Shrinking dictators: how much economic growth can we attribute to national leaders?

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Preliminary – comments welcome.

National leaders – especially autocratic ones - are often given credit for high average rates of economic growth while they are in office (and draw criticism for poor growth rates). Drawing on the literature assessing the performance of schoolteachers and a simple variance components model, we develop a new methodology to produce optimal (least squares) estimates of each leader's contribution to economic growth. We find that even in the world where leaders affect growth, the average rate of growth during a leader's tenure is mostly uninformative about that leader's contribution to growth. Interestingly, we also find that the average growth rate during a leader's tenure is more revealing about true performance in democracies rather than autocracies, largely because autocratic countries have more noisy growth processes. Using the model, we provide estimates of the (unobservable) contribution of individual leaders to growth. We find that least squares estimates of individual leader contributions vary at least as much across democrats as autocrats. We also produce new estimates of the variance of leader effects in general and find that they are at least as large in democracies as autocracies (and are sometimes very small in the latter).

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Introduction

How much should national leaders get credit (or blame) for economic growth that happens during their tenure in office? Popular discussions feature interesting claims of strong leader effects, which also show up in academic papers, but formal research has been relatively scarce.

Popular discussions often give much credit to leaders who presided over periods of high growth — like Deng Xiaoping in China, Lee Kuan Yew in Singapore or Park Chung Hee in South Korea, or, more recently, Paul Kagame in Rwanda —for these "growth miracles". For example, the *New York Times* obituary for Deng Xiaoping asserted "In the 18 years since he became China's undisputed leader, Mr. Deng nourished an economic boom that radically improved the lives of China's 1.2 billion citizens."[2] More recently, *The Economist* magazine in March 2016 describes Rwanda as development's "shining star" with "average growth of 7.5% over the past 10 years," suggesting "much of its success is due to effective government" under Paul Kagame. It quotes diplomats as worrying that "without Mr Kagame's firm hand … the miracle wrought in Rwanda could quickly be reversed."[3] Many rapid growth episodes like these featured autocrats, which has influenced the policy debate on democracy and development.

The World Bank's Commission on Growth and Development conducted a comprehensive survey of evidence on how to produce growth. It singles out 13 economies that have achieved high growth over 25 years or more and suggests that "making the right choices over this set of components [growth strategy and institutions]…is what leaders in the high-growth economies have done" (Brady and Spence 2010 p4). An earlier report in 2008 by the same commission finds that "Successful cases share a further characteristic: an increasingly capable, credible, and committed government. Growth at such a quick pace, over such a long period, requires strong political leadership" (Commission on Growth and Development 2008 p3).

Of course, there are also discussions of low or negative per capita growth attributed to bad autocratic leaders, such as Robert Mugabe, Joseph Mobutu, or most recently Nicolás Maduro in Venezuela.

The academic literature has discussed good and bad leaders' effects on growth, but seldom in a systematic way. It has mainly covered the stylized fact that the *variability* of growth (in both good and bad directions) is higher under autocracies than democracies (although even that fact is seldom formalized explicitly).[4] Some explanations of this stylized fact imply leader effects: "personal inclinations of autocrats might matter much more than personality differences between democratic rulers" (Weede 1996) and "visionary leaders … in autocratic [governments] need not heed legislative, judicial, or media constraints" (Becker 2010). Evidence presented usually contrasts the growth performance of "good" and "bad" leaders: "Highly centralized societies … may get a preceptor like Lee Kwan Yew of Singapore or a preceptor like Idi Amin of Uganda…" Sah (1991). "Singapore…has managed through benevolent dictatorship to produce a high quality of material life for its citizens, albeit without many of the freedoms that others hold dear." Bueno de Mesquita and Smith (2011).

Glaeser et al. (2004) are skeptical of outcome-based measures of institutions, and stress instead in poor countries the "choices of their – typically unconstrained – leaders," noting the large variation possible across dictators "The economic success of…China most recently, has been a consequence of good-for-growth dictators, not of

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[2] http://www.nytimes.com/learning/general/onthisday/bday/0822.html

[3] http://www.economist.com/news/middle-east-and-africa/21694551-should-paul-kagame-be-backed-providing-stability-and-prosperity-or-condemned

[4] See for example: Weede (1996); Quinn and Woolley (2001); Almeida and Ferreira (2002), Acemoglu et al. (2003); Glaeser et. al. (2004); Mobarak (2005), and Yang (2008).

institutions constraining them…there was nothing pre-destined about Deng, one of the best dictators for growth, succeeding Mao, one of the worst."

De Luca et al (2015) analyze how some dictators will be "growth-friendly dictators" because they have a vested interest in the whole economy and hence will produce high economic growth, an idea that goes back to Olson (1993). Other dictators that lack an encompassing interest in the national economy will be more likely to destroy the economy if it maximizes their own gains to do so. Rodrik (2000) summarized the stylized consensus that still holds today on the greater variability of leader growth effects under autocracy compared to democracy: "living under an authoritarian regime is a riskier gamble than living under a democracy."[5]

Despite the importance of this question of how or whether to attribute growth to leaders, there has been surprisingly little formal quantitative analysis, a gap this paper aims to fill. The main exception has been Jones and Olken (JO) (2005) who find that economic growth changes (in either direction) when a leader dies unexpectedly in office (such as by illness or accident) — with the results driven by autocracies. These results seem to confirm the previous stylized facts that autocrats have a higher variance of growth outcomes than democrats. JO correctly deal with idiosyncratic error – a major concern of this paper -- and also addressed causality by using the exogeneity of accidental deaths. JO's test statistic implies that variation in leader quality explains 1.5 percentage points of variation in economic growth. We will place this result, extended by our own new estimates using a different methodology on a larger sample, in context of the total variation of growth to get an assessment of how much the practice of attributing growth averages to leaders is justified.

Besley, Montalvo, and Reynal-Querol (2011) extend the JO findings to show also a positive effect on growth of the leader's educational attainment. These authors also find evidence of leader deaths on growth (and across their whole sample), but don't report an estimate of the contribution of leaders to growth. Meyersson (2016) examines coups, and finds that while successful coups in autocracies have an imprecise effect on growth, coups in democracies tend to reduce growth rates. Yao and Zhang (2015) examine the effect of city leaders on local economic growth, and they find mixed results depend on the test considered.

In democracies, incumbent candidates in rich democracies often claim credit for good growth outcomes during their tenure, while opposition candidates similarly attribute blame for any bad growth outcomes on the incumbent. Voters seem to believe these attributions, as a huge literature shows that recent economic conditions affect elections. Is this rational? Wolfers (2007) finds that voters in elections for US state governors reward incumbents who have presided over good economic performance, even when this performance is explained by exogenous factors such as oil prices. Hayes et al. (2015) find a similar result for voters punishing national leaders for bad growth even when it resulted from foreign shocks. These critiques of voter irrationality could still imply voters could have been rational to attribute growth to leaders if only they had filtered out exogenous shocks.[6]

This voting literature would also suggest a natural next step of indeed trying to measure leader effects in the data (which would include dealing with random shocks to economic performance, as we will address below). At least one recent study, Blinder and Watson (2016), discusses average growth under US Presidents to establish and analyze a strong result that average growth is higher under Democrats than under Republicans.

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[5] Rodrik (2000) finds that the within-country variability of growth is higher under autocracies, which is consistent with strong autocratic leader effects (though he does not test leader effects themselves).

[6] Ashworth et al. (2016) have challenged the whole voter irrationality interpretation, noting for example that the effect of exogenous shocks could reflect interactions with other factors under the leader's control.

Approach in this paper and connection to the teacher value added literature

In this paper, we ask: how much economic growth can we *quantitatively* attribute to a particular leader, based on the average growth rate during their tenure (as well as other observables such as performance of other leaders in the same country, and the length of tenure)? In the literature on the importance of autocrats for growth, there is an implicit belief that this proportion is close to one, or at least well above zero.

To rigorously answer this question, we need methodology for forming the "best" estimates of the contribution of individual leaders. We draw on a large literature assessing the performance of schoolteachers based on test scores (e.g. Chetty et al 2014). Here the national leader represents the schoolteacher, and the average test score for a class represents the average growth rate during the leader's tenure. In Chetty et al (2014), the authors first remove observable determinants of test scores (such as parental factors) via a regression, and calculate the average residual under each teacher. They estimate the 'teacher value added' from a regression of today's residual test scores on past residual averages of the same teacher.[7] Past average test scores are "shrunk" towards zero to reflect the noise in the test scores, much like we do in this paper for leader growth averages. The coefficient on past test scores is known as the *reliability* or *shrinkage* factor of the past test score.

In this paper, we modify the teacher value added approach in Chetty et al (2014) for the leader growth problem. Three of the main differences are that (i) there are few (if any) *exogenous* determinants of growth that are analogous to parental characteristics which can removed via first stage regression,[8] (ii) no national leaders ever rule multiple countries, whereas schoolteachers switch schools and grades,[9] and (iii) there are fewer national leaders than schoolteachers (Chetty et al have data on around 7 million test scores). Given our reduced ability to control for observables we follow a more [statistical] model-based approach, where we form the least-squares estimate of the *unobservable* leader effect, and calculate it using estimated variance components.

An important caveat of this approach is that it misses potentially important *lagged* effects of teachers/leaders on test scores/growth. A teacher whose explanation of fractions boosts test scores under future teachers will be underappreciated in the same way as a leader that builds long-lasting institutions which boost growth after s/he has left office.[10] But in the both the teacher and leader-growth literature, these long lasting mechanisms are usually missing anyway - largely because they are unobservable in real time (if at all).

The least-squares leader estimate (Section 1) involves two components. First we adjust the leader growth average for the average growth rate under *other* leaders in the same country. This helps to remove country-specific growth factors - when there are no country-specific determinants of growth, no adjustment is necessary. The extent to which it is optimal to do this depends on how informative the average growth rate under *other* leaders is about the true country effects. If, for example, there are only a few years of growth data under other leaders, then this

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[7] These are known in the teacher value added literature as leave-year-out (jackknife) estimates of teacher VA. Calculating leader value added estimates using a leave-year-out or leave-term-out is an interesting extension we intend to purse in future versions of this paper.

[8] Chetty et al (2014) can treat school fixed effects as exogenous regressors for the outcome in a particular classroom given data on multiple classrooms per school over many years. We do not have this luxury as leaders are often in power for much of the history of a particular country.

[9] An exception is Yao and Zhang (2015), who use the fact that Chinese city mayors switch cities to estimates the effect of mayors on growth.

[10] For example, when George Washington retired from office after two terms he created a powerful precedent that likely saved the United States economically costly leadership struggles in the future (and formed the basis of the 22nd amendment). But this would not be included in our estimate of Washington's leader effect.

estimate will be a very noisy signal of the country effect, and so the information will be down weighted (the extent to which it is down weighted is captured by γ in our model in section 1).

Second, we calculate the reliability factor (or shrinkage factor) of the adjusted leader growth average. This is a measure of the signal-to-noise ratio of the adjusted leader growth average. The reliability factor will be equivalent to the ratio of the true leader effect to the adjusted average growth under the leader; hence a small reliability factor means shrinking more of the average growth under the leader towards zero to get the least-squares leader effect. For leaders with short tenures, or leaders of countries with very volatile year-to-year (iid) growth, the adjusted leader growth average is an unreliable measure of the true leader effect: the reliability factor is low, and so the leader effect is *shrunk* towards zero. The reliability factor x the adjusted leader growth average is our least-squares estimate of the true leader effect based on observable data. Using Monte Carlo simulations, we verify that our least-squares leader effect estimate is an unbiased estimator of the true leader effect. Our least squares estimate of the leader effect has a Root Mean Squared Error (RMSE) of about 1%, which shows that even though it has the (constrained) minimum RMSE, there is still considerable uncertainty about the true contribution to growth of each national leader.

In order to calculate the size of reliability factor and the country effect adjustment, we need to calculate the size of the variance components in our simple statistical model of growth (consisting of a leader effect, a country effect and an iid error). Good estimates of these variance components are essential for GLS adjustments in random effects estimation. As a result, we utilize two methods from that literature – a baseline and a refinement based on unbalanced panels – which Monte Carlo simulations reveal usually generate pretty good estimates of the variance of the leader effect. We also calculate estimates of the standard deviation of country effects (which are not quite as accurate, but this turns out not to be important) and the variance of the iid error (which is easy to measure because it is so large).

<u>Results</u>

Our first result is that even under a model where leaders do affect economic growth, the average growth rate under a certain leader is mostly uninformative about that leader's true contribution to growth. The simple relationship (in a pooled sample) between the leader growth average and the least-squares leader estimate has a line slope of only around 0.15 (for PWT7.1 growth rates): every 1ppt increase in the leader growth average only translates into an extra 0.15ppts "least squares" leader contribution. This means that even "great leaders" who achieve "miracle" growth rates of around 6ppts can only (on average) only claim about one percentage point of that growth.[11] This result is almost entirely due to the low reliability factor estimates that are applied to adjusted leader growth averages. The reliability factor is lower the shorter the tenure. It is not surprising that one year of growth under a leader might be uninformative; what is more surprising is how long the tenure has to get to yield a clearer signal. For all leaders (which is similar to results for autocrats only), the reliability factor starts close to zero, increases to 0.2 for leaders with 10 years tenure and peaks at about 1/3 for leaders with 30 years tenure.[12] With other econometric methods or growth datasets, the reliability factors can be a bit higher (e.g. ½ for leaders with 30 year tenure) or much lower (close to zero), so the numbers reported here are in the middle of the range.

