Online Appendix (not for publication) to "Leader value-added: assessing the economic growth contribution of individual national leaders" by Easterly and Pennings (March 2020)

Online Appendix 1: Derivation of least squares leader effect and standard deviation as a conditional normal[1]

First write the growth averages under this leader i and other leaders $-i$ (in the same country), in matrix form:

$$G = \begin{bmatrix} \bar{g}_i \\ \bar{g}_{-i} \end{bmatrix} \quad \text{and} \quad \Sigma_G = \begin{bmatrix} V(\bar{g}_i) & \sigma_c^2 \\ \sigma_c^2 & V(\bar{g}_{-ic}) \end{bmatrix},$$

where $V(\bar{g}_i) = \sigma_\mu^2 + \sigma_c^2 + \sigma_e^2/T_i$ and $V(\bar{g}_{-ic}) = \sigma_\mu^2/L_{-ic} + \sigma_c^2 + \sigma_e^2/(N_c - T_i)$.
Then form the multivariate conditional normal matrices:

$$\begin{bmatrix} \mu_i \\ G \end{bmatrix} \sim \mathrm{N}\left(\begin{bmatrix} 0 \\ G \end{bmatrix}, \begin{bmatrix} \sigma_\mu^2 & \Sigma'_{\mu g} \\ \Sigma_{\mu g} & \Sigma_G \end{bmatrix}\right)$$

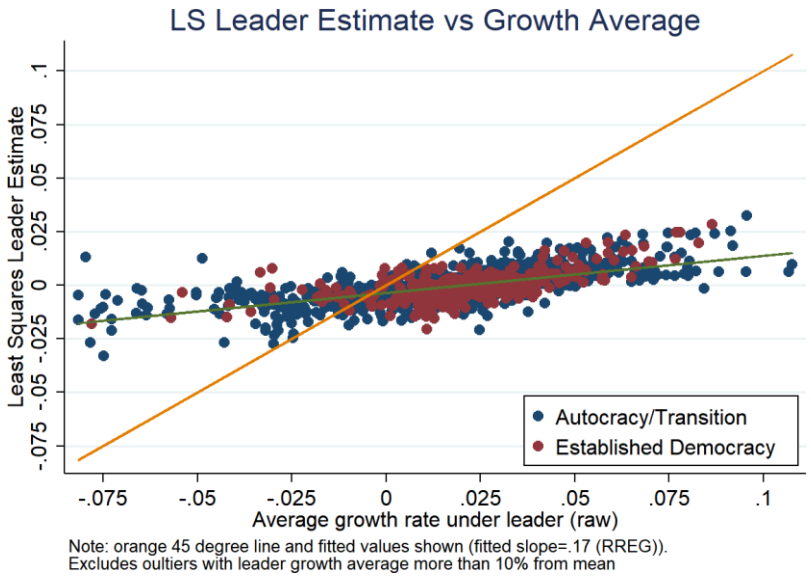
where $\Sigma_{\mu g} = \begin{bmatrix} \sigma_\mu^2 \\ 0 \end{bmatrix}$.
Then the textbook conditional normal formulas imply:

$$\mu_i | G \sim \mathrm{N}(\mathrm{E}(\mu_i|G), \mathrm{V}(\mu_i|G))$$

where $\mathrm{E}(\mu_i|G) = 0 + \Sigma'_{\mu g}\Sigma_G^{-1}(G - 0) = \psi_i(\bar{g}_i - \gamma_i \bar{g}_{-ic})$ is the least squares leader estimate, and
$\mathrm{V}(\mu_i|G) = \sigma_\mu^2 - \Sigma'_{\mu g}\Sigma_G^{-1}\Sigma_{\mu g} = \sigma_\mu^2(1 - \psi_i)$ is the mean squared error.

Online Appendix 2: Least squares leader effects - estimates and scatter plots

Appendix Figure 1

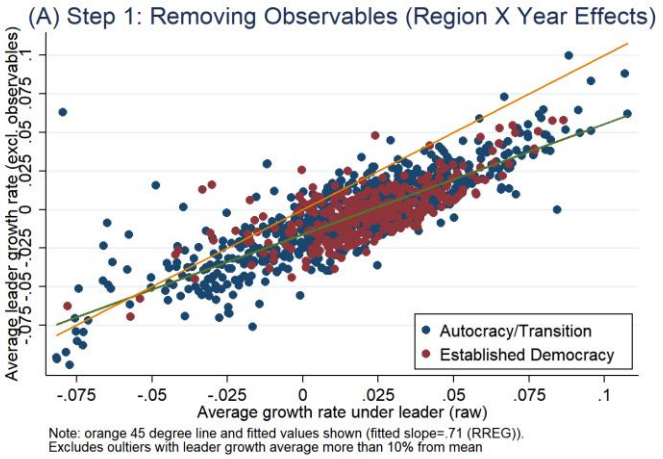


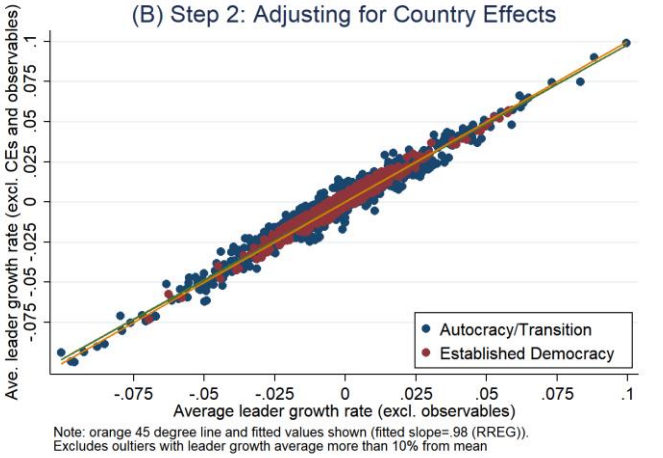
Overall, a 1% increase in the average raw growth rate under the leader is associated with only a 0.17ppts increase in the least squares leader effect (Appendix Figure 1). The path of adjustment from raw leader growth average to least-squares leader estimate involves 3 steps, which are shown in three subplots in Appendix Figure 2.

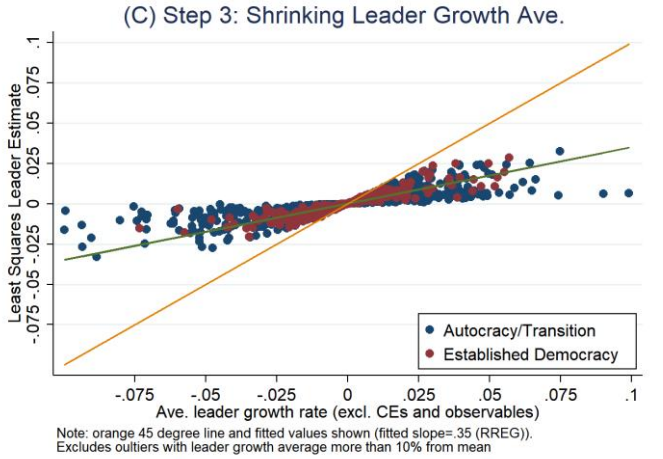
[1] We thank Aart Kraay for suggesting this derivation.

Appendix Figure 2.A shows the effect of removing observables (region x year FE, and the cross-country growth mean) which reduces the size of leader effects modestly – a slope of 0.71 means that a 1ppt increase in the raw leader growth average is associated with a 0.71ppt increase in the leader growth average after adjusting for observables. This adjustment also makes growth rates mean zero.

