 we focus on 5-year economic growth rates as the dependent variables. This also allows us to include a convergence effect in to the regression model (i.e., begin of period GDP). We find that examining the effect of age over a longer time span does not change our main finding. In column 4 we use investments instead of economic growth as the dependent variable. According to our theoretical model, investments are the channel through which the age of the dictator affects economic growth. The results confirm the earlier findings; age enters negative and significant. In column 5 we use an alternative data source for our dependent variable. That is, we use the economic growth variable from the World Development Indicators of the Worldbank (2011). Even though the point estimate of the age coefficient is smaller than in the baseline regression, it is still negative and significant at the 5 percent level.[16] In column 6 we use the Polity IV data set instead of the Przeworski *et al.* (2000) measure to select the sample of dictators. We follow the Polity handbook and classify all regimes with a score lower than 7 as an autocracy. The alternative sample selection criterion does not change our main finding. Finally, in figure 2, we visualize the marginal effect of age when we estimate the model including also age squared to evaluate the existence of non-linearity. As can be seen by the downward sloping curve, the marginal effect of age increases as the age of the dictator increases.

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[15] Estimating the model for alternative thresholds yields the same results.

[16] Using data of Maddison (2003) provides us the same conclusion.

6. Concluding Remarks

As dictators grow older, their time-horizon decreases. We show in a simple model that a decrease in the time-horizon of a dictator leads to less investments in productive capital and, therefore, less economic growth. This effect is supported by empirical estimates using a sample of about 500 dictators for the period between 1950 and 2004. Our evidence supports the view that dictators discount the future when it comes to growth promoting policies. Complementing the literature that focuses on the risk of political replacement (i.e., political instability) and economic growth, we find evidence that the risk of natural death has an effect on economic growth as well. We find some evidence for heir effects on economic growth. That is, we find that for the sample of monarchic dictatorships the estimated impact of age is smaller than for other dictatorships. These findings should, however, be interpreted with care since the differences are small. In addition, the distinction between monarchic dictatorships and other dictatorships is a crude proxy to measure heir effects and deserves further examination.

An interesting direction for future research is to look beyond age and focus on the relationship between personal attributes of dictators and the policies that they enact. Becker and Mulligan (1994), for instance, argue that, in addition to mortality, wealth, addictions, uncertainty and numerous other variables affect the future time horizon of individuals. Combining their analysis with our empirical strategy and the rich dataset of Ludwig (2004) could shed light on how, for instance, drug and alcohol use affect the enacted policies. Alternatively, a fruitful area for future research is to study how shocks to longevity affect the polices enacted by dictators. Hugo Chavez is an interesting point in this respect and it should be interesting to examine whether his cancer diagnose caused a structural break in his economic policies.

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Figures and Tables

Figure 1. Comparison of economic growth between first and second half of tenure of dictator.

Figure 1a. All dictators

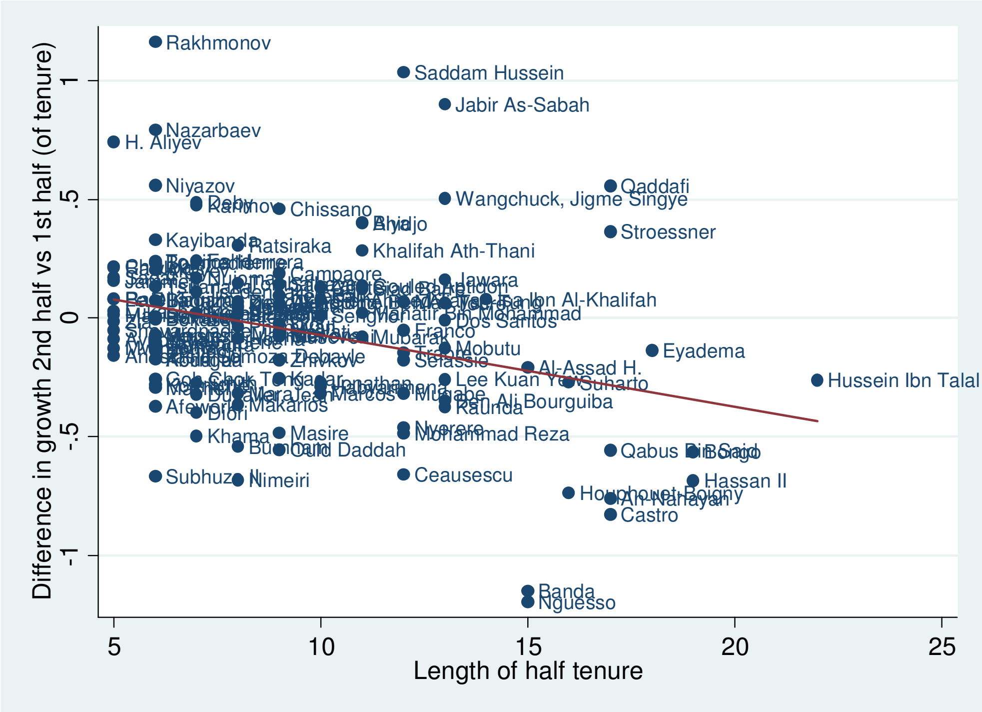


Figure 1b. Dictators with at least 20 years tenure.