Our second result is that we contradict the literature that the *observable* contribution of autocratic leaders to growth is larger than that for democratic leaders (usually justified in the literature by autocratic leaders facing

[11] All figures are in real per capita terms and here come from PWT 7.1 dataset. Our calculations are all de-meaned terms, after a subtracting average per capital growth of around 2% per years (±0.5% depending on the sample), and so the miracle leader is achieving growth of around 8% rather than 6%.

[12] After tenures of around 30 years, the inability to measure the country effect due the absence of *other* leaders starts to weigh on the estimates of the reliability factor.

fewer constraints on their power). Like others in the literature, we find that the average growth rate is more variable under autocrats than democrats (a standard deviation around 1/3 higher according to our estimates using PWT7.1 growth rates). However, most of this difference is just short-run noise and country-level factors. When we calculate the standard deviation of the least-squares leader effects, the standard deviation (across leaders) is almost twice as large under democracies as autocracies (again using PWT7.1 data). This is despite the fact that the average tenure of democrats is shorter than autocrats.

The second result reflects the smaller reliability estimates for autocrats, which means their average growth rates tend to be shrunk towards zero. Most importantly, this is due to year-to-year growth that is much more volatile under autocracies than democracies: an iid standard deviation almost twice as large under autocracies, which means an iid variance almost four times as large (figures for PWT 7.1 data). Autocracies are more likely in poorer countries, which likely have greater measurement error and greater susceptibility to shocks like weather, natural disasters, and terms of trade shocks. The second reason is the absence of clear evidence of a true higher variation of leader effects across autocrats than democrats (see below). These mean that for most tenure lengths, the reliability factor is *twice* as large under democrats as under autocrats.

Our third contribution is to show that even when one relates higher average leader growth to better performance it is difficult to know who are the best and worst leaders due to poor quality growth data. We have four different datasets on growth rates that often show substantially different growth rates for the same years for the same countries. Using the criterion of best 5 percent of leaders' growth averages in each dataset, we find disagreement over who are the "best leaders." We find that only around a quarter of the top 5% "best leaders" are ranked in the top 5% across all four growth datasets. The four datasets also disagree on who are the worst leaders. We view measurement error as one of the reasons the idiosyncratic error term has such a large variance, particularly for countries that are both poor and autocratic. These results corroborate others in the literature. Johnson et al (2013) find that of the studies whose results tended to be revised away across versions of the Penn World Tables, most that relied on annual growth rates. In contrast, studies using a cross section of income levels were mostly robust and studies using a panel of 5-year or 10 year average growth rate averages were partially robust. Using night-time lights as a proxy for GDP, Magee and Doce (2014) find that autocracies tend to "overstate" growth rates more than democracies.

Our final contribution is a direct estimate of the standard deviation of the leader effect on growth across all leaders. This comes from the variance components needed for the reliability adjustment, but is also of interest in its own right. Using an unbalanced panel methodology, we find that the leader SD ($\hat{\sigma}_{\mu}$) is estimated to be around 1-1.75%, depending on the specification, dataset and leader type. Affirming the second point above, the estimates for autocratic leaders are sometimes larger and sometimes smaller than those for democrats, but usually within one (bootstrapped) standard error bound. Without the unbalanced panel adjustment (which actually performs slightly better in Monte Carlo simulations), we find estimates of the leader SD ($\hat{\sigma}_{\mu}$) are zero for autocrats (and overall), but not for democrats. We stress that these are probably reflective of a small leader SD rather than one which is exactly zero and so should not be over-interpreted.

Taken together, these results suggest there is little strong evidence in favor of large leader SD for autocrats --- and that the autocratic leader effects might even be smaller than democratic leader effects. This contradicts the consensus that autocratic leaders have more effect on growth in general (a "risky bet").

Relative to Jones and Olken (2005) (who also estimate this leader SD), our approach relates the leader SD to the underlying growth variation. Our emphasis is on how informative are growth averages even of many years about leader quality. Even when there is substantial variation in leader quality (as JO find, and as we also find in some specifications), even a relatively long average says surprisingly little about how good is the leader in power. Even when we find a very sizable leader effect for an individual leader (usually requiring a long tenure) in one dataset, the disagreement between datasets implies we would have found different leaders to have large effects in a different dataset. In sum, even when there are some leaders which are very good for growth, observers will have great difficulty saying who they are.[13]

The rest of our paper is as follows. Section 1 describes the statistical model and our new least squares estimate of the leader effect. Section 2 describes the data. Section 3 presents an aside on the best and worse leaders and shows how these vary across datasets. Section 4 presents our econometric methodology for estimating the standard deviation of leader effects. It also performs several Monte Carlo exercises verifying the unbiasedness of our least squares estimator of leader effects, and also the accuracy of our estimate of the standard deviation of leader effect. Section 5 presents empirical estimates of the different variance components. Section 6 presents our main results on the least-squares estimates of leader effects for different leaders, and compares the size of effects under autocracies and democracies. Section 7 concludes.

[13] Unlike JO, our calibration does not address causality. The main threat of reverse causality is that leaders with bad growth will be more likely to be replaced; this would bias upwards the size of leader effects in our calibration, which works against the main conclusions here. One advantage of our approach is that we can utilize data on all leaders rather than a small number who might be unrepresentative and more sensitive to data revisions. Natural or accidental deaths in office are extremely rare - Jones and Olken 2005 have 57 examples in 50 years across 100 countries. Johnson et al (2013) re-estimate Jones and Olken's main results using a revised version of the Penn World Tables (PWT 6.2 rather than 6.1 as used by JO2005), and find that it is now democratic leaders, rather than autocratic leaders, which influence growth.

Section 1: Model

In the academic literature and in policy discussions, leaders are often attributed the average growth during their tenure, as discussed above. Even if we give leaders as much credit for growth as possible, there are still two problems with this approach. First, the random *idiosyncratic* component of growth is very large (Easterly et al 1993 and many papers since) and tends to swamp leader effects even over the medium term. This means a good string of good (or bad) growth rates under a leader are attributed to the good (or bad) policies of a leader, when often they are just good (or bad) luck. Second, some countries have higher or lower trend growth rates due to other factors that are not related to individual leaders– such as institutions, culture, geography, or the initial stock of human capital.[14]

Consider a simple decomposition of the annual per capita GDP growth under leader *i* during year *t* into a leader component (μ_i) and idiosyncratic (ε_{ict}) component for a balanced panel of leaders as in Equation (1) ($\bar{g}$ is the average across all leader-years, which could be seen as the constant world growth rate). We view each of these as *random variables*, from which the country draws μ_c~$(0,\sigma_c^2)$, each leader draws μ_i~$(0,\sigma_\mu^2)$ and for each period ε_{it}~$(0,\sigma_\varepsilon^2)$, with μ_i , μ_c and ε_{ict} being independent (and also serially uncorrelated). We assume ε_{it} is i.i.d. for all countries/years, and that each leader is in power for T_i years. N is the total number sample length for country c.

(1) $g_{ict} = \bar{g} + \mu_i + \mu_c + \varepsilon_{ict}$

We are intentionally modeling growth to be as favorable as possible to the practice of attribution of growth to leaders. We give leaders full credit for *all* growth except for that due to country effects and iid shocks. For example, we rule out anybody else in government other than the leader having any effect on growth (bad luck for finance ministers and central bank governors). Other time-varying but persistent factors that affect growth will be attributed to leaders and bias upwards the absolute size of leader effects. Hence our exercise provides an upward bound on the (absolute) size of leader effects.

The average growth rate under leader *i* in country *c* with tenure T_i is given by Equation (2): this is the key measure that is usually attributed to national leaders.

$$(2)\quad \bar{g}_{ic} = \frac{1}{T_i}\sum_{t=1}^{T_i} g_{ict}$$

It will also be useful to record the average growth rates for all *other* leaders than *i* in the same country (which we denote –*i*). This is going to be useful to distinguish between country effect and individual leader effects.

$$(3)\quad \bar{g}_{-ic} = \frac{1}{N-T_i}\sum_{t=T_i+1}^{N} g_{-ict}$$

<u>Definition of problem</u>

We want to have the "best" estimate of the size of the (unobservable) leader effect μ_i based on observable data: the average growth rate during that leader's tenure $\bar{g}_{ic}$, and also the average growth rate under *other* leaders in the same country $\bar{g}_{-ic}$. "Best" here is the least squares error, as commonly used for evaluating forecasts (in the empirical work and Monte Carlo simulations we report the Root Mean Squared Error RMSE). Ideally we would like an unbiased estimator, though we don't impose it. We also restrict the model to a linear function of the own

[14] Institutions that consistently select good leaders, or constrain bad ones, would come through as part of the country effect.

leader average and other leader average $\beta_1\bar{g}_{ic} + \beta_2\bar{g}_{-ic}$. This can be rearranged into a more intuitive form (without making any restrictions), as in Equation 4. $\bar{g}_{ic} - \gamma\bar{g}_{-ic}$ is the *adjusted* leader growth average which uses the economic performance under *other* leaders as a proxy for the country effect (which is then subtracted). ψ is the *reliability/scaling factor* which down weights the adjusted leader growth to minimize the error variance.[15]

$$(4)\quad \hat{\mu}_i = \hat{\psi}(\bar{g}_{ic} - \hat{\gamma}\bar{g}_{-ic})$$

Specially, the problem is to choose ψ and γ to minimize the expected squared error:

$$(5)\quad \min_{\psi,\gamma} E\left[\mu_i - \psi(\bar{g}_{ic} - \gamma\bar{g}_{-ic})\right]^2$$

$\hat{\gamma}$ is just the OLS estimate of a regression of $\bar{g}_{ic}$ on $\bar{g}_{-ic}$ (equation 6), where σ_c^2 is the variance of the country effect, σ_e^2 is the variance of the iid error term, σ_μ^2 is the variance of the leader effect. [16] We use the notation T_i as the tenure of this leader, in case it is different from the average tenure of other leaders in the country (T).

$$(6)\quad \hat{\gamma} = \frac{E(\bar{g}_{ic}\bar{g}_{-ic})}{E(\bar{g}_{-ic}{}^2)} = \frac{\sigma_c^2}{\sigma_c^2 + \frac{\sigma_e^2}{N-T_i} + \frac{\sigma_\mu^2 T}{N-T_i}}$$

If σ_c^2=0 then $\hat{\gamma} = 0$, then the *adjusted* leader growth average is just the leader growth average - there is no need to adjust for country effects when there aren't any. In contrast, when $\sigma_e^2 = \sigma_\mu^2$=0, then the average growth rate under *other* leaders is a perfect signal of the size of the country effect μ_c and so $\hat{\gamma} = 1$. $\hat{\gamma}$ is also close to one if (i) there is a long sample for the country (a large N) which smooths out the iid noise and (ii) the country sample size (N) is long relative to the tenure of an individual leader (T_i), so that the other leader effects even out. If $\hat{\gamma} \approx 1$ then we subtract the full *other* leader average from the leader average. In countries where growth was high under other leaders, the model will attribute most of this to the country effect and adjust the leader growth average downwards.

$$(7)\quad \hat{\psi} = \frac{E\left[\mu_i(\bar{g}_{ic} - \hat{\gamma}\bar{g}_{-ic})\right]}{E((\bar{g}_{ic} - \hat{\gamma}\bar{g}_{-ic})^2)} = \frac{\sigma_\mu^2}{\sigma_c^2(1-\hat{\gamma}) + \sigma_\mu^2 + \frac{\sigma_e^2}{T_i}}$$

The estimate of the *reliability/scaling factor* is given by Equation (7), which is the weight applied to the adjusted leader growth average ($\bar{g}_{ic} - \gamma\bar{g}_{-ic}$). One can see that if $\sigma_c^2 = \sigma_e^2 = 0$, then $\hat{\psi}$ =1 and the best estimate of the leader effect μ_i is $\bar{g}_{ic}$ --- the average is a perfect signal of the leader's effect on growth.

However, if $\sigma_e^2 > 0$ then the optimal reliability factor $\hat{\psi}$ <1 because the leader growth average includes noise due to the idiosyncratic shocks to growth ε_{it}. $\hat{\psi}$ will be especially small due to the iid error if (i) leaders have a short tenure (small T_i), or if (ii) σ_ε^2 tends to be large. We will see that (ii) is the case more in autocratic than in

[15] $\psi = \beta_1$ and $\beta_2 = -\gamma\psi$

[16] This is not by construction, but because $E(\mu_i\bar{g}_{-ic}) = 0$.

democratic countries. For leaders with a long tenure, these random errors even out over time meaning the leader growth average is more informative of the true leader growth effect.

The reliability factor $\hat{\psi}$ will also be small in the case that the country effect σ_c^2 is large *and* we are not able to control for it by subtracting for the *other* leaders' average because $\hat{\gamma} << 1$. This might be case if there the sample of other leaders is small (N-T_i is small). In the rest of the paper, we estimate the variance components of Equations (6) and (7) and make our best estimate of the contribution of each leader to growth.