Appendix Figure 2





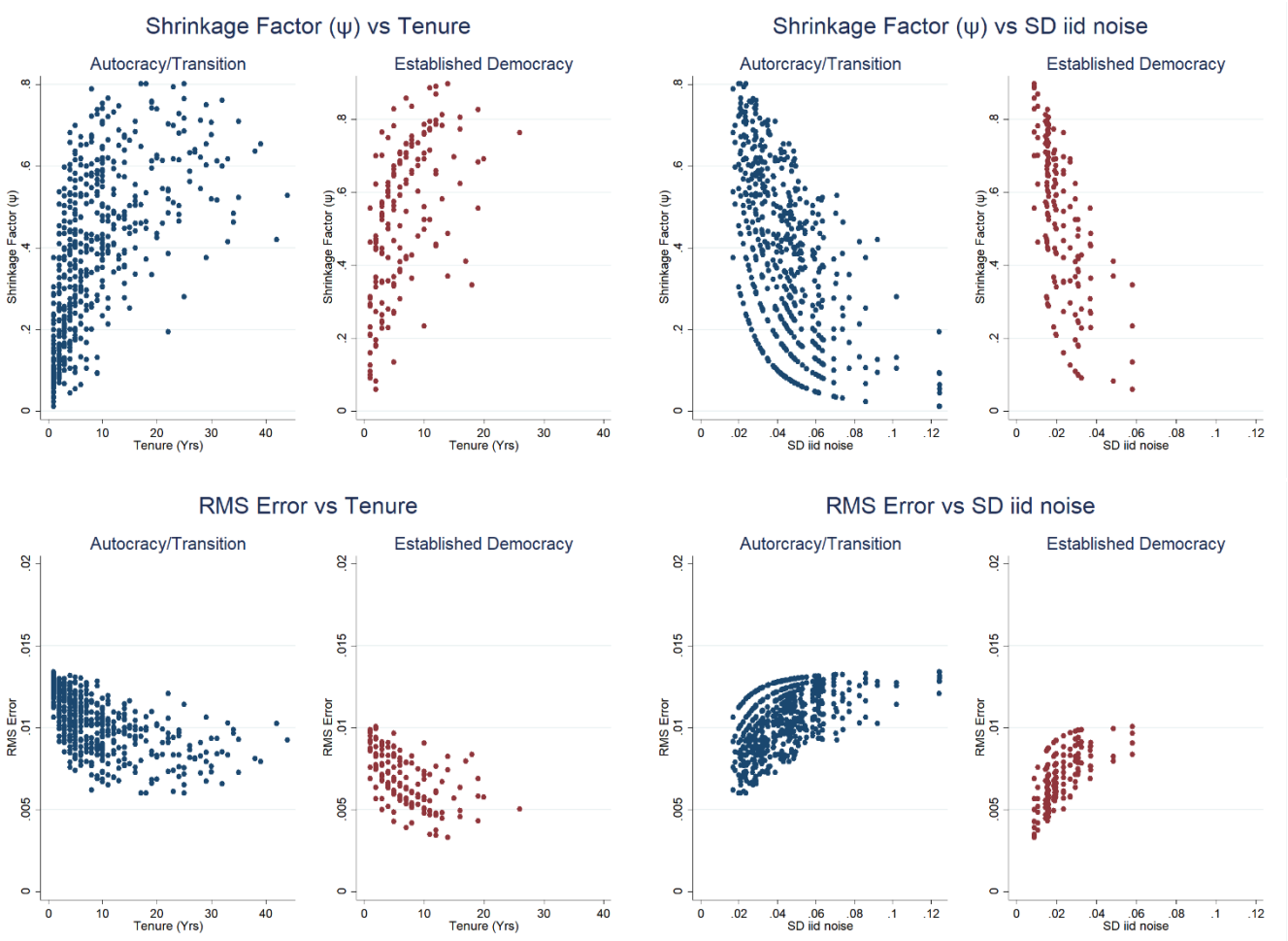


Adjusting for country effects (by subtracting $\gamma \bar{g}_{-i}$) does not reduce the leader growth average substantially in general, though can be important for specific leaders. Appendix Figure 2.B plots the leader growth average after removing observables (x-axis) vs leader growth average adjusted for country effects and observables (y-axis).[2] The two are highly correlated, with a slope of 0.98, which is close to the 45 degree line.

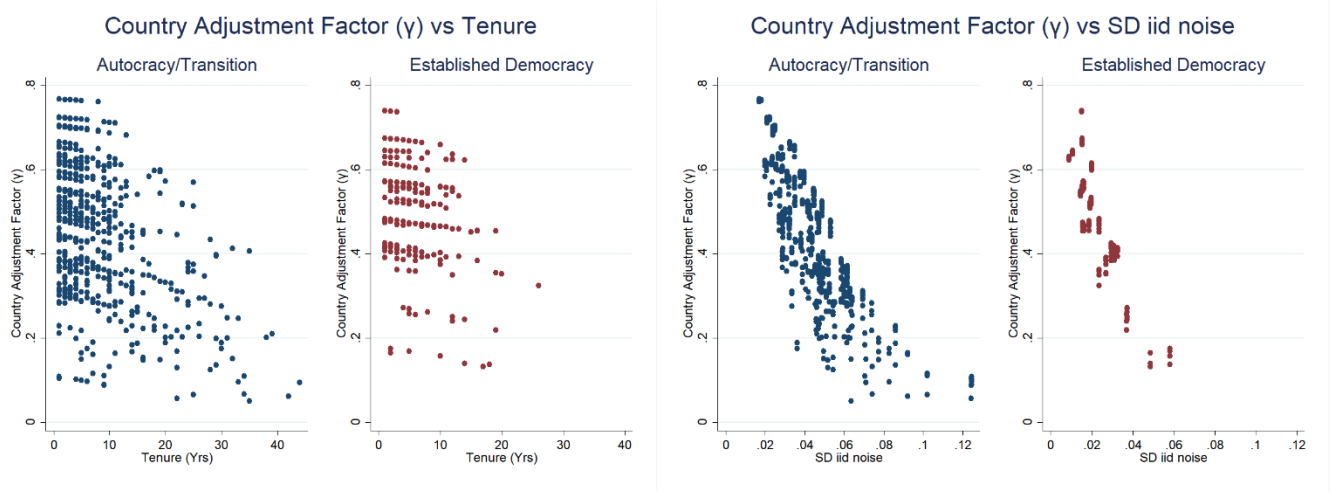
The final step of adjustment – and the most important – is "shrinking" the adjusted leader growth average towards zero. Appendix Figure 2.C plots the *adjusted* leader growth average on the x-axis (after removing observables and country effects) vs the least squared leader estimate on the y-axis, with the ratio of the two representing the shrinkage factor ψ. On average a 1ppt increase in the adjusted leader growth average only leads to an increase in the LS leader effect by 0.35.

Appendix Figure 3 provides plots of how the shrinkage factor (ψ), errors, and country adjustment factor (γ), change with tenure and country-level iid noise, for autocracies/transition countries and democracies. A short tenure and small $\psi < 0.2$ are common among autocratic leaders (which is not visually obvious in the figure as all these leader estimates are on top of each other). However, a small ψ is rare in established democracies.

Appendix Figure 3



[2] Note that the *adjusted* leader growth average can be higher or lower than the raw leader growth average, depending on whether other leaders had a low or high average growth.



Online Appendix 3: Using different growth datasets

Just as a teacher's value added can depend on the type of standardized test conducted, so leaders' least squares growth contribution can (and does) vary depending on the growth dataset used to measure it. In this section we compare the size and significance of least squares leader effects using two other datasets: PWT 7.1 and WDI (but applying the same least squares methodology; only the underlying growth data varies). This comparison is particularly relevant as Johnson et al. (2013) find that many studies using annual growth data are not robust to different revisions of the Penn World Tables.[3] Note that we prefer the results using PWT9 growth data as they improve upon PWT7.1 methodologically, and have a longer and more complete sample than WDI.