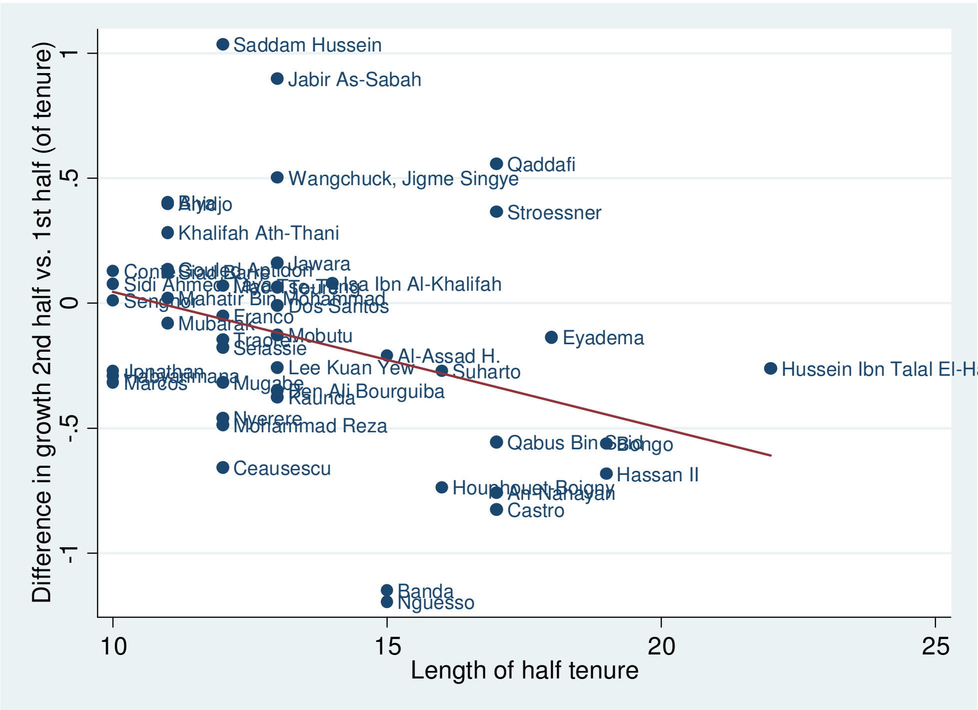
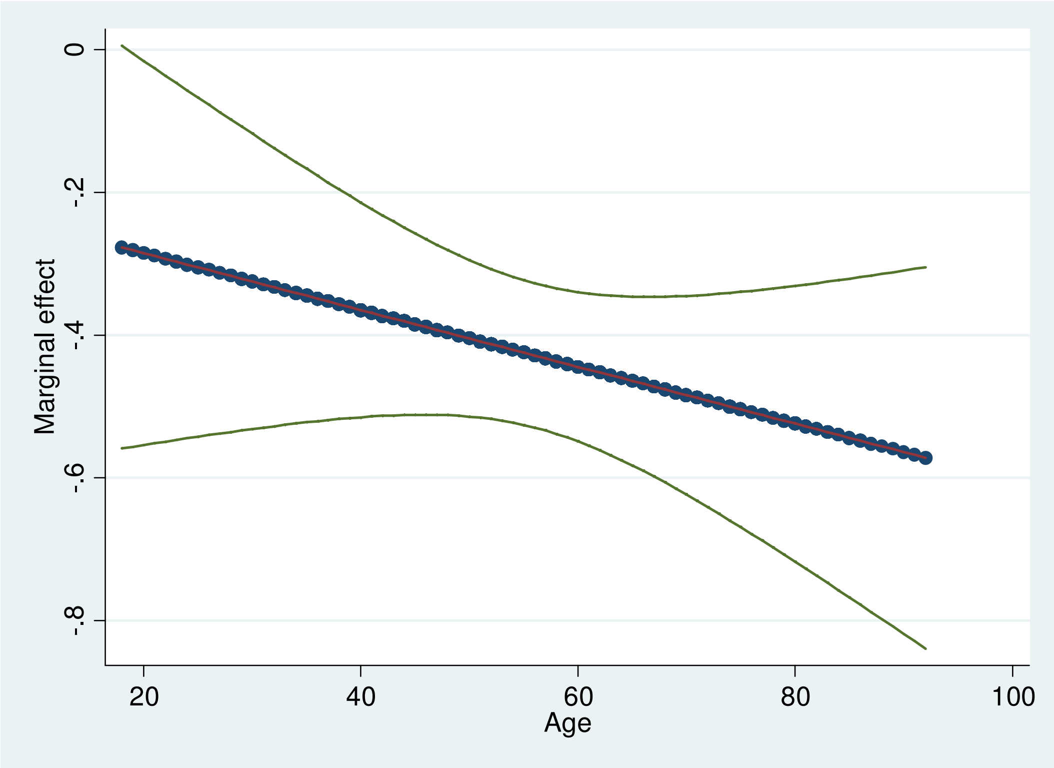