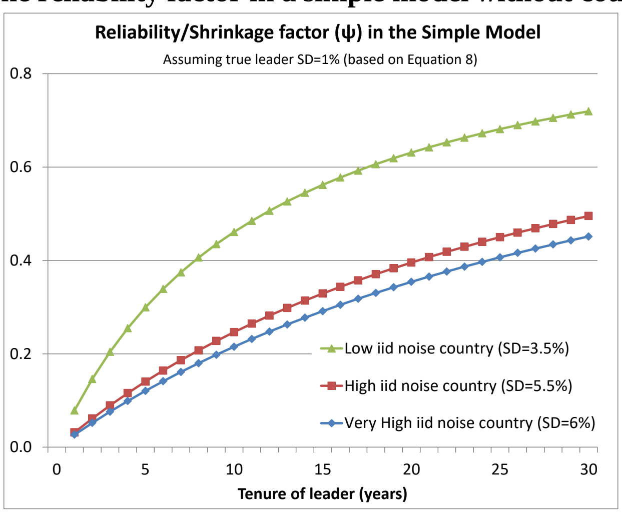
<u>The reliability factor in a simple model without country effects</u>

In our full model (Section 6) the most important drivers of the reliability/shrinkage factor are the variance of iid noise and the length of leader tenure. To illustrate this, we assume that the *unobservable* standard deviation of the leader effect is 1% across all leaders (similar to results in Section 5), and there are no country effects ($\sigma_c^2 = 0$), which means that Equation 7 can be applied directly to leader growth average, and simplifies to:

$$(8) \quad \hat{\psi}_{Simple} = \frac{\sigma_\mu^2}{\sigma_\mu^2 + \sigma_e^2 \; / T_i}$$

In Figure 1 we plot the reliability factor vs leader tenure for low iid error variance (σ_e =3.5%) and high iid error variance (σ_e =5.5%), and very high iid error variance (σ_e =6%) . One can see that, in general, the average growth rate during a leader's tenure is relatively uninformative about the size of the true (but unobservable) leader effect μ_i (a low reliability factor ψ). However, it is much less informative for very high iid error countries than lower iid error countries. For example, for a leader of 5 years tenure (close to the average), the reliability factor is *two and a half times larger* in the low iid noise countries than in very high iid noise countries, with a reliability estimate of around 0.12 in the later. We'll see that autocracies tend to have much more noisy growth processes (very high SD of around 6%) than democracies (low SD around 3.5%), which why the average growth rate under autocrats a particularly *unreliable* estimate of the true leader contribution (pooling across leaders has a iid noise SD of around 5.5%). This is particularly true for autocrats with short tenures. Country effects (included in the full model in Section 6), reduce reliability estimates for leaders with very long tenures because it becomes hard to distinguish between the contribution of the leader and the contribution of the country.

Figure 1: The reliability factor in a simple model without country effects



Section 2: Data and data quality (or lack thereof)

Section 2.1: Data Sources

In order to estimate the size of leader effects we need data on leaders, growth and a measure of whether each country is a Democracy or Autocracy. To make sure that our results are robust across methods, we use multiple measures of leaders and growth.

Data on who are the leaders in power is taken from the Jones and Olken (2005) and Archigos 2.9 datasets (Goemans et al 2009). In the body of the paper we report findings using the Jones and Olken dataset (henceforth JO) dataset, but replicate many of the calculations using the Archigos dataset in the Appendix.[17] For most leaders and countries the datasets overlap, though the Archigos dataset generally has a wider coverage of countries and periods. Following Jones and Olken (2005), we use the log growth rate: $\ln(Y_t)- \ln(Y_{t-1})$, where Y_t is real per capita GDP. This measure has the convenient property that the antilog of the average log growth over a given period is equal to the compound growth rate over that period.

We use data on growth from four sources: the Penn World Tables (PWT) versions 7.1 (the latest at time of the first draft of this work; Heston et al 2012), version 6.1 (used by Jones and Olken 2005; Heston et al 2002), Angus Maddison's (MAD) growth series and real per capita GDP growth (constant local currency) from the World Bank's World Development Indicators (WDI). See the Appendix for further details.

Democracies are defined as countries with an average Polity IV score >8. This is somewhat stricter than the Polity>0 score used by Jones and Olken (2005) and others in the political science literature, but is only slightly stricter than the 6-10 range recommended in the Polity IV documentation. We choose the higher cutoff to minimize transitions in and out of democracy that occur with a lower cutoff.

Section 2.2: Descriptive Statistics

After dropping some outliers (see next subsection) we have 112 countries for which we have growth, leader and polity data (129 for Archigos), of these about 20% are democracies (see Appendix Table 1B for the full listing). The sample is 1950-2000 to be consistent with Jones and Olken (2005), except for WDI which starts in 1961.

Table 2 shows the basic descriptive statistics of the JO dataset (Appendix Table 2 shows the corresponding statistics for Archigos). We have around 4000-5000 observations and 600-800 leaders. Average per capita growth is about 1.8% per annum, and is higher on average in democracies than autocracies. As pointed out in the previous section, the unconditional variance of growth is much higher for autocratic countries than democratic ones.

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[17] JO and Archigos leader-country-year structures are almost identical for Monte Carlo simulations, so we only report JO.

Table 2: Growth Descriptive Statistics (JO leaders)					
	A. All				
	Mean	SD	Obs	Leaders	Tenure
PWT 7.1	1.85%	5.7%	4794	825	5.8
PWT 6.1	1.80%	5.7%	4762	820	5.8
Maddison	1.80%	4.9%	4759	804	5.9
WDI	1.71%	5.0%	3860	662	5.8
	B. Democracies				
	Mean	SD	Obs	Leaders	Tenure
PWT 7.1	2.5%	3.7%	1220	275	4.4
PWT 6.1	2.6%	3.6%	1218	274	4.4
Maddison	2.7%	3.1%	1139	253	4.5
WDI	2.4%	3.0%	906	204	4.4
	C. Autocracies				
	Mean	SD	Obs	Leaders	Tenure
PWT 7.1	1.6%	6.2%	3574	550	6.5
PWT 6.1	1.5%	6.3%	3544	546	6.5
Maddison	1.5%	5.3%	3620	551	6.6
WDI	1.5%	5.4%	2954	458	6.4

Section 2.2 Outliers

Per capita growth rates are often very volatile and a small number of observations can have a large effect on estimated results. Intuitively, this is because the importance of the observation increases with the square of its size. Other things equal, a growth observation 5 percentage points above the mean has 100 times the weight of one 0.5 percentage points above the mean. Things get worse for very extreme observations: a growth rate 50 percentage points above the mean has 10000 times the weight of one 0.5% above the mean. These extreme observations do exist, for example, for countries entering or exiting civil wars. By this logic, a couple of coincidental leader transitions around times of civil wars or other extraordinary events can completely change our results, and overturn the evidence of thousands of other observations.[18]

We take a very conservative definition of outliers – log growth of more than 40% (in absolute value) in particular year – and drop these from our main results. There are only around 6 outliers per dataset for the 3000-4000 observations (10 for Archigos). The individual observations dropped are listed in Appendix Table 1A.

Two aspects of the outliers are striking. First is the number of extreme observations that coincide with wars. Some of the largest outliers include in Iraq during the gulf war of 1991, the Rwandan genocide of 1994 (and rebound in 1995), the Lebanese civil war in the late 1970s and early 1980s and the first Liberian civil war around the early 1990s (and rebound in 1997 with peace). The second striking fact is the level of disagreement about growth rates during these periods: the average difference between the maximum and minimum growth rates in each year across the four datasets is 42%! This reflects the difficulty of measuring the change in per capita output during extreme times like civil war or genocide, and further justifies dropping them from the dataset.

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[18] Moreover, in the Monte Carlo simulations, we model log growth rates as a being normally distributed, which is a bad assumption if the tails are too fat.

Section 3: Best and worst leaders (an aside on poor quality data)

Apart from the statistical and conceptual issues discussed in the rest of this paper, one reason to be wary of results concerning leaders and growth is that measures of growth vary across dataset, often substantially. Johnson et al (2013) provide numerous examples of large changes in growth rates across versions of the Penn World Tables, which often changes the results of key papers.

One of the papers they examine is Jones and Olken (2005) using PWT 6.2 or PWT 7 (JO used PWT6.1). In all versions they find a significant leader effect, but using PWT 6.2 this was driven by *democrats* rather than autocrats, but using PWT 7.0 both autocratic and democratic leaders transitions have a significant effect on growth.

The problem is even for the *same* leader, the average growth rates vary substantially across sources. Consider a policymaker who asked four researchers to bring them a list of the best 5% of leaders (leaders with the highest average growth rate during their tenure). Each researcher choses a different dataset from one of the four used in this paper. How much would their lists overlap? The answer: not that much.

Table 3A the list of the best of leaders by each of the measures.[19] The cutoff to be a "benevolent leader" varies slightly across datasets, but is around 6% - which seems unofficially to be regarded as "miracle" growth rate in policy circles. Of the 36 "best" leaders, it turns out that only around a quarter are common to all four datasets. Moreover, the average number of datasets in which each "benevolent leader" appears is only 2.3. Even some of the most famous benevolent leaders are not universally recognized as such – the average growth rate under Deng Xiaoping is a whisker under 6% according to PWT6.1 and Lee Kwan Yew records an average growth rate of around 5.6% for PWT7.1 – both marginally under the cutoffs. The fact that even these celebrity leaders sometimes miss out on the top 5% reflects the error rate of growth measurement under different leaders.

Unfortunately we can't be much more confident about the worst leaders either (listed in Table 3B). Only around 20% of the worst leaders are listed in all four datasets, and the worst leaders are only in 2.2 datasets. Results using the Archigos dataset are similar and are presented in the Appendix (Appendix Table 3A-3B).

We will not use further these discrepancies between datasets on individual leaders in the results below. We will just note that even when we find a strong effect for a particular leader in a particular dataset, there is some uncertainty because a different dataset would have given a different verdict on that leader.

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[19] We drop leaders with tenure of 3 years of less to more accurately measure average growth under each leader.

Table 3A: Best leaders (1 if average growth in top 5% of outcomes) (JO leaders)						
Leader name and country	**ISO code**	**PWT 6.1**	**PWT 7.1**	**Maddison**	**WDI**	**Count**
Raab Julius	AUT	1	1	1	0	3
Kubitschek Juscelino	BRA	0	1	0	1	2
Medici Emilio	BRA	1	1	1	1	4
Khama Sir Seretse	BWA	1	1	1	1	4
Aylwin (Azocar) Patricio	CHL	1	1	1	1	4
Xiaoping Deng	CHN	0	1	1	1	3
Fernandez Reyna Leonel Antonio	DOM	1	0	1	0	2
Rodriguez (Lara) Guillermo	ECU	1	1	0	1	3
Mba Leon	GAB	1	0	0	0	1
Obiang Nguema Mbasongo Teodoro	GNQ	0	0	1	1	2
Pavlos I	GRC	0	0	0	1	1
Papadopoulos Georgios Christou	GRC	1	1	1	1	4
Preval Rene Garcia	HTI	1	0	0	0	1
Bustamante William Alexander	JAM	0	0	1	0	1
Shearer Hugh Lawson	JAM	1	0	0	1	2
Ikeda Hayato	JPN	1	1	1	1	4
Sato Eisaku	JPN	1	1	1	1	4
Chun Doo Hwan	KOR	1	1	1	1	4
Park Chung Hee	KOR	1	1	1	0	3
Roh Tae Woo	KOR	0	1	1	1	3
Muluzi Bakili	MWI	1	0	0	0	1
Razak Tun Abdul	MYS	0	1	0	0	1
Debayle Luis Anastasio Somoza	NIC	0	0	0	1	1
Mendez Marco Aurelio Robles	PAN	0	1	0	0	1
Caetano Marcello das Neves Alves	PRT	0	1	1	1	3
Salazar Antonio de Oliveira	PRT	0	0	0	1	1
Ceausescu Nicolae	ROM	1	0	0	0	1
Kagame Paul	RWA	1	0	0	1	2
Lee Kuan Yew	SGP	1	0	1	1	3
Margai Sir Milton	SLE	0	1	0	0	1
Grunitzky Nicolas	TGO	1	1	1	1	4
Thanarat Sarit	THA	0	0	1	0	1
Ching-Kuo Chiang	TWN	1	1	1	1	4
Kai-Shek Chiang	TWN	0	0	1	1	2
Teng-Hui Lee	TWN	0	0	0	1	1
Lacalle Luis	URY	0	1	0	0	1
Growth Cutoff (best leader)		6.06%	5.87%	5.48%	6.04%	
Number of leaders						**36**
Average number of datasets leader for which leader is in best 5%						**2.3**
Proportion of all “best” leaders (by at least one measure) for which all datasets agree						**25.0%**

Table 3B: Worst leaders (1 if average growth in worst 5% of outcomes) (JO Leaders)						
Leader name and country	**ISO code**	**PWT 6.1**	**PWT 7.1**	**Maddison**	**WDI**	**Count**
Yameogo Maurice	BFA	1	0	0	0	1
Rahman Sheikh Mujibur	BGD	0	1	1	1	3
Siles (Zuazo) Hernan	BOL	0	0	0	1	1
Kolingba Andre	CAF	1	1	1	0	3
Patasse Ange-Felix	CAF	1	0	0	0	1
Lissouba Pascal	COG	1	0	1	1	3
Odio Rodrigo Jose Ramon Carazo	CRI	1	1	1	1	4
Trujillo y Molina Rafael Leonidas	DOM	0	0	0	1	1
Acheampong Ignatius Kuti	GHA	1	0	0	0	1
Cordova Roberto Suazo	HND	0	1	0	0	1
Khomeini Ayatollah Sayyed Ruhollah Mousavi	IRN	1	1	1	1	4
Manley Michael Norman	JAM	0	0	0	1	1
Hurtado Miguel de la Madrid	MEX	0	1	0	0	1
Keita Modibo	MLI	1	1	0	0	2
Machel Samora	MOZ	1	1	1	1	4
Haidalla Mohamed Khouna Ould	MRT	1	0	1	0	2
Kountche Seyni	NER	0	1	0	0	1
Obasanjo Olusegun	NGA	0	1	0	0	1
Shagari Alhaji Shehu	NGA	1	1	1	1	4
Chamorro Violeta Barrios de	NIC	1	0	0	0	1
Saavedra Jose Daniel Ortega	NIC	1	0	1	1	3
Morena Manuel Antonio Noriega	PAN	0	0	1	1	2
Garcia (Perez) Alan	PER	1	1	1	1	4
Constantinescu Emil	ROM	1	0	1	0	2
Iliescu Ion	ROM	0	0	1	0	1
Momoh Joseph Saidu	SLE	0	1	1	1	3
Strasser Valentine	SLE	0	1	1	0	2
Fuentes Jose Napoleon Duarte	SLV	0	0	0	1	1
Malloum Felix	TCD	0	1	1	1	3
Chambers George Michael	TTO	0	1	1	1	3
Manning Patrick Augustus Mervyn	TTO	1	0	0	0	1
Robinson Arthur Napoleon Raymond	TTO	0	1	0	0	1
Obote Apollo Milton	UGA	0	0	0	1	1
Alvarez (Armelino) Gregorio	URY	1	1	1	1	4
Herrera (Campins) Luis	VEN	1	1	1	1	4
al-Hashidi Ali 'Abd Allah Saleh	YEM	1	0	0	0	1
Seko Mobutu Sese (Joseph)	ZAR	1	1	1	1	4
Growth Cutoff (worst leader)		-2.85%	-2.19%	-2.35%	-2.55%	
Number leaders						**37**
Average number of datasets leader for which leader is in worst 5%						**2.2**
Proportion of all “worst” leaders (by at least one measure) for which all datasets agree						**21.6%**