The aggregate fraction of significant leaders—and fraction of those significant leaders that are democratic—is fairly similar to the results in the main text if we use WDI data, but not if we use PWT7.1 growth data. Specifically, for WDI data, the overall fraction of leaders with tenure ≥3yrs that is significant is 6.6%, very similar to 6.8% in the main text. Around 31% of those significant leaders are democratic, compared to 36% in the main text.[4] Using PTW7.1 growth data, the fraction of significant leaders (tenure ≥3yrs) is much smaller: around 3.7%, which is half that in the main text. However, the fraction of significant leaders that are democratic is much higher, at 75%. The reason is the much lower estimate of σ_μ^{AUT} using PWT 7.1 data, as discussed below.

It turns out that the set of significant leaders also changes substantially depending on the dataset used, which is another reason why we would not want to rely solely on growth data to judge the performance of leaders – even when using an optimal methodology.

There are three ways that different growth datasets can generate different leader effects. First, different datasets can generate different estimates of the underlying variation in leader quality σ_μ and other variance components (see Appendix Table 8), which feed into estimates of ψ and γ, which then affect LS leader estimates. Specifically, the PWT9 data generates higher estimates of the underlying variation in leader quality ($\sigma_\mu^{PWT9} = 1.33\%$) than either PWT 7.1 ($\sigma_\mu^{PWT7.1} = 1.10\%$) or WDI ($\sigma_\mu^{WDI} = 1.25\%$). This is driven by greater variation in leader quality in autocracies/transition countries, which leads to more autocrats being significant in PWT9.[5]

[3] Johnson S., W. Larson, C Papageorgiou and A. Subramanian (2013) "Is newer better? Penn World Table Revisions and their impact" Journal of Monetary Economics 60, 255 –274

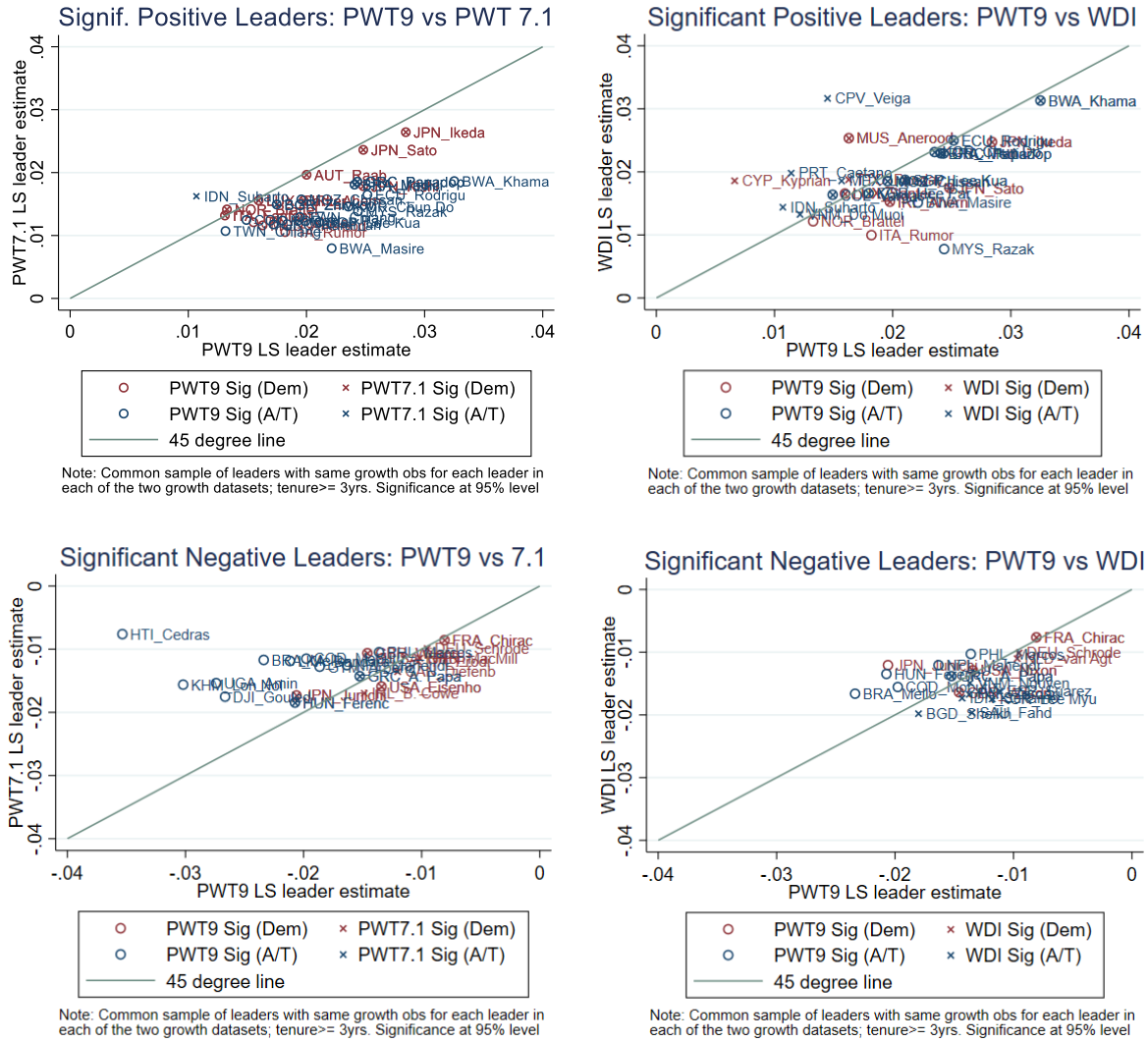
[4] The WDI sample has a higher number of democrats overall 34%, but nonetheless the fraction of leaders that are significant is roughly similar for autocracies and democracies.

[5] For autocracies/transitions countries $\sigma_\mu^{PWT9} = 1.35\%$ as against $\sigma_\mu^{PWT7.1} = 1.08\%$ and $\sigma_\mu^{WDI} = 1.22\%$. Estimates of σ_e are higher in PWT7.1 and slightly lower in WDI.

Second, growth datasets can disagree on the raw leader growth average $\bar{g}_i$ (or other leader growth average $\bar{g}_{-ic}$) for the same set of leaders and years. This is due to differences in methodologies and judgement calls when data quality is questionable.[6] This is a particularly big problem in lower income countries, which are often autocratic.

Finally, growth datasets cover different years and countries, resulting in missing leaders, or leaders with truncated tenures. Some of this is mechanical (and not problematic) because WDI growth data does not start until 1961 (rather than 1951 for PWT), and so WDI is missing all potential significant leaders in the 1950s (such as Eisenhower). Likewise, PWT7.1 finishes in 2010, and so will truncate the tenures of more modern leaders. On the other hand, much of the data is sometimes missing for whole countries (Afghanistan in PWT9 and Germany in PWT 7.1) or data starts late (WDI growth data for Haiti only starts in 1997, whereas PWT has data back 1961). Cases of differential omission across datasets, like Afghanistan and Haiti, may reflect different standards of what is the minimum acceptable data quality to report the GDP growth rate.