Figure 2. Non-linearity of the age effect.



Note: the figure shows the estimated marginal effect (and the 95 per cent confidence interval) of age on economic growth based on a model specification including age and age squared.

Table 1. Predicting coup attempts

Dependent variable: coup attempt	
GDP	-0.580***
	(-2.59)
Previous coup attempts (number of)	-0.337***
	(-4.89)
Previous successful coup attempts (number of)	0.218*
	(1.87)
Regime duration	-0.00381
	(-0.54)
Democracy	-1.001***
	(-5.06)
Constant	2.028
	(1.33)
Countries	77
Observations	3,658

Note: the model is estimated using logit. Country and year fixed effects are included. Z-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 2. Age and economic growth in different dictatorships

Dictatorship:	Variable	Obs	Mean	Std. Dev.	Min	Max
Civilian	Age	1825	57.26	11.33	21	92
	Growth	1752	1.97	9.43	-65.08	88.73
Military	Age	1307	52.16	10.57	27	84
	Growth	1274	1.59	8.60	-42.90	123.27
Monarchic	Age	504	51.07	15.20	17	84
	Growth	447	2.09	11.13	-27.35	134.13

Table 3. Baseline estimation results

Dependent variable: economic growth	(1)	(2)	(3)	(4)	(5)
	growth	growth	growth	growth	growth
Age	-0.434***		-0.185**	-0.300***	-0.406***
	(-8.200)		(-2.586)	(-9.085)	(-7.437)
Political instability		-0.682***	-0.682***		
		(-2.771)	(-2.771)		
Constant	14.08***	20.24***	25.31***	-9.487***	15.15***
	(5.973)	(3.564)	(4.100)	(-9.747)	(4.290)
Observations	3,499	2,355	2,354	411	3,088
R-squared	0.212	0.234	0.234	0.203	0.235
Countries	116	76	76	15	116
Country fixed effects	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES
Leader fixed effects	YES	YES	YES	YES	YES

Note: model is estimated using panel fixed effects. Robust t-statistics in parentheses.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 4. Aging, economic growth and endogeneity

Dependent variable: economic growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Age	-0.162**	-0.219***	-0.172**	-0.217**	-0.358***	-0.185**	-0.198**	-0.228**	-0.521**
	(-2.073)	(-2.862)	(-2.565)	(-2.338)	(-4.743)	(-2.586)	(-2.560)	(-2.531)	(-2.377)
Political instability	-0.811**	-0.678***	-0.557**	-0.696***	-0.639**	-0.682***	-0.678***	-0.520**	-0.768*
	(-2.327)	(-2.847)	(-2.494)	(-2.733)	(-2.587)	(-2.771)	(-2.717)	(-2.279)	(-2.058)
Investments (% of GDP)		0.150						0.163	0.0636
		(0.920)						(1.208)	(0.400)
Government expenditures (% of GDP)			-0.303***					-0.297***	-0.217**
			(-3.034)					(-2.941)	(-2.479)
Openness (total trade as a % of GDP)				0.0239				0.00598	0.0186
				(0.550)				(0.192)	(0.473)
Civil war dummy					-3.861**			-3.973**	-7.431***
					(-2.425)			(-2.339)	(-3.083)
Cold war dummy						-6.327		5.988	-13.35
						(-1.219)		(1.525)	(-1.687)
Population growth rate							-19.70	-19.32	0.297
							(-1.323)	(-1.154)	(0.0130)
Constant	23.34***	25.17***	27.88***	25.63***	25.02***	23.71***	27.06***	19.54***	49.12***
	(3.453)	(4.117)	(4.536)	(3.990)	(4.258)	(4.256)	(3.891)	(3.654)	(2.967)
Observations	371	2,354	2,354	2,354	2,301	2,354	2,261	2,210	354
R-squared	0.199	0.239	0.249	0.236	0.234	0.234	0.233	0.247	0.234
Countries	26	76	76	76	76	76	73	73	25
Country fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Leader fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: model is estimated using panel fixed effects. Columns 1 and 9 are based on a sample of leaders that left office for exogenous reasons (see Besley *et al.* (2011). Columns 2-8 are based on the full sample. Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5. The effect of tenure on economic growth