Section 4: Econometric methodology and Monte-Carlo Results

Section 4.1: Estimates of variance components

In order to produce our own least-squares estimate of leader *i* on growth $\hat{\mu}_i = \hat{\psi}(\bar{g}_{ic} - \hat{\gamma}\bar{g}_{-ic})$ we need to calculate $\hat{\gamma}$ and $\hat{\psi}$, which depend on estimates of the variance components σ_c^2, σ_μ^2, σ_ε^2.[20] Moreover, σ_μ^2 is of general interest, because it measures how much leaders affect growth in general, even if we can't observe leader effects. Intuitively, if there is a lot of variance of growth *between* leaders then σ_μ^2 will be large, whereas if there is a lot of variation in growth *within* leader terms, then σ_ε^2 should be large – but it is not as straightforward as that.

Estimating the size of the leader effect (σ_μ)

The difficulty of estimating σ_μ^2 has been long recognized in the random effects panel literature, where estimates of σ_μ^2 and σ_ε^2 are needed to perform Generalized Least Squares. Baltagi (2005 p16) shows that $\hat{\sigma}_\mu^2$ can be backed out from the estimates using Equation (9) where $\hat{\sigma}_\varepsilon^2$ and $\hat{\sigma}_{\mu 1}^2$ can be estimated using standard variance formulas in Equation (10) and (11) (formulas provided for balanced panels).

(9) $$\hat{\sigma}_\mu^2 = \hat{\sigma}_{\mu 1}^2 - \hat{\sigma}_\varepsilon^2 / T$$

(10) $$\hat{\sigma}_{\mu 1}^2 = \left[\frac{1}{N} \sum_{i=1}^{N} (\bar{g}_i - \bar{g})^2 \right]$$

(11) $$\hat{\sigma}_\varepsilon^2 = \frac{1}{N_L (T-1)} \sum_{i-1}^{N_L} \sum_{t=1}^{T} (g_{it} - \bar{g}_i)^2$$

It is possible for $\hat{\sigma}_{\mu 1}^2$ to be negative if $\hat{\sigma}_{\mu 1}^2$ is small and so the estimator replaces negative estimates with zero (i.e. $\hat{\sigma}_\mu^2 = \max(0, \hat{\sigma}_{\mu 1}^2 - \hat{\sigma}_\varepsilon^2 / T)$), with the Monte Carlo studies finding this not being a serious problem (Baltagi 2005 p18).

We use two variations of Equation (9) to generate feasible estimates of the true leader effects $\hat{\sigma}_\mu^2$: the first is Stata's default for random effects (which we label RE), and the second is similar but includes a small sample correction for unbalanced panels (which we label SA) from Baltagi and Chang (1994).[21] Our panel of leaders is very unbalanced, and so the SA method is usually preferred. The methods are identical for balanced panels.

One way that we *cannot* calculate the variation of leader effects is just by calculating the standard deviation of the leader growth average, as in Equation 10 – and as reported when the `xtreg, fe` command is used in Stata. One of the main points of this paper is that this only weakly informative about the true leader effect because the presence

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[20] This is combined with the tenure of different leaders, as well as average growth rates, which are observable directly in the data.

[21] Both of these methods use Swamy-Arora's approach to calculate residuals, which involves calculating $\hat{\sigma}_\varepsilon^2$ and $\hat{\sigma}_{\mu 1}^2$ using the residuals from two regressions: $\hat{\sigma}_\varepsilon^2$ is calculated from the residuals of a within regression (only time variation) and $\hat{\sigma}_{\mu 1}^2$ is calculated using a between regression (only cross-sectional variation). Baltagi and Chang (1994) show their unbalanced panel small sample adjustment show performs well in Monte Carlo simulations. The methods are implemented in Stata using xtreg, re (default) and xtreg, sa (with unbalanced panel correction). See the Stata manual, Baltagi (2005) and Baltagi and Chang (1994 for further details).

of iid noise only averages out slowly, which means that the variance of the average growth rates will be substantially biased upwards as a measure of leader quality variation, as in Equation (12).

$$E\hat{\sigma}_1^2 = \sigma_\mu^2 + \frac{\sigma_\varepsilon^2}{T} > \sigma_\mu^2 \qquad (12)$$

Estimating the size of the other variance components (σ_ε^2 and σ_c^2)

We also need to estimate the size of the iid error and the country effect.[22] The country effect is estimated (in the full model) by adding country dummy variables to the random effects regression, and then calculating their variance (in the simple model there is no country effect). In principle, this has the same upwards bias problem as estimating the variance of leader effects due to the averaging of the iid error. However in practice the average sample length for a country is around 10 times that for a leader, and so the size of the bias is much smaller (we verify this via Monte Carlo simulation). Being very large, the size of the iid error is estimated well in almost all simulations.

Monte Carlo verification of variance components estimates

To evaluate the performance of the methodology we perform a Monte Carlo simulation of annual growth rates as of Equation 1 (Table 4.1), with either real or nonexistent country effects.[23] In each iteration we draw a leader effect (μ_i), a country effect (μ_c equal zero if there are no country effect), and an iid error (ε_{ct}) from a normal distribution to generate growth data, combined with the actual leadership structure from the Jones and Olken's (2005) leaders dataset. In panel A, we estimate a simple model without any country dummies, and in Panel B we estimate the full model with country dummies.[24]

Table 4.1: Monte Carlo Estimates of Variance Components (True: sd(leader)=1.5%, sd(iid)=5%, JO leaders)

	Panel A: Simple Model (no country dummies)				**Panel B: Full Model (with country dummies)**					
	SA-Method		**RE-Method**		**SA-Method**			**RE-Method**		
	SD(leader)	**sd(iid)**	**SD(leader)**	**sd(iid)**	**SD(leader)**	**sd(iid)**	**sd(CE)**	**SD(leader)**	**sd(iid)**	**sd(CE)**
No Country Effects	1.50%	5.00%	1.47%	5.00%	1.85%	5.00%	1.11%	1.57%	5.00%	1.11%
True sd(CE)=0	[0.12%]	[0.05%]	[0.26%]	[0.05%]	[0.14%]	[0.05%]	[0.08%]	[0.26%]	[0.05%]	[0.08%]
Country Effect Pvalue:*							78.56%			55.05%
With Country Effects	2.11%	5.00%	2.09%	5.00%	1.85%	5.00%	1.86%	1.56%	5.00%	1.86%
True sd(CE)=1.5%	[0.13%]	[0.06%]	[0.22%]	[0.06%]	[0.14%]	[0.06%]	[0.13%]	[0.26%]	[0.06%]	[0.13%]
Country Effect Pvalue:*							0.00%			0.00%

Note: Mean of 500 replications (std dev in brackets[]). * P-value of test country effects (CE)=0

Simple Model

In a world *without* country effects, both simple methods (SA and RE) estimate leader effects very accurately (close to the true 1.5%), though SA has a lower standard error across repetitions. In a world *with* country effects,

[22] In earlier drafts of this paper we also controlled for serial correlation in the error term, but it turned out to be difficult to estimate and distinguish from country effects.

[23] In all Monte Carlo simulations we assume that idiosyncratic and leader effects (and hence log growth) are normally distributed. This is a convenient assumption given the ease of drawing from a normal, and that a normal distribution is defined by only two parameters (mean and SD). Unfortunately, as Figure A2 (in the Appendix for the Jones-Olken dataset) shows, the data have excess kurtosis relative to a normal (the normal has the same mean and SD as PWT6.1 growth). Tests reject normality for all the dataset based on both skewness and kurtosis. An interesting extension for future work would be to draw data from a mixture of normals in the Monte Carlo to match these higher-order moments.

[24] Results are almost identical using the Archigos structure of leader tenure (not reported).

both SA and RE in the simple model (Panel A) are biased upward by about 0.6ppts, as they confuse a high country effect for a string of good leaders. All methods estimate σ_ε very accurately.

Full Model

When we add country dummies (to pick up country effects), the estimates of leader effect (σ_μ) are more accurate than the simple model if there really are country effects, but less accurate if there are no true country effects. In addition, the RE method is more accurate than the SA method. For the full model and RE method, the leader SD (σ_μ) estimate of 1.57% is close to the true leader SD of 1.5%. The full model SA method performs substantially worse, with a leader SD (σ_μ) estimate of 1.85%. Note however, that both methods are biased *upwards*, and so we should be more confident we are not underestimating the true leader SD. Despite the higher accuracy of the full model RE over SA in Monte Carlo simulations, when applied to data in the following section the RE method generates drastically low estimates of the leader SD, and so we check both estimates.

The full model's country effects estimates are only slightly biased if there really are country effects, and tests for country effects perform well. With a true SD (country effects) of 1.5%, the models produced SD(country effect) estimates of around 1.85%. Although the full model produced estimates of country effects of 1.1% when there were no country effects, tests for country effects performed well: with a p-value of 0 when there were country effects and a p-value 0.8 when there were no country effects. As such, we can only use the full model in the case with significant country effects, which reduces the size of potential biases.

Section 4.2: Estimates of Least-Squares Leader Effects

Monte Carlo simulations suggest that our least-squares estimates of leader effects are unbiased and have a root mean squared error of around 1% (Table 4.2). The fifth column of Table 4.2 reports estimates of λ from a regression of the true leader effect μ_i on the least-squares leader estimate $\hat{\mu}_i$ using simulated data as in Equation 13 (which is why we can observe μ_i).[25] If $\lambda = 1$, then our estimates are unbiased. One can see that in both models (with and without country effects), the Monte Carlo estimates of λ are close to one.

$$(13) \qquad \mu_i = \lambda \hat{\mu}_i + e_i \quad \text{where} \quad \hat{\mu}_i = \hat{\psi}(\bar{g}_{ic} - \hat{\gamma}\bar{g}_{-ic})$$

The estimates of Root Mean Squared Error for each estimated leader effect (Equation 14, where L is the number of leaders) are in the final column of Table 4.2 and are around 1%. It is worth noting that even though this is the minimum error as described in Section 1, there is still a reasonable amount of uncertainty about the accuracy of leader effect estimates for individual leaders. This means if the leader effect estimate is small, we are really not able to rule out that it may be zero.

$$(14) \qquad RMSE = \sqrt{\frac{1}{L}\sum_{i=1..L}\left(\mu_i - \hat{\psi}(\bar{g}_{ic} - \hat{\gamma}\bar{g}_{-ic})\right)^2}$$

The first four columns of Table 4.2 report reliability parameters (ψ) and average adjustment (γ) parameters used to generate these mean estimates. The third column shows the estimates of γ, the degree to which we adjust leader growth averages for the performance of other leaders in the same country. γ averages around 0.7 across leaders in the model with country effects. This estimate varies across leaders (with a standard deviation of around 0.1) due to variation in the cumulative tenure of other leaders in the same country (and the average tenure of the other

[25] We estimate without a constant, because all data had been demeaned initially.

leaders). As expected, γ=0 in the model without country effects. The first column of Table 4.2 shows the average of ψ (calculated from the true variance components) across leaders, which is around 0.29 in the model without country effects, and 0.25 in the model with country effects using the same "true" parameters as is Table 4.1.[26] This estimate varies substantially across leaders, with a standard deviation of around 0.14-0.18 – mostly because of different tenures and varying estimates of γ.

Table 4.2: Monte Carlo Estimates of Leader Effects (500 reps)

	PSI Mean*	PSI (SD)*	GAMMA Mean*	GAMMA (SD)*	Unbiased^	RMSE
No CE	0.29	0.18	0.00	0.00	1.00	1.10%
					[0.05]	[0.03%]
With CE	0.25	0.14	0.70	0.10	0.98	1.18%
					[0.06]	[0.04%]

Notes: Calculated using the actual leader dataset and SD(leader)=sd(CE)=1.5%, sd(iid)=5%.
* Mean and SD across leaders (does not change with draws of growth). ^ Unbiased =1

Section 5: Estimates of variance components

We now begin estimating leader variance components using the real data. These are not the *observed* least-squares leader effects that we can calculate for each leader in the data, but rather standard deviations of *unobserved* variables μ_i, μ_c, ε_{ict} in the variance components model of growth in Equation (1). The variance components calculated in this section (and in Table 5.1) are mostly of interest as a building block for the calculation of the reliability statistic and least squares leader estimates in Section 6, though have some secondary importance as parameters in their own right. We feel that one can only really claim that leaders are important for growth if one can distinguish the good-for-growth leaders from the rest. The SD of the leader component (SD(μ_i)) measures the underlying variation in the distribution of leader quality (each leader then draws a quality from this distribution). The standard deviation of the least squares leader estimate (SD($\hat{\mu}_i$)) (to be discussed in the next section) measures the variation in estimated effects on growth of individual leaders in the data (which also depends on other leader-specific variables like tenure).