Appendix Figure 4: Comparing the same set of sometimes significant leaders across growth datasets



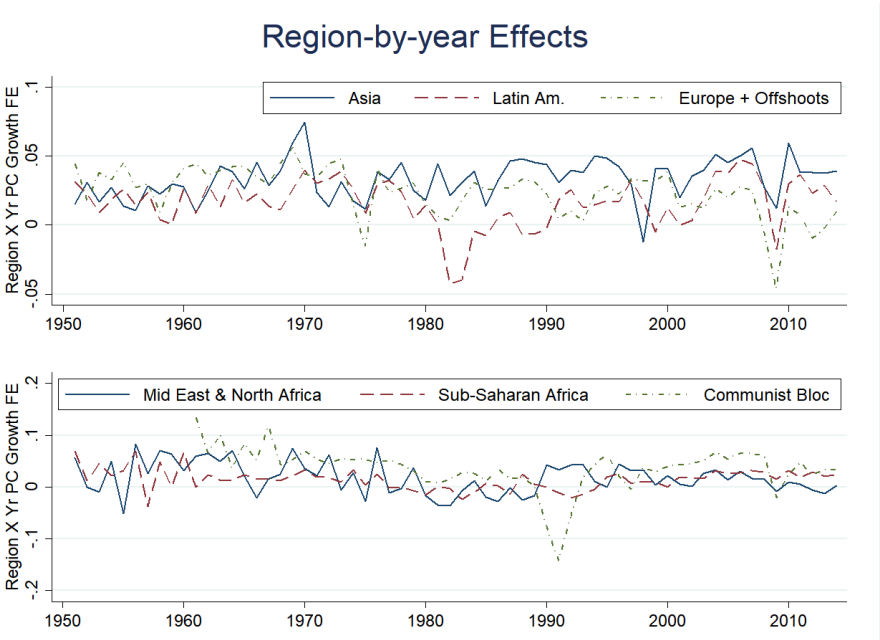
[6] For example, when Rwanda was recovering from genocide in 1995, log GDP per capita growth was around 30% in PWT9 and WDI, but around 60% (and hence an outlier) using PWT 7.1. As these data also depend on estimates of GDP per capita in 1994 during the genocide, they are highly questionable.

The combined set of significant leaders by different datasets is presented in Appendix Table 4 (positive) and Appendix Table 5 (negative). While all three datasets agree on leaders with significantly positive contributions like Ikeda, Medici, and Papadopoulos (significant and in the top 10 in all datasets, Khama is marginally insignificant in PWT 7.1), more than half of the top 10 leaders in PWT9 are either insignificant, lowly ranked or missing in at least one of the other two datasets. Moreover, there is more disagreement about the set of negative leaders: for bottom 10 significantly negative leaders in PWT9, none are significant in all three datasets (in part due to missing data), and only around 1/3 are significant in one of the other two datasets. Most important here is the lower σ_μ and higher σ_e in PWT 7.1 (which reduces ψ and increases RMSEs), but also that there are many missing leaders—especially in WDI. The later in part reflects the propensity for leaders with extremely high or low growth rates to come from countries that experienced civil war, political turmoil or with questionable quality growth data which result in difficulties collecting reliable data on growth.

In Appendix Figure 4, we plot the size of significant leader effects for each data set, focusing on a set of leaders that have the full set of growth data (that is, we omit leaders where their tenure is truncated by the start or end of the sample for a particular dataset). While leader estimates are positively related, they are also a long way from 45 degree line, indicating substantial disagreement in the size of least squares leader effects. Comparing PWT9 vs PWT7.1, almost all of the autocratic/transition leader effects are closer to zero for PWT7.1 due to lower σ_μ^{AUT}, higher σ_e and hence more shrinkage (smaller ψ) in that dataset. This is particularly striking for the leader with the lowest growth contribution under PWT9 – Cedras (HTI) – which has leader effects 2.5 percentage points higher in PWT 7.1 (and insignificant), mostly explained by a value of ψ with PWT7.1 that is half that of PWT9. PWT9 and WDI tend be in more agreement, with some of the same significant leaders (Khama) having similar sized leader effects. However there are also major disagreements: Veiga (CPV) gets a leader effect of 3% in WDI, but 1.5% in PWT 9 (and is insignificant), largely because Veiga's leader growth average is 4 percentage points lower under PWT9. Similarly, Razak (MYS) gets a leader effect of 2.5% in PWT vs 0.8% in WDI, mostly explained by a growth average 3.5 percentage points lower under WDI.

Online Appendix 4: Additional Figures and Tables

Appendix Figure 5



Notes: Fitted values from regression of growth on region X year dummy variables. Sample size changes year-by year

Appendix Table I: Descriptive Statistics

Growth Dataset	Sample	Mean	SD	Obs	Leaders	Ave. Tenure
PWT9 (main dataset)	All	1.93%	5.24%	7096	1141	6.3
	Aut	1.79%	5.70%	5480	788	7.0
	Dem	2.40%	3.20%	1616	335	4.8
PWT7.1 (appendix/ robustness)	All	1.94%	5.90%	6706	1089	6.2
	Aut	1.80%	6.39%	5214	763	6.8
	Dem	2.42%	3.72%	1492	313	4.8
WB WDI (appendix/ robustness)	All	1.87%	4.99%	6155	998	6.3
	Aut	1.77%	5.41%	4846	715	6.8
	Dem	2.24%	2.90%	1309	264	5.0

Notes: Kuwait 1991/92 dropped as not independent country. Excluding outliers. Includes leaders of all tenures

Appendix Table 2: Outliers based PWT9 Growth Rates

Country Name	Country Code	Year	Growth rate PWT 9	Comparison growth PWT 7.1	WDI
Algeria	DZA	1962	-45.9%	-45.2%	-24.4%
Central African Republic	CAF	2013	-46.7%	Missing	-47.7%
Equatorial Guinea	GNQ	1997	63.5%	76.7%	88.2%
Equatorial Guinea	GNQ	2001	48.4%	38.6%	45.7%
Iran (Islamic Republic of)	IRN	1970	-52.6%	14.0%	7.7%
Iraq	IRQ	1991	-110.9%	-103.9%	-105.0%
Iraq	IRQ	2003	-42.9%	-44.4%	-42.9%
Iraq	IRQ	2004	40.6%	41.9%	40.6%
Kuwait	KWT	1990	Dropped because of Iraqi invasion of Kuwait		
		1991			
		1992	65.3%	13.5%	Missing
Liberia	LBR	All	Influential country*		
Lebanon	LBN	1976	-85.3%	-81.0%	Missing
Lebanon	LBN	1977	60.3%	55.7%	Missing
Lebanon	LBN	1982	-46.5%	-58.1%	Missing
Lebanon	LBN	1989	-55.6%	-57.7%	-55.6%
Mauritania	MRT	1964	41.8%	42.6%	21.5%
Myanmar	MMR	All	Dropped due to growth data irregularities (GDPPC triples in 1970)		
Rwanda	RWA	1994	-62.0%	-70.9%	-64.9%
Zimbabwe	ZWE	2009	42.5%	8.6%	4.2%

Notes: Outliers are dropped when the abs(log-per capita growth)>40% in a given year. Listed data are outliers based on PWT9 growth rates (outliers for PWT 7.1 and WDI generated in an analagous way). *Liberia is dropped due to many influential observations during the first and second Liberian Civil wars.