Dependent variable: economic growth	(1)	(2)	(3)
Age	-0.0799**		-0.0933**
	(-2.333)		(-2.022)
Tenure		-0.0404	0.0308
		(-1.130)	(0.603)
Observations	2,210	2,211	2,210
R-squared	0.070	0.066	0.070
Countries	73	73	73
Country fixed effects	YES	YES	YES
Year fixed effects	YES	YES	YES
Leader fixed effects	NO	NO	NO

Note: model is estimated using panel fixed effects. The specification include control variables (see column 8 of table 4) which are omitted for clarity. Robust t-statistics in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 6. Further robustness analyses

	(1)	(2)	(3)	(4)	(5)	(6)
Specification check:	Dynamic	Outliers	Growth 5-year	Investments	Growth WDI	Polity IV
Age	-0.0864**	-0.391***	-0.00380**	-0.0779***	-0.0772**	-0.417***
	(-2.289)	(-7.468)	(-2.058)	(-3.518)	(-2.059)	(-8.125)
Lagged economic growth	0.0231					
	(0.286)					
Begin of period GDP			-0.326*			
			(-1.793)			
Constant	4.015*	12.84***	2.847**	3.945***	4.807*	12.46***
	(1.744)	(5.255)	(2.101)	(2.907)	(1.839)	(5.234)
Observations	3,422	3,450	511	3,499	2,543	3,235
R-squared	0.215	0.174	0.557	0.086	0.200	0.204
Countries	116	116	112	116	104	115
Country fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Leader fixed effects	YES	YES	YES	YES	YES	YES

Note: model is estimated using panel fixed effects. Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix A. Model solution and comparative statics

By substituting the constraints into the utility function we can write the optimization program of a young dictator as:[17]

$$\max_{K_2,K_3} \Lambda_1 = \ln(AK_1 - K_2) + (1-\tfrac{1}{\theta}\mu)(1-\pi)\ln(AK_2 - K_3) \\ +(1-\mu)(1-\tfrac{1}{\theta})(1-\pi)^2 \ln(K_3), \tag{A.1}$$

with K_1 given.

The first order necessary conditions are:

$$\frac{\partial \Lambda_1}{\partial K_2} = 0 : -\frac{1}{AK_1 - K_2} + \frac{(1-\tfrac{1}{\theta}\mu)(1-\pi)A}{AK_2 - K_3} = 0, \tag{A.2}$$

$$\frac{\partial \Lambda_1}{\partial K_3} = 0 : -\frac{(1-\tfrac{1}{\theta}\mu)(1-\pi)}{AK_2 - K_3} + \frac{(1-\mu)(1-\tfrac{1}{\theta})(1-\pi)^2}{K_3} = 0. \tag{A.3}$$

We can rewrite (A.2) and (A.3) as:

$$AK_2 - K_3 = (1-\tfrac{1}{\theta}\mu)(1-\pi)A(AK_1 - K_2), \tag{A.4}$$

$$(1-\tfrac{1}{\theta}\mu)K_3 = (1-\mu)(1-\tfrac{1}{\theta})(1-\pi)(AK_2 - K_3). \tag{A.5}$$

Defining output growth, g_1, in period 1 as $Y_2/Y_1 \equiv 1 + g_1$ and noting that along the growth path $K_2/K_1 = Y_2/Y_1$ we can substitute (A.5) into (A.4) to derive $1+g_1$:

$$1 + g_1 = \frac{K_2}{K_1} = \frac{A(1-\pi)((1-\tfrac{1}{\theta}\mu) + (1-\mu)(1-\tfrac{1}{\theta})(1-\pi))}{1 + (1-\pi)((1-\tfrac{1}{\theta}\mu) + (1-\mu)(1-\tfrac{1}{\theta})(1-\pi))}. \tag{A.6}$$

From the perspective of a dictator who survived until second period the optimization program amounts to:

$$\max_{K_3} \Lambda_2 = \ln(AK_2 - K_3) + (1-\tfrac{1}{\theta})(1-\pi)\ln(K_3), \tag{A.7}$$

with K_2 given.