Using the SA method, the unobserved leader component is estimated to have SD of 1-1.75% ($\hat{\sigma}_\mu$), depending on the specification, dataset and leader type (Table 5.1, Panel A). In Section 6 we use the shaded estimates of the leader variance component (from PWT7.1 – SD= 1% overall, SD= 1.4% for democrats and SD= 1.2% for autocrats) to calculate our reliability factors for the least squares leader effect estimates. The numbers in Table 5.1 Panel A (SA method) are for the full model (including country dummies) using Baltagi and Chang (1994) random effects estimator, adjusted for unbalanced panels. Note that these estimates are imprecise – country-level block bootstrap standard errors (in brackets) are usually around 0.4%.[27] Analogous estimates using the Archigos leader dataset are presented in the Appendix. For autocracies (democracies), the Archigos SA estimates of the leader SD are often slightly higher (lower), though not uniformly so.

Using the RE method, estimates of the unobserved leader quality SD ($\hat{\sigma}_\mu$) are zero for autocrats (and overall). The reason for this corner solution is the leader SD estimate is backed out from the difference between the

[26] The true variance components and leader structure do not change across Monte Carlo draws of the growth process, which is why there are no standard errors in the first four columns of Table 4.2.

[27] Estimates are quite close to mean of the bootstrap distribution.

variance of the leader growth average and the adjusted noise (Equation 9). When the difference is negative, the model reports a zero, even if it is just the case that the leader growth average is small and measured with much noise. We interpret them as a small unobserved leader SD rather than literally zero. We also note that the more accurate measure of the unobserved leader SD in Monte Carlo simulations was the RE. Analogous estimates of the leader SD using the Archigos dataset (in the appendix) are zero for two of the four datasets for democracies and autocracies.

Taken together, our results suggest there is little strong evidence in favor of a larger underlying unobserved leader SD for autocrats than for democrats--- and the autocratic unobserved leader effects might even be smaller than democratic leader effects. This contradicts the consensus that autocratic leaders have more effect on growth in general, even if they are a "risky bet". With the SA methodology, the unobserved leader effects are slightly more variable across democratic leaders in PWT7.1, but slightly more variable across autocrats in the other three datasets. But even in this later case, the estimates are well within one bootstrap standard error, and so they should be interpreted as being approximately the same. With the RE methodology, the democratic leader effects are always larger - and by a significant margin – because the autocratic leader SD is zero. As mentioned above, we interpret these results as a small unobserved autocratic leader SD, and not one that is exactly zero. This result is consistent with unobserved autocratic leaders' SD being less than that of democratic leaders' SD.

Table 5.1: Estimates of Variance Components in the data (JO Leaders)

	Pooled				Democrats				Autocrats			
	SD(leader)	sd(iid)	sd(CE)	pval(CE)	SD(leader)	sd(iid)	sd(CE)	pval(CE)	SD(leader)	sd(iid)	sd(CE)	pval(CE)
					Panel A: SA Method							
PWT71	**1.03%**	**5.53%**	**1.65%**	0.00%	**1.43%**	**3.42%**	**0.92%**	5.56%	**1.21%**	**6.04%**	**1.76%**	0.00%
	[0.43%]	[0.24%]	[0.14%]		[0.31%]	[0.28%]	[0.14%]		[0.46%]	[0.27%]	[0.17%]	
PWT61	1.41%	5.53%	1.52%	0.00%	1.22%	3.33%	0.74%	2.06%	1.76%	6.06%	1.60%	0.00%
	[0.40%]	[0.27%]	[0.13%]		[0.28%]	[0.30%]	[0.10%]		[0.44%]	[0.30%]	[0.15%]	
MAD	1.41%	4.58%	1.68%	0.00%	1.38%	2.72%	0.86%	0.48%	1.59%	4.99%	1.74%	0.00%
	[0.23%]	[0.22%]	[0.14%]		[0.25%]	[0.21%]	[0.11%]		[0.23%]	[0.24%]	[0.17%]	
WDI	1.52%	4.70%	1.71%	0.00%	1.39%	2.69%	0.94%	7.31%	1.74%	5.13%	1.84%	0.00%
	[0.24%]	[0.22%]	[0.13%]		[0.25%]	[0.19%]	[0.17%]		[0.27%]	[0.24%]	[0.16%]	
					Panel B: RE Method							
PWT71	0.00%	5.53%	1.65%	0.00%	1.41%	3.42%	0.92%	5.06%	0.00%	6.04%	1.76%	0.00%
	[0.12%]	[0.24%]	[0.13%]		[0.41%]	[0.28%]	[0.13%]		[0.15%]	[0.27%]	[0.17%]	
PWT61	0.00%	5.53%	1.53%	0.00%	0.98%	3.33%	0.74%	0.41%	0.00%	6.06%	1.62%	0.00%
	[0.29%]	[0.27%]	[0.13%]		[0.45%]	[0.30%]	[0.10%]		[0.55%]	[0.31%]	[0.15%]	
MAD	0.00%	4.58%	1.67%	0.00%	1.16%	2.72%	0.86%	0.07%	0.00%	4.99%	1.74%	0.00%
	[0.38%]	[0.22%]	[0.14%]		[0.35%]	[0.21%]	[0.11%]		[0.51%]	[0.24%]	[0.17%]	
WDI	0.00%	4.70%	1.73%	0.00%	1.06%	2.69%	0.92%	1.30%	0.00%	5.13%	1.86%	0.00%
	[0.31%]	[0.22%]	[0.14%]		[0.34%]	[0.19%]	[0.16%]		[0.48%]	[0.24%]	[0.17%]	

Note: shaded numbers are used for the least-squares individual leader effect calcs. Bootstrap SE in brackets (500 reps)

Country effects and iid errors

For the pooled sample and autocracies, we find that standard deviation of the unobserved country component σ_c are statistically significant and around 1.5%-1.8%. For this group, the p-value is almost zero on the test for country effects (recall that in Monte Carlo simulations, this test was successfully able to detect the presence of country effects). Monte Carlo evidence also suggests that the SD of unobserved country component is slightly upward biased - conditional on there actually being country effects, which we have established - so we would expect the estimates here to be an upper bound. For democracies, the p-value of the test varies a bit across datasets, but is always significant at the 10% level, and is usually significant at the 5% level. The estimates of the SD country effect are much smaller – between 0.75% and 1% - which is consistent with greater homogeneity of democracies compared to autocracies.[28]

As previewed earlier, year-to-year growth variation (the iid error component) is much more noisy in autocracies than democracies, which drives many of our results. For autocracies, the SD of the iid error is around 5-6%, depending on the dataset, as compared to 2.7%-3.4% in democracies. Overall the sample is dominated by autocracies, so pooled estimates of SD of the iid error are around 4.5%-5.5%. These estimates were the ones used in the Monte Carlo simulations earlier in the paper.

Section 6: Least-squares estimates of the leader effects

Now that we have estimates of the variance components (from Table 5.1, Panel A using PWT 7.1 growth data), we can use them to produce estimates of the least squares leader effect $\hat{\mu}_i = \hat{\psi}(\overline{g}_{ic} - \hat{\gamma}\overline{g}_{-ic})$ for every national leader in our dataset using Equations (6) and (7). We choose the PWT7.1 SA estimates of the underlying leader quality SD –from which the actual leaders make unobserved draws -- as a baseline because they are in between those using the RE methodology (which are often zero), and other datasets using the SA methodology.[29] The least-squares leader effects we estimate in the data reflect how much growth we can attribute to a particular leader. The reliability factor (which is a function of tenure and the variance components), determines whether a high average growth rate is likely reflective of true leader quality (if there is a lot of variation in the unobserved underlying leader quality component), or whether it is likely to reflect more iid noise or country-specific factors.

Across the whole sample of around 800 leaders in the JO dataset, the standard deviation of the estimated least squares leader effect $\hat{\mu}_i$ is around 0.37%: around a tenth of the SD of the average growth rate during a leader's tenure (3.3%). This means the average growth rate under a leader is relatively uninformative about which leaders are "good" for growth and which leaders are "bad" for growth, and so the average growth rates are "shrunk" towards zero. This partly reflects the severe noise in average growth rates, especially for shorter tenures. However, even relatively long tenures are surprisingly uninformative for most leaders, in part because we then have the separate problem of distinguishing the leader effect from the country effect. Under some circumstances – high recorded growth under the leader relative to the country effect and a long tenure -- a strong estimated leader effect does emerge. Even then, regardless of tenure or recorded growth performance, no leader has an estimated least-squares leader effect $\hat{\mu}_i$ of more 2% in absolute value (demeaned).

The relation between the average growth rate under each leader (x-axis) and the least-squared leader effect (y-axis), is shown in Figure 2, Panel A (for leaders with a tenure of at least 3 years). If the average growth rate under each leader was perfectly informative about that leader's true quality, the dots representing leaders would line up exactly on the 45 degree diagonal (slope of 1). If they were completely uninformative about leader quality, the fitted line would be horizontal. One can see that, although the fitted line is slightly upward sloping, it is much flatter than the diagonal (slope=0.13).

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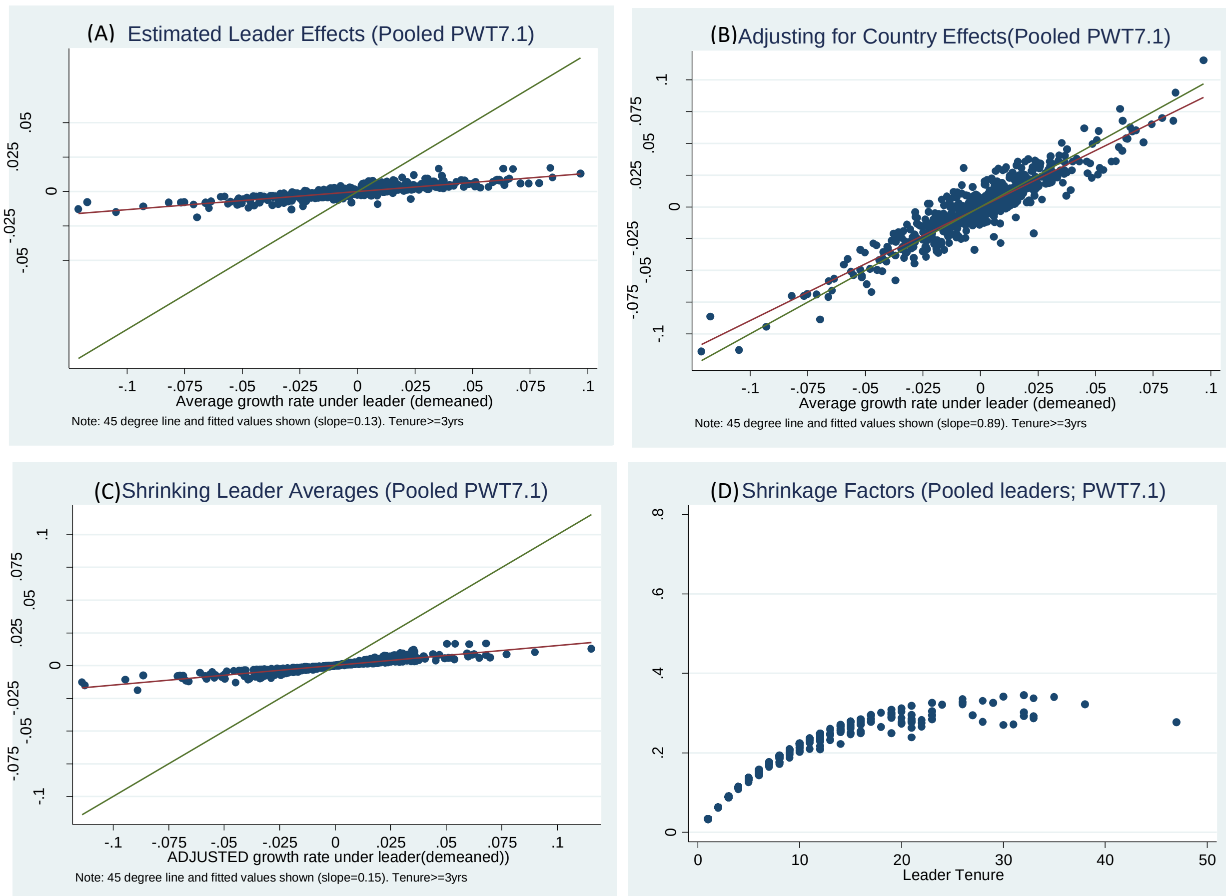
[28] As we showed in Section 4, the size of upward bias of country effects is larger when there are no true country effects. Consistent with the borderline p-values, it is possible that there are no true country effects for democracies, and the country effect SD of 0.75-1% is due to the upward bias. As such, these estimates should be treated with caution.

[29] See the Appendix for least squares leader estimates using the variance components from the WDI dataset and SA method.