Appendix Table 3: Country List

Code	Name	Polity Ave	Leaders	Obs*	Code	Name	Polity Ave	Leaders	Obs*
Autocracies/Transition Countries					**Autocracies/Transition Countries (cont)**				
ALB	Albania	-0.3	7	44	NGA	Nigeria	-0.5	11	55
DZA	Algeria	-5.1	6	52	OMN	Oman	-9.2	1	44
AGO	Angola	-4.1	2	40	PAK	Pakistan	1.2	15	64
ARG	Argentina	1.3	18	64	PAN	Panama	2.2	15	64
BHR	Bahrain	-8.9	2	44	PRY	Paraguay	-2.0	9	63
BGD	Bangladesh	0.8	8	44	PER	Peru	3.0	10	64
BEN	Benin	-0.2	9	55	PHL	Philippines	3.2	10	64
BTN	Bhutan	-7.5	8	44	POL	Poland	2.5	7	44
BOL	Bolivia (Plurina	2.0	18	64	PRT	Portugal	2.8	8	64
BWA	Botswana	6.9	4	49	QAT	Qatar	-10.0	4	44
BRA	Brazil	2.8	16	64	KOR	Republic of Korea	1.5	11	61
BGR	Bulgaria	1.8	11	44	ROU	Romania	-0.3	10	54
BFA	Burkina Faso	-3.8	7	55	RWA	Rwanda	-5.4	3	53
BDI	Burundi	-2.6	7	53	SAU	Saudi Arabia	-10.0	4	44
CPV	Cabo Verde	4.1	3	40	SEN	Senegal	-0.4	4	54
KHM	Cambodia	-0.2	5	44	SLE	Sierra Leone	-0.9	9	53
CMR	Cameroon	-6.0	2	54	SGP	Singapore	-1.7	3	54
CAF	Central African	-3.4	6	53	ZAF	South Africa	5.8	9	64
TCD	Chad	-4.7	5	54	ESP	Spain	3.1	7	64
CHL	Chile	3.7	11	63	LKA	Sri Lanka	6.0	10	64
CHN	China	-7.4	6	62	SDN	Sudan (Former)	-4.0	4	44
COL	Colombia	6.3	17	64	SUR	Suriname	2.8	6	40
COM	Comoros	1.4	7	40	SWZ	Swaziland	-9.0	4	44
COG	Congo	-4.8	6	54	SYR	Syrian Arab Republic	-8.0	6	54
CIV	Cote d'Ivoire	-5.5	5	54	TWN	Taiwan	-1.0	6	63
COD	D.R. of the Con	-3.6	4	55	THA	Thailand	1.0	20	64
DJI	Djibouti	-3.4	2	38	TGO	Togo	-4.9	4	54
DOM	Dominican Rep	2.4	11	63	TUN	Tunisia	-5.5	4	54
ECU	Ecuador	4.0	20	64	TUR	Turkey	6.5	16	64
EGY	Egypt	-5.8	8	64	TZA	U.R. of Tanzania: Mai	-4.1	4	54
SLV	El Salvador	2.1	16	64	UGA	Uganda	-2.8	5	53
GNQ	Equatorial Guir	-6.3	3	50	ARE	United Arab Emirates	-8.0	2	44
ETH	Ethiopia	-7.6	5	64	URY	Uruguay	5.6	23	64
FJI	Fiji	4.4	5	45	VEN	Venezuela (Bolivarian	5.7	10	64
GAB	Gabon	-5.7	3	54	VNM	Viet Nam	-7.0	6	44
GMB	Gambia	2.3	2	50	ZMB	Zambia	-0.9	5	51
GHA	Ghana	-1.1	11	59	ZWE	Zimbabwe	-0.9	3	49
GRC	Greece	6.2	15	63	**Established Democracies**				
GTM	Guatemala	1.4	18	64	AUS	Australia	10.0	12	64
GIN	Guinea	-5.3	5	55	AUT	Austria	10.0	11	64
GNB	Guinea-Bissau	-1.4	8	41	BEL	Belgium	9.8	15	64
HTI	Haiti	-4.1	11	54	CAN	Canada	10.0	9	64
HND	Honduras	2.8	18	64	CRI	Costa Rica	10.0	15	64
HUN	Hungary	3.0	9	44	CYP	Cyprus	8.7	7	55
IDN	Indonesia	-2.5	6	54	DNK	Denmark	10.0	13	64
IRN	Iran (Islamic Re	-6.4	6	58	FIN	Finland	10.0	6	64
IRQ	Iraq	-6.9	4	41	FRA	France	8.2	13	64
JOR	Jordan	-6.1	2	60	DEU	Germany	10.0	8	64
KEN	Kenya	-1.6	4	52	IND	India	8.7	12	64
KWT	Kuwait	-8.0	3	41	IRL	Ireland	10.0	12	64
LAO	Lao People's DI	-6.5	5	44	ISR	Israel	7.7	12	64
LBN	Lebanon	2.8	7	40	ITA	Italy	10.0	24	64
LSO	Lesotho	0.5	6	49	JAM	Jamaica	9.6	7	53
MDG	Madagascar	0.6	7	54	JPN	Japan	10.0	25	64
MWI	Malawi	-2.9	5	51	LUX	Luxembourg	10.0	8	64
MYS	Malaysia	5.1	6	58	MUS	Mauritius	9.7	4	47
MLI	Mali	-1.2	6	54	NLD	Netherlands	10.0	12	64
MRT	Mauritania	-5.8	7	53	NZL	New Zealand	10.0	13	64
MEX	Mexico	-0.6	12	64	NOR	Norway	10.0	13	64
MNG	Mongolia	2.2	6	44	SWE	Sweden	10.0	8	64
MAR	Morocco	-6.8	3	59	CHE	Switzerland	10.0	45	64
MOZ	Mozambique	-0.9	3	40	TTO	Trinidad and Tobago	8.9	6	53
NPL	Nepal	-2.0	15	54	GBR	United Kingdom	10.0	13	64
NIC	Nicaragua	-0.7	8	64	USA	United States	10.0	12	64
NER	Niger	-2.1	9	54					

Notes: *Obs with PWT growth data (excluding outliers). Established democracies have average polity score>7.5. (Other countries are autocracies/transition)

Appendix Table 4: Significant Positive Leaders at the 95% level in any of the three datasets*