The first order necessary condition is:

$$\frac{\partial \Lambda_2}{\partial K_3} = 0 : -\frac{1}{AK_2 - K_3} + \frac{(1-\tfrac{1}{\theta})(1-\pi)}{K_3} = 0. \tag{A.8}$$

We can rewrite (A.8) as:

$$K_3 = (1-\tfrac{1}{\theta})(1-\pi)(AK_2 - K_3), \tag{A.9}$$

so that the period 2 growth rate becomes:

$$1 + g_2 = \frac{K_3}{K_2} = \frac{A(1-\tfrac{1}{\theta})(1-\pi)}{1 + (1-\tfrac{1}{\theta})(1-\pi)}. \tag{A.10}$$

[17] To avoid cluttering the analysis with indices we solve the model in terms of the age of the dictator.

Straightforward differentiation of (A.6) and (A.10) then gives the results stated in the text:[18]

Hypothesis 1:

$$\frac{\partial(1+g_1)}{\partial\mu}=\frac{-A(1-\pi)\frac{1}{\theta}}{(1+(1-\pi)((1-\frac{1}{\theta}\mu)+(1-\mu)(1-\frac{1}{\theta})(1-\pi)))^2}<0. \tag{A.11}$$

Hypothesis 2:

$$\frac{\partial(1+g_1)}{\partial\pi}=\frac{-A((1-\frac{1}{\theta}\mu)+2(1-\mu)(1-\frac{1}{\theta})(1-\pi))}{(1+(1-\pi)((1-\frac{1}{\theta}\mu)+(1-\mu)(1-\frac{1}{\theta})(1-\pi)))^2}<0, \tag{A.12}$$

$$\frac{\partial(1+g_2)}{\partial\pi}=\frac{-A(1-\frac{1}{\theta})}{(1+(1-\frac{1}{\theta})(1-\pi))^2}<0. \tag{A.13}$$

Hypothesis 3:

$$\frac{\partial(1+g_1)}{\partial\theta}=\frac{A\frac{1}{\theta^2}(1-\pi)(\mu+(1-\mu)(1-\pi))}{(1+(1-\pi)((1-\frac{1}{\theta}\mu)+(1-\mu)(1-\frac{1}{\theta})(1-\pi)))^2}>0, \tag{A.14}$$

$$\frac{\partial(1+g_2)}{\partial\theta}=\frac{\frac{1}{\theta^2}(1-\pi)}{(1+(1-\frac{1}{\theta})(1-\pi))^2}>0. \tag{A.15}$$

[18] In order to derive the comparative static effects it is instructive to use the pleasant property that for any function of the form $g(x,y)=\frac{f(x,y)}{1+f(x,y)}$ it holds that $\frac{\partial g(x,y)}{\partial x}=\frac{f_x(x,y)}{(1+f(x,y))^2}$, which can be shown by a straightforward application of the quotient rule.

Appendix B. Descriptive statistics and data sources

Variable	Observations	Mean	Std. Dev.	Min	Max	Source
Economic growth	4043	1.99	9.09	-65.08	134.13	Heston et al. (2009)
Economic growth (WDI)	3054	2.15	6.92	-50.05	90.47	Worldbank (2011)
Age	4021	54.91	12.10	17.00	92.00	Goemans et al. (2009)
Tenure	4022	9.18	8.34	0.01	46.42	Goemans et al. (2009)
Political instability	2590	10.50	10.16	1.00	80.52	own calculations
Investments (% of GDP)	4114	17.52	12.75	-14.33	80.91	Heston et al. (2009)
Government expenditures (%of GDP)	4114	19.15	11.65	1.44	83.35	Heston et al. (2009)
Openess (total trade as % of GDP)	4114	72.80	53.87	1.09	622.63	Heston et al. (2009)
Civil war	4113	0.04	0.20	0.00	1.00	Gleditsch et al. (2002)
Cold war	4583	0.68	0.46	0.00	1.00	own calculation
Population growth rate	4347	0.02	0.02	-0.17	0.19	Heston et al. (2009)
GDP (ln)	4114	8.00	1.06	5.04	11.49	Heston et al. (2009)
Previous coup attempts (number of)	4583	1.58	2.27	0.00	15.00	Powell and Thyne (2010)
Previous successful coup attempts (number of)	4583	0.86	1.33	0.00	9.00	Powell and Thyne (2010)
Regime duration	4055	15.44	17.92	0.00	110.00	Marshall and Jaggers (2011)