Figure 2: Least Squares Leader Effect Estimates – Pooled Sample



For most leaders, the weak relationship between the average growth rate and the estimated least-squared leader effect $\hat{\mu}_i$ is mostly due to the small values of ψ (the reliability factor). The adjustment for country effects does not display large dampening effects. To see this, in Figure 2B we have plotted the *raw* leader growth average (x-axis) vs leader growth average adjusted for country effects (i.e. after subtracting $\hat{\gamma}\bar{g}_{-ic}$) on the y-axis.[30] The two are highly correlated, with a slope of 0.9, which is close to the 45 degree line, suggesting on average the country effect does not dampen much the leader effects. Note however that the adjustment for country effects is important in improving the fit for particular leaders -- for example there are leaders with a growth average which increases or decreases by 3ppts after adjustment for country effects. However, this adjustment is only weakly related to the size of the leader growth average and so does not systematically reduce the largest (in absolute value) leader effects.

Figure 2C plots the *adjusted* leader growth average on the x-axis (different from the unadjusted leader growth average in Figure 2A) vs the least squared leader estimate on the y-axis, with the ratio of the two representing the reliability factor ψ (this is similar to Figure 2A, but with a different x axis). The figure shows the higher *adjusted*

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[30] Note that the *adjusted* leader growth average can be higher or lower than the raw leader growth average, depending on whether other leaders had lower or higher (respectively average growth than the leader in question.

average growth rate is only weakly associated with an increase in the least squares leader effect (slope =0.15) due to a small average value of the reliability factor ψ.[31]

We plot the size of the reliability factor (ψ, y-axis) vs the tenure of the leader (x-axis) in Figure 2D. Leaders with a longer tenure have a much higher reliability factor, mostly because we can average out the iid error more. However, each extra year of tenure has successively less effect on the reliability factor.

Relative to the simple model (no country effects) example in Figure 1 (with high iid noise SD of 5.5%), the reliability factor in Figure 2D is similar for tenures of less than 10-15 years (which covers most leaders). However, the relationship between tenure and reliability in Figure 2D flattens out after 10-15 year tenures due to country effects, whereas the reliability estimate in Figure 1 keeps on rising.. The reason for the former is that tenure and γ are strongly negatively correlated (correlation coefficient of -0.75) because the longer a leader stays in office the less data we have about the performance of *other* leaders in the same country, which limits our ability to infer the size of the country effect. This means that no leader in our sample – even for those with long tenures – has a reliability factor greater than 0.35.

Democracies vs Autocracies

In the literature there is a consensus that autocrats have a larger effect on growth than democrats, in part because of their greater variability of personalities (tyrant through to benevolent autocrat), and in part because of fewer checks on their power (see literature review in the Introduction). In Table 6.1, we find the opposite: after adjusting for iid noise and country effects, there is actually more variation in estimated least squares leader effects $\hat{\mu}_i$ in democracies. We view the least-squares estimates of the leader effects as a more practical measure of the contribution of leaders (rather than the *unobservable* variation in leader quality process with SD estimated in Table 5.1): the claim that growth is due to a strong leader is only useful if we can identify those leaders.

Table 6.1: Estimated Leader effects in Democracies and Autocracies

	Democracies	Autocracies	Ratio (Aut/Dem)
SD(average growth under leader $\bar{g}_{ic}$)	2.7%	3.6%	1.33
SD(least squares leader effect $\hat{\mu}_i$)	0.82%	0.46%	0.56
Leaders	275	548	

Notes: Based on PWT7.1 data and JO leaders. Estimated separately for democrats & autocrats.

Like others in the literature, we find that the average growth rate is more variable under autocrats than democrats. In the first row of Table 6.1 we see that the standard deviation of the average growth rate under leaders in autocracies is a third higher than that in democracies.[32] However, most of this difference is because of either short-run noise or country-level factors. In the second row of Table 6.1 we calculate the standard deviation of the least-squares leader effects. The standard deviation is almost twice as large under democracies as autocracies.[33]

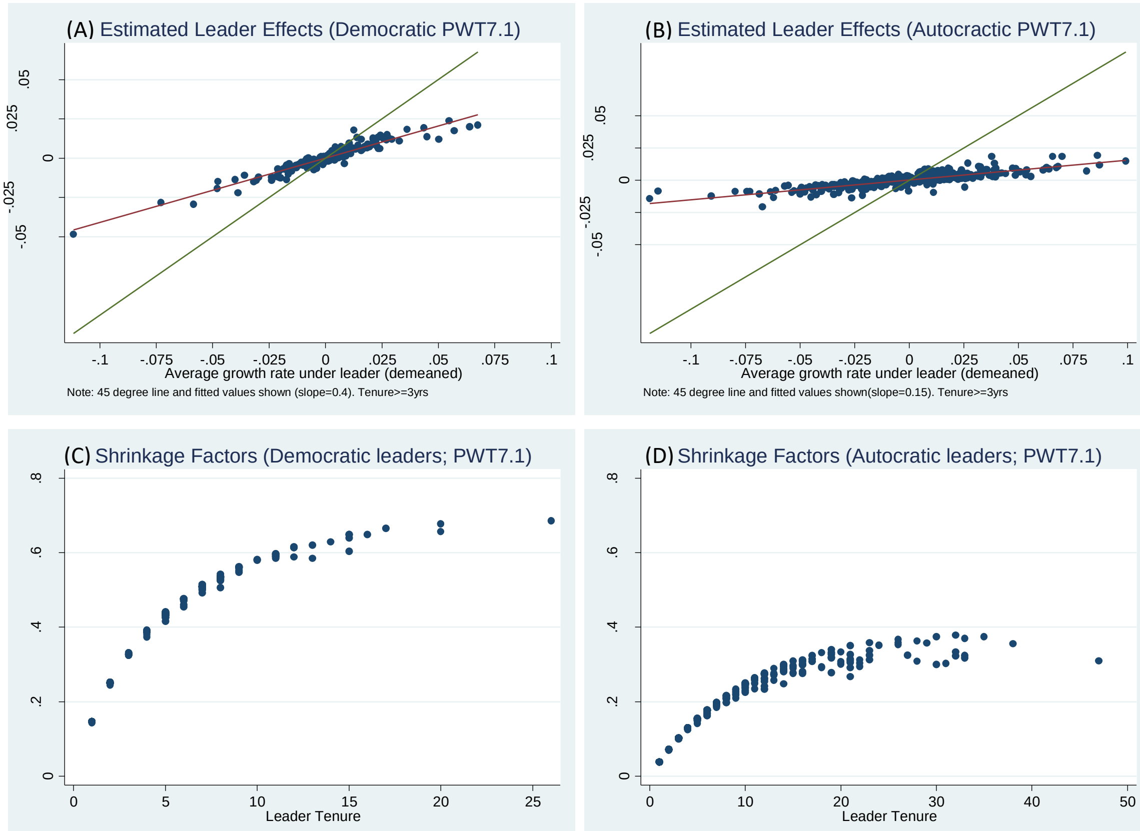
[31] There is a weak negative relationship (corr=-0.23) between the absolute value of the adjusted leader growth average and ψ, because leaders with very high or every low growth rates are more likely to have short tenures.

[32] Note that we remove outliers (Section 2), which strongly affect calculations like this one.

[33] This result is robust to dropping influential leaders like George Chambers of Trinidad & Tobago (LHS outlier in Figure 3A). Using WDI data (in the Appendix), the SD of least squares leader effect is similar in autocracies and democracies. Although less striking the result in Table 6.1this still contradicts against the consensus view that *observable* leader effects are larger for autocrats than democrats.

One can see this relationship graphically in Figure 3A and 3B for autocracies and democracies (respectively). The average growth rate under each leader is on the x-axis and is more dispersed for autocracies than democracies. However, there is more variation in the least-squares leader estimates (y-axis) in democracies than autocracies. For democracies, the average growth rate under a leader is *much* more informative about the least-squares estimate of leader effects: a line slope of 0.4 for democracies, as against a line slope of 0.15 for autocracies.

Figure 3: Least Squares Leader Effect Estimates – Democracies vs Autocracies



The stronger relation between leader growth averages and least-squares leader effect estimates is almost entirely due to the much larger reliability factors (ψ) in democracies. The reliability factors (y-axis) vs tenure (x-axis) are plotted in Figure 3C and D (for autocracies and democracies, respectively). For a given leader tenure, the reliability factors for democrats are around *twice* as large as those for autocrats.

To relate our results to Jones and Olken (2005), we did a simulation of reliability factors using their estimate of the *unobservable* leader SD of 1.5% in the simple model (we had to omit the country effects because JO don't report their standard deviation). The JO findings of strong variation in leader quality are still compatible with low reliability factors because the iid noise can still swamp the variation in μ_i .We indeed calculate low reliability (considerable shrinkage) – for example, about 0.3 for autocrats with tenure of near the sample average tenure of 6.5 years.[34] Hence, even where there is considerable evidence of underlying variation in leader quality, it is hard to infer whether a particular leader is of high quality.

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[34] This is somewhat higher than in our results in Figure 2 and 3 because (i) omission of country effects in the simple model, and (ii) our slightly lower estimates of the SD of the unobserved leader component.

Section 7: Conclusions

In this paper, we show that even under a model where leaders do affect economic growth, the average growth rate during the tenure of a leader is mostly uninformative about that leader's true contribution to growth. This is partly because year-to-year growth rates are volatile, and so average growth rate under most leaders has lots of noise, and not much signal. Moreover, the average growth rates during a leader's tenure vary substantially across growth datasets, so the set of high (and low) growth leaders changes depending on the dataset used.

We also contradict the received wisdom in the literature that the contributions of autocratic leaders to growth are larger than those for democratic leaders. Although the growth average during the leader's tenure is more volatile in autocracies, the least-squares estimates of leader effects are usually *less* variable in autocracies because the reliability of those averages is so much lower (as autocracies have much more noisy year-to-year growth).

What are the implications of these results? First, policymakers should be much more careful about attributing economic growth to leadership. This is especially true when the tenures of leaders are short and in autocracies, where annual growth is more volatile. However, it is also a problem over longer periods – with our calibration of leader effects and idiosyncratic growth variation, one needs to more than halve leader growth averages even after 20 years. And then, as the bias due to the error term dies away, there then arises a new difficulty in distinguishing between a long-serving leader effect and a country effect.

Second, much of the conventional wisdom on the existence of "benevolent autocrats" – as well as the existence of other "malevolent autocrats" – is not consistent with the stylized facts as we have refined them here. The stylized facts here suggest little support for the view that strong positive growth outcomes under autocracy can be attributed mainly to unconstrained "good" leaders. Since almost any autocratic leader will try to claim that they are a "benevolent autocrat," this removes what may often be a popular justification for autocratic rule, which seems to be influential even among aid policymakers and humanitarian advocates of development.

Third, our results are consistent with plausible views of how even seemingly unconstrained autocratic leaders might find it difficult to exert control over the growth rate of the economy. Even if there were a "benevolent" autocrat determined to raise growth, he or she has to solve difficult principal-agent problems to get his growth-promoting orders carried out all the way down the government bureaucracy. The autocrat also has to solve a serious knowledge problem getting accurate information from the lower levels on what are the most serious obstacles to growth and/or what are the biggest opportunities for government actions to raise growth. Autocratic leaders also may face many constraints even though they don't face democratic ones, as there are other power centers in autocratic systems that may be able to veto actions contrary to their interests. In sum, the theory of benevolent autocrats producing growth miracles requires strong assumptions about the autocrats' ability to motivate the government bureaucracy, solve knowledge problems, and overcome other elite interests running contrary to growth. But the biggest assumption of all was that an autocrat selected through a ruthless process of amassing power could indeed turn out to be benevolent very often.

Development policy could be one of the last refuges of the "Great Man" theory of history, which has been discarded in history itself and in most other social science analysis. But growth could be and often is modeled in economics as the outcome of a general equilibrium process (which could include political economy general equilibrium), where the outcome does not correspond to the intentions of any one individual, not even the national leader. We indeed find that even in a model assuming leader effects, most of what is going on in economic growth has little to do with the national leader.