Name	Country	Dem	Rank (LS leader est)			Significant 95%			LS Leader Estimate			RMS Error		
			PWT9	PWT71	WDI	PWT9	PWT71	WDI	PWT9	PWT71	WDI	PWT9	PWT71	WDI
Khama	BWA	0	#1	#4	#2	1	0	1	3.3%	1.9%	3.1%	1.0%	1.0%	0.9%
Ikeda	JPN	1	#2	#1	#5	1	1	1	2.8%	2.6%	2.5%	0.7%	0.7%	0.9%
Rodriguez Lara	ECU	0	#3	#8	#4	1	0	1	2.5%	1.6%	2.5%	1.0%	0.9%	0.8%
Kishi	JPN	1	#4	#7		1	1		2.5%	1.8%		0.7%	0.7%	
Sato	JPN	1	#5	#2	#16	1	1	1	2.5%	2.4%	1.7%	0.6%	0.6%	0.7%
Razak	MYS	0	#6	#17	#80	1	0	0	2.4%	1.4%	0.8%	1.0%	0.9%	0.9%
Papadopoulos	GRC	0	#7	#5	#8	1	1	1	2.4%	1.9%	2.3%	0.8%	0.8%	0.8%
Medici	BRA	0	#8	#6	#7	1	1	1	2.4%	1.8%	2.3%	0.9%	0.9%	0.9%
Chun Doo Hwan	KOR	0	#9	#14	#6	1	0	1	2.4%	1.5%	2.3%	0.9%	0.8%	0.8%
Masire	BWA	0	#10	#53	#25	1	0	0	2.2%	0.8%	1.5%	1.0%	0.9%	0.9%
Lee Kuan Yew	SGP	0	#11	#31	#11	1	0	1	2.1%	1.2%	1.9%	0.7%	0.7%	0.8%
Raab	AUT	1	#12	#3		1	1		2.0%	2.0%		0.5%	0.6%	
Ahern	IRL	1	#13	#11	#24	1	1	1	2.0%	1.6%	1.5%	0.6%	0.6%	0.6%
Chissano	MOZ	0	#14	#10	#15	1	0	1	2.0%	1.6%	1.9%	0.9%	0.8%	0.9%
Chiang Ching-Kuo	TWN	0	#15	#23		1	0		1.9%	1.3%		0.7%	0.7%	
Rumor	ITA	1	#16	#41	#55	1	0	0	1.8%	1.1%	1.0%	0.6%	0.6%	0.6%
Hee Park	KOR	0	#17	#27	#17	1	0	1	1.8%	1.2%	1.7%	0.7%	0.7%	0.6%
Zhivkov	BGR	0	#19	#13	#70	1	1	0	1.7%	1.5%	0.9%	0.7%	0.6%	0.8%
Karamanlis	GRC	0	#20	#32	#23	1	0	1	1.7%	1.2%	1.5%	0.7%	0.7%	0.7%
Anerood Jugnauth	MUS	1	#24	#35	#3	1	0	1	1.6%	1.2%	2.5%	0.8%	0.8%	0.6%
Panday	TTO	1	#25	#143	#10	0	0	1	1.6%	0.4%	1.9%	0.9%	0.9%	0.9%
Santer	LUX	1	#26	#12	#18	1	1	1	1.6%	1.6%	1.7%	0.7%	0.7%	0.7%
Lopez Portillo	MEX	0	#27	#69	#13	0	0	1	1.6%	0.7%	1.9%	0.9%	0.9%	0.9%
Yoshida, Shigeru	JPN	1	#29	#30		1	0		1.6%	1.2%		0.8%	0.8%	
Vargas	COL	0	#30	#26	#19	1	0	1	1.5%	1.2%	1.6%	0.8%	0.8%	0.7%
Veiga	CPV	0	#34	#46	#1	0	0	1	1.4%	0.9%	3.2%	1.0%	0.9%	0.9%
Bratteli	NOR	1	#38	#16	#39	1	1	0	1.3%	1.4%	1.2%	0.7%	0.7%	0.7%
Chiang Kai-shek	TWN	0	#39	#40		1	0		1.3%	1.1%		0.6%	0.6%	
Fanfani	ITA	1	#40	#21	#44	1	1	0	1.3%	1.3%	1.1%	0.6%	0.6%	0.7%
Do Muoi	VNM	0	#46	#49	#31	0	0	1	1.2%	0.9%	1.3%	0.9%	0.8%	0.6%
Caetano	PRT	0	#49	#24	#9	0	0	1	1.1%	1.3%	2.0%	0.8%	0.8%	0.8%
Suharto	IDN	0	#54	#9	#30	0	1	1	1.1%	1.6%	1.4%	0.7%	0.6%	0.6%
Stroessner	PRY	0	#97	#47	#28	0	0	1	0.8%	0.9%	1.5%	0.7%	0.6%	0.7%
Ayub Khan	PAK	0	#107	#142	#21	0	0	1	0.7%	0.4%	1.6%	0.7%	0.8%	0.7%
Verwoerd	ZAF	0	#109	#211	#20	0	0	1	0.7%	0.2%	1.6%	0.8%	0.7%	0.7%
Kyprianou	CYP	1	#115	#119	#12	0	0	1	0.7%	0.5%	1.9%	0.9%	0.9%	0.6%

Note: List of leaders with tenure>=3yrs which are statistically significant in any of the 3 datasets. Blank indicates leader is missing in dataset. Leaders are ordered by their PWT9 leader estimate as in the main text. *Leaders with tenure ≥3 year and complete growth data by PWT9.

Appendix Table 5: Significant Negative Leaders at the 95% level in any of the three datasets*

Name	Country	Dem	Rank (from worst)			Significant 95%			LS Leader Estimate			RMS Error		
			PWT9	PWT71	WDI	PWT9	PWT71	WDI	PWT9	PWT71	WDI	PWT9	PWT71	WDI
Cedras	HTI	0	-#1	-#71		-1	0		-3.5%	-0.8%		1.1%	1.0%	
Lon Nol	KHM	0	-#2	-#7		-1	0		-3.0%	-1.6%		1.2%	1.0%	
Amin	UGA	0	-#3	-#9		-1	0		-2.7%	-1.5%		0.9%	0.9%	
Gouled Aptidon	DJI	0	-#4	-#2	-#1	-1	0	-1	-2.7%	-1.8%	-3.9%	0.9%	0.9%	0.8%
Mello	BRA	0	-#5	-#20	-#10	-1	0	0	-2.3%	-1.2%	-1.7%	1.0%	0.9%	1.0%
Khalifah Ath-Thani	QAT	0	-#6	-#187		-1	0		-2.1%	-0.3%		0.9%	1.0%	
Bandaranaike, S.W.R.D.	LKA	0	-#7	-#18		-1	0		-2.1%	-1.2%		1.0%	1.0%	
Ferenc Gyurcsany	HUN	0	-#8	-#1	-#22	-1	-1	0	-2.1%	-1.8%	-1.3%	0.8%	0.8%	0.9%
Junichiro Koizumi	JPN	1	-#9	-#3	-#35	-1	-1	0	-2.1%	-1.7%	-1.2%	0.7%	0.7%	0.8%
Mobutu	COD	0	-#10	-#23	-#13	-1	0	0	-2.0%	-1.2%	-1.6%	0.8%	0.9%	0.9%
Arbenz Guzman	GTM	0	-#11	-#14		-1	0		-1.9%	-1.3%		0.8%	0.8%	
Sheikh Mujib Rahman	BGD	0	-#12	-#8	-#2	0	0	-1	-1.8%	-1.6%	-2.0%	1.1%	0.9%	1.0%
Mahendra	NPL	0	-#18	-#15	-#34	-1	0	0	-1.6%	-1.3%	-1.2%	0.8%	0.8%	0.8%
A. Papandreou	GRC	0	-#21	-#10	-#20	-1	-1	-1	-1.5%	-1.4%	-1.4%	0.7%	0.7%	0.7%
B. Cowen	IRL	1	-#22	-#4	-#59	0	-1	0	-1.5%	-1.7%	-1.0%	0.8%	0.8%	0.9%
Wilson	GBR	1	-#23	-#30	-#11	-1	-1	-1	-1.5%	-1.1%	-1.6%	0.6%	0.5%	0.5%
Sukarno	IDN	0	-#25	-#13	-#7	0	0	-1	-1.4%	-1.3%	-1.7%	1.0%	0.9%	0.8%
Zardari	PAK	0	-#30		-#9	0		-1	-1.4%		-1.7%	0.9%		0.8%
Nguyen Van Linh	VNM	0	-#31	-#181	-#15	0	0	-1	-1.4%	-0.3%	-1.5%	1.0%	0.9%	0.7%
Marcos	PHL	0	-#32	-#32	-#58	-1	0	0	-1.4%	-1.0%	-1.0%	0.7%	0.7%	0.7%
Fahd	SAU	0	-#33	-#302	-#3	0	0	-1	-1.4%	0.0%	-2.0%	1.1%	0.9%	0.9%
Nixon	USA	1	-#34	-#22	-#27	-1	0	-1	-1.3%	-1.2%	-1.3%	0.6%	0.6%	0.5%
Eisenhower	USA	1	-#36	-#6		-1	-1		-1.3%	-1.6%		0.5%	0.6%	
Diefenbaker	CAN	1	-#48	-#12		0	-1		-1.2%	-1.4%		0.6%	0.7%	
Lee Myung Bak	KOR	0	-#52	-#94	-#6	0	0	-1	-1.2%	-0.6%	-1.7%	0.9%	0.9%	0.8%
Suarez Gonzalez	ESP	0	-#59	-#33	-#12	0	0	-1	-1.1%	-1.0%	-1.6%	0.9%	0.8%	0.7%
Prodi	ITA	1	-#69	-#17	-#66	0	-1	0	-1.0%	-1.2%	-0.9%	0.6%	0.6%	0.6%
MacMillan	GBR	1	-#71	-#24	-#32	0	-1	0	-1.0%	-1.1%	-1.3%	0.6%	0.5%	0.7%
van Agt	NLD	1	-#75	-#43	-#51	0	0	-1	-1.0%	-0.9%	-1.1%	0.6%	0.7%	0.5%
Schroder	DEU	1	-#80	-#37	-#60	0	-1	-1	-1.0%	-1.0%	-1.0%	0.6%	0.5%	0.5%
Berlusconi	ITA	1	-#83	-#36	-#103	0	-1	0	-0.9%	-1.0%	-0.7%	0.5%	0.5%	0.4%
Chirac	FRA	1	-#108	-#53	-#94	-1	-1	-1	-0.8%	-0.9%	-0.8%	0.3%	0.4%	0.3%

Note: List of leaders with tenure>=3yrs which are statistically significant in any of the 3 datasets. Blank indicates leader is missing in dataset. Leaders are ordered by their PWT9 leader estimate as in the main text. *Leaders with tenure ≥3 year and complete growth data by PWT9.

Appendix Table 6: Leaders with a significant positive growth effect at 90% level (tenure 3+ yrs; complete growth data*)

	Name	Country	LS Leader Estimate	RMS Error	Raw Growth Average	Shrinkage (ψ)	Sig95%	Sig 99%	Tenure	Dem	1stYear	Rank (Incl. insignificant)
1	Khama	BWA	3.25%	1.01%	9.56%	0.43	1	1	15	0	1966	#1
2	Ikeda	JPN	2.84%	0.73%	8.65%	0.50	1	1	4	1	1961	#2
3	Rodriguez Lara	ECU	2.52%	1.05%	9.14%	0.39	1	0	4	0	1972	#3
4	Kishi	JPN	2.48%	0.73%	7.81%	0.50	1	1	4	1	1957	#4
5	Sato	JPN	2.48%	0.61%	7.70%	0.65	1	1	8	1	1965	#5
6	Razak	MYS	2.44%	1.01%	7.47%	0.43	1	0	5	0	1971	#6
7	Papadopoulos	GRC	2.43%	0.83%	8.21%	0.62	1	1	6	0	1968	#7
8	Medici	BRA	2.41%	0.94%	8.71%	0.51	1	0	4	0	1970	#8
9	Chun Doo Hwan	KOR	2.35%	0.85%	8.09%	0.60	1	1	7	0	1981	#9
10	Masire	BWA	2.21%	0.99%	5.87%	0.46	1	0	17	0	1981	#10
11	Lee Kuan Yew	SGP	2.11%	0.73%	6.26%	0.71	1	1	30	0	1961	#11
12	Raab	AUT	2.00%	0.51%	5.89%	0.75	1	1	8	1	1953	#12
13	Ahern	IRL	1.98%	0.55%	5.32%	0.72	1	1	11	1	1997	#13
14	Chissano	MOZ	1.96%	0.92%	4.26%	0.53	1	0	18	0	1987	#14
15	Chiang Ching-Kuo	TWN	1.94%	0.73%	6.82%	0.71	1	1	10	0	1978	#15
16	Rumor	ITA	1.82%	0.63%	6.85%	0.63	1	1	4	1	1969	#16
17	Hee Park	KOR	1.80%	0.66%	6.42%	0.76	1	1	19	0	1961	#17
18	Yen Chia-Kan	TWN	1.78%	0.97%	7.47%	0.49	0	0	3	0	1975	#18
19	Zhivkov	BGR	1.75%	0.66%	5.08%	0.76	1	1	19	0	1971	#19
20	Karamanlis	GRC	1.72%	0.68%	4.87%	0.75	1	0	13	0	1956	#20
21	Walesa	POL	1.71%	0.98%	1.95%	0.47	0	0	5	0	1991	#21
22	Subhuza II	SWZ	1.68%	1.00%	4.62%	0.45	0	0	12	0	1971	#22
23	Kubitschek	BRA	1.63%	0.89%	4.79%	0.56	0	0	5	0	1956	#23
24	Anerood Jugnauth	MUS	1.63%	0.80%	4.22%	0.41	1	0	17	1	1982	#24
25	Panday	TTO	1.63%	0.86%	6.52%	0.31	0	0	6	1	1996	#25
26	Santer	LUX	1.60%	0.69%	4.72%	0.56	1	0	10	1	1985	#26
27	Lopez Portillo	MEX	1.57%	0.92%	3.51%	0.53	0	0	6	0	1977	#27
28	Cristiani	SLV	1.55%	0.84%	3.15%	0.62	0	0	5	0	1989	#28
29	Yoshida, Shigeru	JPN	1.55%	0.78%	6.29%	0.43	1	0	3	1	1952	#29
30	Vargas	COL	1.49%	0.76%	2.22%	0.68	1	0	4	0	1987	#30
31	Betancur	COL	1.49%	0.76%	1.22%	0.68	0	0	4	0	1983	#32
32	Mubarak	EGY	1.46%	0.79%	3.50%	0.65	0	0	29	0	1982	#33
33	Mendez Montenegr	GTM	1.42%	0.79%	3.56%	0.66	0	0	4	0	1966	#35
34	Rivera	SLV	1.38%	0.84%	4.22%	0.62	0	0	5	0	1962	#36
35	Bratteli	NOR	1.33%	0.66%	4.15%	0.60	1	0	4	1	1971	#38
36	Chiang Kai-shek	TWN	1.31%	0.61%	5.51%	0.79	1	0	23	0	1952	#39
37	Fanfani	ITA	1.31%	0.59%	4.96%	0.67	1	0	5	1	1958	#40
38	Ceausescu	ROU	1.00%	0.60%	5.22%	0.80	0	0	25	0	1965	#67

Notes: list of leaders who have significantly positive LS leader effect at the 10% level (two-tailed). That is where (LS leader estimate)-Z*(RMS Err)>0 for Z=1.65. Sig 99% is analagous, but where Z=2.576. *Growth data runs 1951-2014 so this excludes leaders with part of their tenure before 1951 or after 2014.