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Appendix 1: Additional Figures and Tables

Appendix Table 1A: Outliers

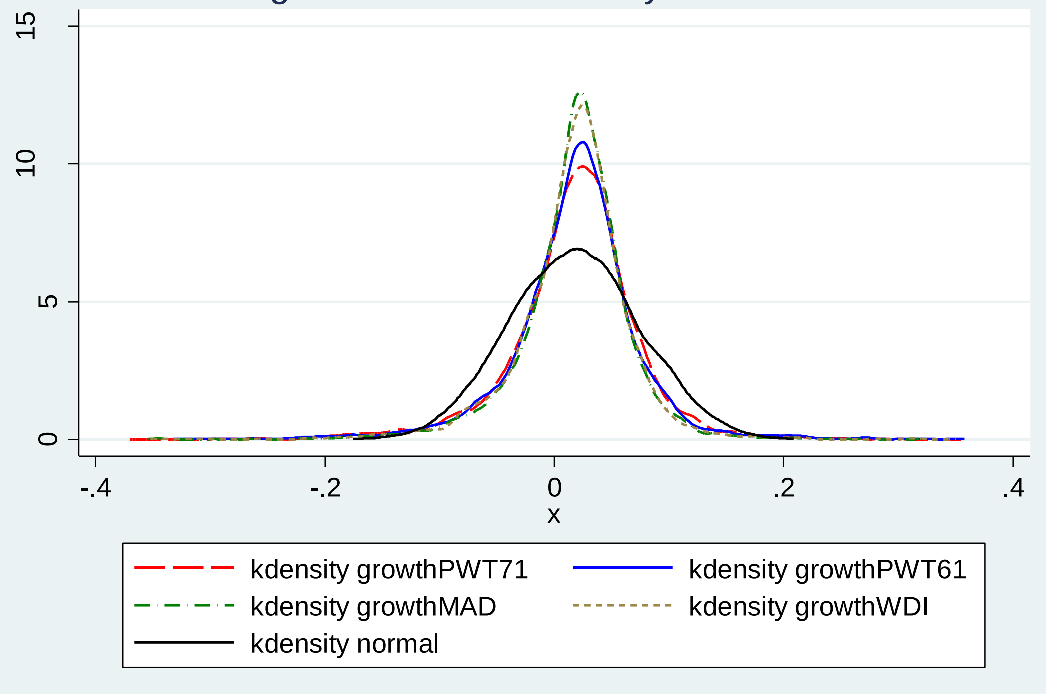
			JO Outliers					Archigos outliers					Max-Min
Country Name	**Isocode**	**Year**	**PWT7.1**	**PWT 6.1**	**WDI**	**MAD**	**Total**	**PWT7.1**	**PWT 6.1**	**WDI**	**MAD**	**Total**	**Growth**
Afghanistan	AFG	1993						-0.41				1	0.26
Algeria	DZA	1962	-0.45				1	-0.45				1	0.28
Angola	AGO	1975		-0.44		-0.47	2						0.43
Angola	AGO	1993		-0.49			1						0.29
Chad	TCD	1979		0.50			1		0.50			1	0.76
Congo	COG	1962		0.50			1		0.50			1	0.56
Equatorial Guinea	GNQ	1996	0.65				1	0.65				1	0.46
Equatorial Guinea	GNQ	1997	0.77	0.57	0.51	0.51	4	0.77	0.57	0.51	0.51	4	0.26
Equatorial Guinea	GNQ	1999		-0.44			1		-0.44			1	0.76
Equatorial Guinea	GNQ	2000		0.55			1		0.55			1	0.46
Iraq	IRQ	1991						-1.04			-0.95	2	0.08
Lebanon	LBN	1976						-0.81				1	0.83
Lebanon	LBN	1977						0.56				1	0.53
Lebanon	LBN	1982						-0.58				1	0.51
Lebanon	LBN	1984						0.40				1	0.38
Lebanon	LBN	1989						-0.58		-0.56		2	0.57
Liberia	LBR	1990						-0.59		-0.70		2	0.84
Liberia	LBR	1992						-0.50		-0.41		2	0.46
Liberia	LBR	1993						-0.43				1	0.41
Liberia	LBR	1997						0.64		0.65		2	0.73
Mauritania	MRT	1964	0.43	0.42			2	0.43	0.42			2	0.21
Nicaragua	NIC	1979	-0.49				1	-0.49				1	0.22
Oman	OMN	1967								0.48	0.48	2	0.00
Oman	OMN	1968								0.57	0.57	2	0.00
Romania	ROM	1980		-0.54			1		-0.54			1	0.59
Rwanda	RWA	1994	-0.71	-0.54	-0.64	-0.51	4	-0.71	-0.54	-0.64	-0.51	4	0.20
Rwanda	RWA	1995	0.61			0.44	2	0.61			0.44	2	0.34
Swaziland	SWZ	1974						0.40				1	0.38
Tanzania	TZA	1988		-0.43			1		-0.43			1	0.51
Total			7	11	2	4	24	19	9	8	6	42	
Average Max-Min Diff													0.42

Notes: log growth rates, which explain how it is possible to get a number less than -1.

Appendix Table 1B: Country List

Country Name	Isocode	Democracy		Country Name	Isocode	Democracy	
		Archigos	JO			Archigos	JO
Afghanistan	AFG	0		South Korea	KOR	0	0
Angola	AGO		0	Kuwait	KWT	0	
Albania	ALB	0		Laos	LAO	0	
United Arab Emirates	ARE	0		Lebanon	LBN	0	
Argentina	ARG	0	0	Liberia	LBR	0	
Australia	AUS	1	1	Libya	LBY	0	
Austria	AUT	1	1	Sri Lanka	LKA	0	0
Burundi	BDI	0	0	Lesotho	LSO	0	0
Belgium	BEL	1	1	Luxembourg	LUX		1
Benin	BEN	0	0	Morocco	MAR	0	0
Burkina Faso	BFA	0	0	Madagascar	MDG	0	0
Bangladesh	BGD	0	0	Mexico	MEX	0	0
Bulgaria	BGR	0		Mali	MLI	0	0
Bahrain	BHR	0		Myanmar	MMR	0	
Bolivia	BOL	0	0	Mongolia	MNG	0	
Brazil	BRA	0	0	Mozambique	MOZ		0
Bhutan	BTN	0		Mauritania	MRT	0	0
Botswana	BWA	0	0	Mauritius	MUS	1	1
Central African Republic	CAF	0	0	Malawi	MWI	0	0
Canada	CAN	1	1	Malaysia	MYS	0	0
Switzerland	CHE	1	1	Namibia	NAM		0
Chile	CHL	0	0	Niger	NER	0	0
China	CHN	0	0	Nigeria	NGA	0	0
Cote d'Ivoire	CIV	0	0	Nicaragua	NIC	0	0
Cameroon	CMR	0	0	Netherlands	NLD	1	1
Congo	COG	0	0	Norway	NOR	1	1
Colombia	COL	0	0	Nepal	NPL	0	0
Comoros	COM		0	New Zealand	NZL	1	1
Costa Rica	CRI	1	1	Oman	OMN	0	
Cuba	CUB	0		Pakistan	PAK	0	0
Cyprus	CYP	1		Panama	PAN	0	0
Czech Republic	CZE	0		Peru	PER	0	0
Germany	DEU	1	1	Philippines	PHL	0	0
Denmark	DNK	1	1	Papua New Guinea	PNG		1
Dominican Republic	DOM	0	0	Poland	POL	0	0
Algeria	DZA	0	0	Portugal	PRT	0	0
Ecuador	ECU	0	0	Paraguay	PRY	0	0
Egypt	EGY	0	0	Qatar	QAT	0	
Spain	ESP	0	0	Romania	ROM	0	0
Ethiopia	ETH	0	0	Rwanda	RWA	0	0
Finland	FIN	1	1	Saudi Arabia	SAU	0	
Fiji	FJI	0	0	Sudan	SDN	0	
France	FRA	0	0	Senegal	SEN	0	0
Gabon	GAB	0	0	Singapore	SGP	0	0
United Kingdom	GBR	1	1	Sierra Leone	SLE	0	0
Ghana	GHA	0	0	El Salvador	SLV	0	0
Guinea	GIN	0	0	Somalia	SOM	0	
Gambia	GMB	0	0	Sweden	SWE	1	1
Guinea-Bissau	GNB		0	Swaziland	SWZ	0	
Equatorial Guinea	GNQ	0	0	Syria	SYR	0	0
Greece	GRC	0	0	Chad	TCD	0	0
Guatemala	GTM	0	0	Togo	TGO	0	0
Guyana	GUY	0	0	Thailand	THA	0	0
Honduras	HND	0	0	Trinidad and Tobago	TTO	1	1
Haiti	HTI	0	0	Tunisia	TUN	0	0
Hungary	HUN	0	0	Turkey	TUR	0	0
Indonesia	IDN	0	0	Taiwan	TWN	0	0
India	IND	1	1	Tanzania	TZA	0	0
Ireland	IRL	1	1	Uganda	UGA	0	0
Iran	IRN	0	0	Uruguay	URY	0	0
Iraq	IRQ	0		United States	USA	1	1
Iceland	ISL		1	Venezuela	VEN	0	0
Israel	ISR	1	1	Vietnam	VNM	0	
Italy	ITA	1	1	Yemen	YEM		0
Jamaica	JAM	1	1	Yugoslavia	YUG	0	
Jordan	JOR	0	0	South Africa	ZAF	0	0
Japan	JPN	1	1	Dem. Rep. of Congo	ZAR	0	0
Kenya	KEN	0	0	Zambia	ZMB	0	0
Cambodia	KHM	0		Zimbabwe	ZWE	0	0
Countries		**129**	**112**				
Democracies		**24**	**26**				
Autocracies		**105**	**86**				
Common Countries		**103**					

Figure A2: Kernal Density Plot: Growth



Appendix Table 2: Descriptive Statistics (Archigos leaders)

	Mean	SD	Obs	Leaders	Tenure
A. All					
PWT7.1	1.86%	6.2%	5161	894	5.8
PWT 6.1	1.86%	5.6%	4622	829	5.6
Maddison	1.69%	5.4%	5750	961	6.0
WDI	1.68%	5.4%	4150	722	5.7
B. Democracies					
	Mean	SD	Obs	Leaders	Tenure
PWT7.1	2.6%	3.8%	1132	256	4.4
PWT 6.1	2.6%	3.6%	1127	256	4.4
Maddison	2.7%	3.0%	1130	255	4.4
WDI	2.5%	2.9%	830	189	4.4
C. Autocracies					
	Mean	SD	Obs	Leaders	Tenure
PWT7.1	1.6%	6.7%	4029	638	6.3
PWT 6.1	1.6%	6.1%	3495	573	6.1
Maddison	1.5%	5.8%	4620	706	6.5
WDI	1.5%	5.8%	3320	533	6.2

Appendix Table 3A: Best leaders (1 if average growth in top 5% of outcomes) (Archigos)						
Leader name and country	**ISO code**	**PWT 6.1**	**PWT 7.1**	**Maddison**	**WDI**	**Count**
Berisha	ALB	0	0	0	1	1
Raab	AUT	0	1	1	0	2
Mwambutsa	BDI	1	0	0	0	1
Kubitschek	BRA	0	0	0	1	1
Medici	BRA	1	1	1	1	4
Khama	BWA	1	1	1	1	4
Aylwin	CHL	0	1	1	0	2
Deng Xiaoping	CHN	1	1	1	1	4
Hua Guofeng	CHN	0	1	0	1	2
Fernandez Reyna	DOM	1	0	1	0	2
Rodriguez Lara	ECU	1	1	0	1	3
Mba	GAB	1	0	0	0	1
Papadopoulos	GRC	1	1	1	1	4
Preval	HTI	1	0	0	0	1
Shearer	JAM	1	0	0	1	2
Ikeda	JPN	1	1	1	1	4
Sato	JPN	1	1	1	1	4
Chun Doo Hwan	KOR	1	1	1	1	4
Hee Park	KOR	1	1	1	0	3
Roh Tae Woo	KOR	0	1	1	1	3
Elias Hrawi	LBN	0	1	1	1	3
Razak	MYS	0	1	1	0	2
Robles	PAN	0	1	0	0	1
Caetano	PRT	0	1	1	1	3
Salazar	PRT	0	0	0	1	1
Ceausescu	ROM	1	0	0	0	1
Paul Kagame	RWA	1	0	0	1	2
Lee Kuan Yew	SGP	1	0	1	1	3
Margai,M	SLE	0	1	0	0	1
Grunitzky	TGO	1	1	1	1	4
Sarit	THA	0	0	1	0	1
Chiang Ching-Kuo	TWN	1	0	1	1	3
Chiang Kai-shek	TWN	0	0	0	1	1
Lee Teng-Hui	TWN	0	0	0	1	1
Do Muoi	VNM	1	1	1	1	4
Growth Cutoff (best leader)		6.26%	6.04%	5.53%	6.20%	
Number of leaders						35
Average number of datasets leader for which leader is in best 5%						**2.4**
Proportion of all “best” leaders (by at least one measure) for which all datasets agree						**25.7%**

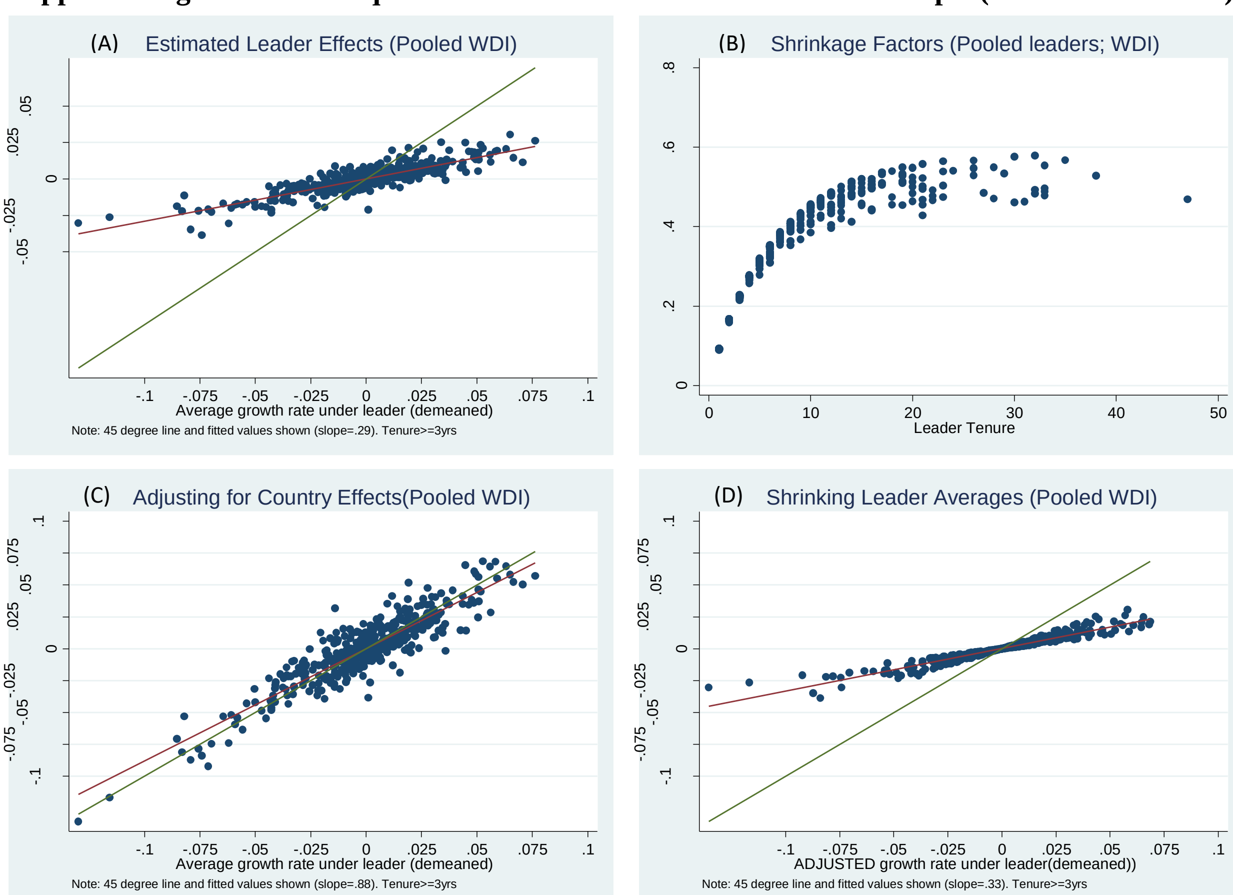
Appendix Table 3B: Worst leaders (1 if average growth in worst 5% of outcomes) (Archigos)						
Leader name and country	**ISO code**	**PWT 6.1**	**PWT 7.1**	**Maddison**	**WDI**	**Count**
Alia	ALB	0	1	1	1	3
Yameogo	BFA	1	0	0	0	1
Siles Zuazo	BOL	0	0	0	1	1
Kolingba	CAF	1	1	1	0	3
Patasse	CAF	1	0	0	0	1
Lissouba	COG	1	0	1	1	3
Carazo Odio	CRI	1	1	1	1	4
Rafel Trujillo	DOM	0	0	0	1	1
Acheampong	GHA	1	1	0	0	2
Suazo Cordova	HND	0	1	0	0	1
Ayatollah Khomeini	IRN	1	1	1	1	4
Manley	JAM	0	0	0	1	1
de La Madrid	MEX	0	1	0	0	1
Keita	MLI	1	1	0	0	2
Ould Haidalla	MRT	1	0	1	1	3
Kountche	NER	0	1	0	0	1
Seibou	NER	0	0	1	1	2
Obasanjo	NGA	0	1	0	0	1
Shagari	NGA	1	1	1	1	4
Anastasio Somoza Debayle	NIC	0	0	1	0	1
Daniel Ortega	NIC	1	0	1	1	3
Violeta Chamorro	NIC	1	0	0	0	1
Noriega	PAN	0	0	1	0	1
Garcia Perez	PER	1	1	1	1	4
Momoh	SLE	0	1	1	1	3
Strasser	SLE	1	1	1	0	3
Duarte	SLV	1	0	0	1	2
Malloum	TCD	0	1	1	1	3
Chambers	TTO	0	1	1	1	3
Manning	TTO	1	0	0	0	1
Robinson	TTO	0	1	0	0	1
Obote	UGA	0	0	0	1	1
Alvarez Armalino	URY	1	1	1	1	4
Betancourt	VEN	0	0	1	0	1
Caldera Rodriguez	VEN	1	0	0	0	1
Campins	VEN	1	1	1	1	4
Mobutu	ZAR	1	1	1	1	4
		-2.62%	-2.16%	-2.26%	-2.49%	
Number leaders						**37**
Average number of datasets leader for which leader is in worst 5%						**2.2**
Proportion of all “worst” leaders (by at least one measure) for which all datasets agree						**18.9%**

Appendix Table 5: Estimates of Variance Components in the data (Archigos Leaders)

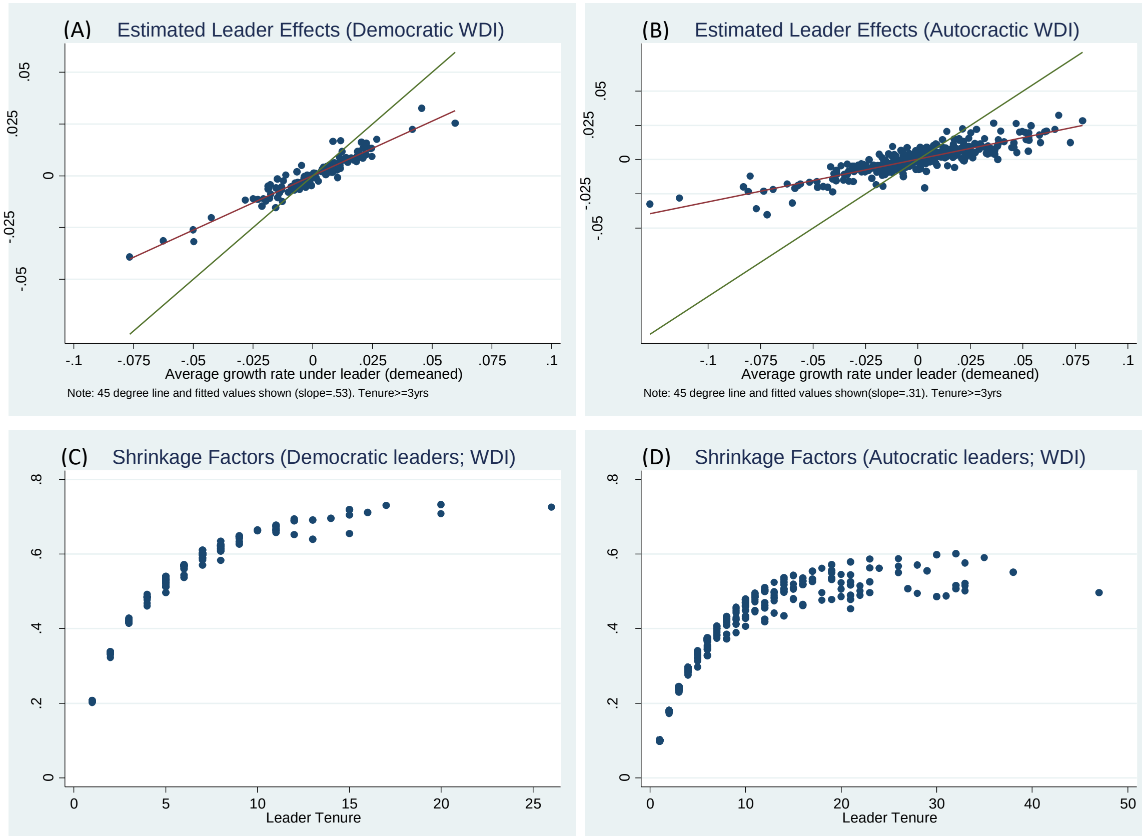
	Pooled				Democrats				Autocrats			
	SD(leader)	sd(iid)	sd(CE)	pval(CE)	SD(leader)	sd(iid)	sd(CE)	pval(CE)	SD(leader)	sd(iid)	sd(CE)	pval(CE)
Panel A: SA Method												
PWT71	0.94%	6.07%	1.77%	0.00%	1.07%	3.60%	0.92%	0.59%	1.29%	6.56%	1.86%	0.00%
	[0.51%]	[0.28%]	[0.18%]	[0.47%]	[0.55%]	[0.47%]	[0.13%]	[10.35%]	[0.51%]	[0.31%]	[0.21%]	[5.59%]
PWT61	1.65%	5.40%	1.51%	0.00%	0.75%	3.51%	0.84%	0.08%	2.06%	5.85%	1.60%	0.02%
	[0.40%]	[0.26%]	[0.12%]	[0.52%]	[0.45%]	[0.42%]	[0.13%]	[9.73%]	[0.39%]	[0.29%]	[0.14%]	[9.74%]
MAD	2.08%	5.06%	1.71%	0.00%	1.31%	2.70%	0.93%	0.03%	2.38%	5.45%	1.77%	0.12%
	[0.29%]	[0.24%]	[0.13%]	[1.0%]	[0.25%]	[0.19%]	[0.12%]	[3.32%]	[0.33%]	[0.27%]	[0.16%]	[13.7%]
WDI	1.91%	4.96%	2.25%	0.00%	1.58%	2.49%	1.07%	3.54%	2.15%	5.37%	2.41%	0.00%
	[0.29%]	[0.24%]	[0.13%]	[1.0%]	[0.25%]	[0.19%]	[0.12%]	[3.32%]	[0.33%]	[0.27%]	[0.16%]	[13.7%]
Panel B: RE Method												
PWT71	0.00%	6.07%	1.77%	0.00%	0.51%	3.60%	0.90%	0.02%	0.00%	6.56%	1.87%	0.00%
	[0.03%]	[0.28%]	[0.18%]	[0.0%]	[0.60%]	[0.47%]	[0.13%]	[8.43%]	[0.12%]	[0.31%]	[0.20%]	[0.0%]
PWT61	0.00%	5.40%	1.52%	0.00%	0.00%	3.51%	0.85%	0.00%	0.47%	5.85%	1.61%	0.00%
	[0.52%]	[0.26%]	[0.11%]	[0.0%]	[0.50%]	[0.42%]	[0.13%]	[9.55%]	[0.75%]	[0.29%]	[0.14%]	[1.17%]
MAD	0.00%	5.06%	1.69%	0.00%	1.15%	2.70%	0.93%	0.00%	0.60%	5.45%	1.73%	0.00%
	[0.50%]	[0.24%]	[0.13%]	[0.0%]	[0.36%]	[0.19%]	[0.13%]	[2.65%]	[0.65%]	[0.27%]	[0.16%]	[0.09%]
WDI	0.83%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	[0.78%]	[0.22%]	[0.26%]	[0.77%]	[0.43%]	[0.17%]	[0.26%]	[12.7%]	[0.92%]	[0.24%]	[0.31%]	[5.27%]

Note: shaded numbers are used for the least-squares individual leader effect calcs. Bootstrap SE in brackets (500 reps)

Appendix Figure 2: Least Squares Leader Effect Estimates – Pooled Sample (WDI & JO leaders)



Appendix Figure 3: Least Squares Leader Effect Estimates – Democracies vs Autocracies (WDI)



Appendix Table 6.1: Estimated Leader effects in Democracies and Autocracies (WDI & JO Leaders)

	Democracies	Autocracies	Ratio (Aut/Dem)
SD(average growth under leader $\bar{g}_{ic}$)	2.1%	3.3%	1.6
SD(least squares leader effect $\hat{\mu}_i$)	0.9%	0.9%	1
Leaders	204	453	

Notes: Based on WDI data and JO leaders. Estimated separately for democrats & autocrats.

Data Sources

Leader Data

The main data series on leaders come from Jones and Olken (2005) – we thank Ben Jones and Ben Olken for sharing their data with us. In the case where there are multiple leaders in a single year, we keep the leader who ended his/her tenure in that year and started their tenure earliest.

The secondary data source on leaders is Archigos 2.9 dataset (Goemans et al 2009), downloaded from http://www.rochester.edu/college/faculty/hgoemans/Archigos_v.2.9_tv-Public.dta (accessed 3 Sept 2013). As with JO, in the case there are multiple leaders in a year, we keep the leader who ended his/her tenure in that year and started their tenure earliest.[35]

Polity IV Data (Democracy vs Autocracy)

Polity IV data comes from: http://www.systemicpeace.org/inscr/p4v2012.xls (accessed 3 Sept 2013). We calculated the average Polity score over our sample, with a democracies having an average polity score >8, and autocracies <=8. Countries with no Polity data for the whole sample were dropped. [36]

PWT Growth Data

We use two versions of PWT data 6.1 and 7.1, over the sample 1950-2000. These can be downloaded from: https://pwt.sas.upenn.edu/php_site/pwt_index.php (Accessed 3 Sept 2013) . Our GDP per capita variable is *rgdpl:* Real GDP per capita (Constant Prices: Laspeyres). We generate $growth_t=\ln(rgdpl_t)-\ln(rgdpl_{t-1})$

World Bank World Development Indicator Growth Data

We use GDP per capita growth (annual %) (NY.GDP.PCAP.KD.ZG) Data can be downloaded from: http://databank.worldbank.org/data/views/variableSelection/selectvariables.aspx?source=world-development-indicators (Accessed 3 Sept 2013) We convert actual growth rates into log growth rates for comparison growth=log(1+G/100)

Madison Growth Data

We downloaded Angus Maddison original (pre-2010) Statistics on World Population, GDP and Per Capita GDP, 1-2008 AD from http://www.ggdc.net/maddison/oriindex.htm (Accessed 3 Sept 2013). We calculate growth from Maddison's series on Per Capita GDP (1990 Int. Geary-Khamis dollars): $growth=\ln(GDPpc_t)-\ln(GDPpc_{t-1})$

Data Sample and Cleaning

Following Jones-Olken, we used annual data over 1950-2000. WDI growth data was only available starting in 1961 (and so the sample runs 1961-2000). We drop observations where |growth|>0.4 as described in the text. (listed in Table A1). For Archigos, we drop countries with less than 30 years of growth data (combined across all our data sources). We follow JO and drop observations for which there is no PWT6.1 data, or less the 5 years of observations (there are no countries with 5-30 observations of data in JO after dropping these observations).

[35] To merge 3-letter country isocodes and Correlates of War country codes we used Andreas Beger's crosswalk (http://myweb.fsu.edu/ab05h/research.html#dofiles). We thank Andreas Beger for making this publicly available.

[36] Jones and Olken's dataset uses an older version of Polity IV, which categorizes almost all countries into autocracies/democracies the same as the latest version of Polity IV - except for Botswana. In the most modern version of Polity IV, Botswana is (just) an autocracy by our definition, and so we code it as such in both databases.