Appendix Table 7: Leaders with a significant negative growth effect at 90% level (tenure 3+ yrs; complete growth data*)

	Name	Country	LS Leader Estimate	RMS Error	Raw Growth Average	Shrinkage (ψ)	Sig 95%	Sig 99%	Tenure	Dem	1stYear	Rank (Incl. insignificant)
1	Cedras	HTI	-3.53%	1.10%	-9.85%	0.33	-1	-1	3	0	1992	-#1
2	Lon Nol	KHM	-3.02%	1.18%	-11.12%	0.23	-1	0	4	0	1971	-#2
3	Amin	UGA	-2.74%	0.88%	-2.97%	0.58	-1	-1	8	0	1971	-#3
4	Gouled Aptidon	DJI	-2.67%	0.93%	-4.28%	0.52	-1	-1	22	0	1977	-#4
5	Mello	BRA	-2.34%	1.00%	-2.97%	0.45	-1	0	3	0	1990	-#5
6	Khalifah Ath-Thani	QAT	-2.13%	0.94%	-3.19%	0.51	-1	0	23	0	1972	-#6
7	Bandaranaike, S.W.R	LKA	-2.12%	1.04%	-2.85%	0.41	-1	0	4	0	1956	-#7
8	Ferenc Gyurcsany	HUN	-2.07%	0.85%	2.48%	0.60	-1	0	4	0	2005	-#8
9	Junichiro Koizumi	JPN	-2.06%	0.66%	1.08%	0.59	-1	-1	6	1	2001	-#9
10	Mobutu	COD	-1.98%	0.84%	-3.20%	0.61	-1	0	31	0	1966	-#10
11	Arbenz Guzman	GTM	-1.86%	0.79%	-0.99%	0.66	-1	0	4	0	1951	-#11
12	Sheikh Mujib Rahma	BGD	-1.80%	1.06%	-3.45%	0.38	0	0	4	0	1972	-#12
13	Mahendra	NPL	-1.63%	0.78%	0.41%	0.66	-1	0	11	0	1961	-#18
14	A. Papandreou	GRC	-1.52%	0.73%	0.68%	0.71	-1	0	10	0	1982	-#21
15	B. Cowen	IRL	-1.49%	0.77%	-4.22%	0.45	0	0	3	1	2008	-#22
16	Wilson	GBR	-1.46%	0.56%	0.78%	0.71	-1	-1	7	1	1965	-#23
17	Senghor	SEN	-1.41%	0.83%	-1.15%	0.62	0	0	20	0	1961	-#27
18	Marcos	PHL	-1.36%	0.69%	0.85%	0.74	-1	0	20	0	1966	-#32
19	Nixon	USA	-1.34%	0.58%	1.83%	0.69	-1	0	6	1	1969	-#34
20	Eisenhower	USA	-1.34%	0.53%	1.23%	0.73	-1	0	8	1	1953	-#36
21	de Valera	IRL	-1.34%	0.69%	0.82%	0.56	0	0	5	1	1951	-#38
22	Diefenbaker	CAN	-1.21%	0.64%	1.05%	0.61	0	0	6	1	1957	-#48
23	Prodi	ITA	-1.03%	0.59%	1.51%	0.67	0	0	5	1	1996	-#69
24	MacMillan	GBR	-1.02%	0.56%	1.68%	0.71	0	0	7	1	1957	-#71
25	Schroder	DEU	-0.96%	0.57%	1.24%	0.70	0	0	7	1	1999	-#80
26	Berlusconi	ITA	-0.93%	0.48%	-0.12%	0.79	0	0	10	1	1994	-#83
27	Chirac	FRA	-0.81%	0.34%	1.72%	0.89	-1	0	12	1	1995	-#108

Notes: list of leaders who have significant negative LS leader effect at the 10% level (two-tailed). That is if (LS leader est.)+Z*(RMS Err)<0 for Z=1.645. Sig 99% is analagous, but where Z=2.576. *Growth data runs 1951-2014 so this excludes leaders with part of their tenure before 1951 or after 2014.

Appendix Table 8: Alterantive Estimates of Variance Components

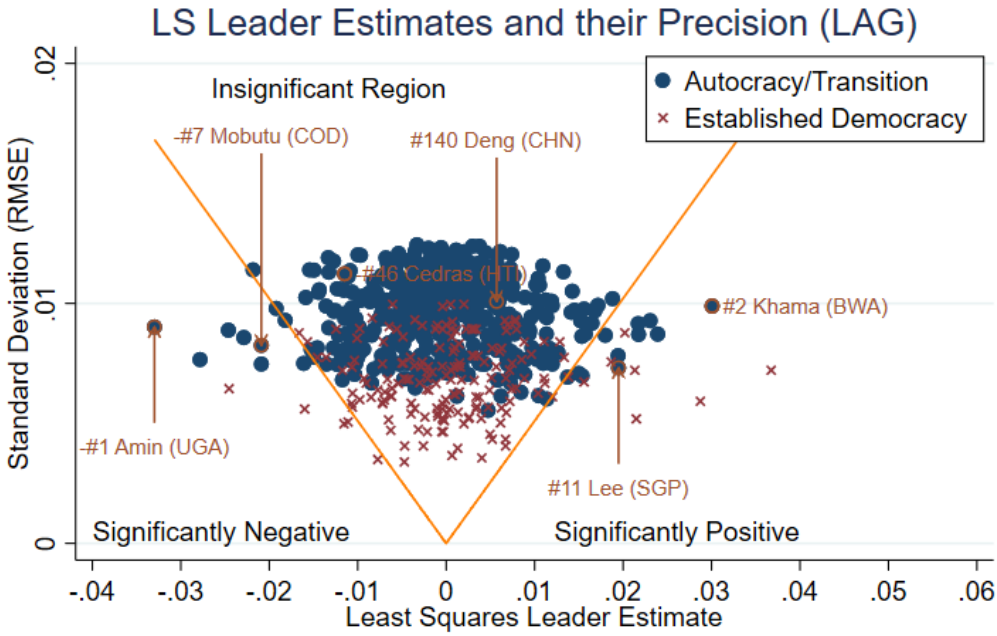
	1. Pooled					2. Autocracies/Transition			3. Established Democracies		
	SD(leader)	SD(CE)	SD(iid)*	Obs	Leaders	SD(leader)	SD(CE)	SD(iid)*	SD(leader)	SD(CE)	SD(iid)*
Default (PWT9)	1.33%	0.65%	4.58%	7052	1122	1.35%	0.72%	4.99%	1.04%	0.42%	2.62%
WDI Data	1.25%	0.85%	4.27%	6083	976	1.22%	0.97%	4.66%	1.10%	0.32%	2.17%
PWT 7.1 Data	1.10%	0.64%	5.37%	6645	1074	1.08%	0.73%	5.81%	1.01%	0.32%	3.23%
1 year lag (PWT9)	1.27%	0.70%	4.57%	6931	1102	1.27%	0.78%	4.99%	1.10%	0.46%	2.49%
No Observables, γ=0 (PWT9)	1.71%	0.90%	4.90%	7052	1122	1.74%	1.01%	5.32%	1.27%	0.53%	2.90%

Notes: Estimates of variance components using the method described in the text (Equations 9-11) on growth data (excluding outliers). Default (PWT9) is repeated from Table II in the main text. WDI and PWT7.1 apply the same methodology, but with with different sources of growth data. "1 year lag" also uses PWT growth data, but lags the effect of leaders on growth by 1 year. The "no observables" specification removes adjustments for observable region X yr effects and imposes γ=0. Established Democracies are defined as countries with a average polity score>7.5 (Autocracies/Transition Countries otherwise)* SD(iid) is the across-sample SD of the iid error, though in the estimation of leader effects, we allow this to vary across countries.

Online Appendix 5: Alternative Assumption – Leaders affect Growth with a 1 year Lag

Assuming that leaders affect growth with a one year lag (rather than contemporaneously) reduces the estimate SD of Autocratic/Transition countries (σ_{μ}^{AUT}) from 1.35% to 1.27%, which reduces the size of shrinkage factor ψ for autocratic countries. It also slightly increases σ_{μ}^{DEM} by 0.06ppts. The total number of statistically significant leaders is reduced with the lag specification (by around 25%, from 44 to 33), which is qualitatively what one would expect if the leader effects were contemporaneous and so lagging *reduced* the connection between leaders and growth. The fraction of leaders that are democratic increases slightly from 36% to 42%. The overall top-growth leader (Khama; BWA) drops to second place, and Japanese leader Kishi jumps several spots to first place (other Japanese leaders are reshuffled). At the other end, the overall lowest-growth leader, Raoul Cedras (HTI, $T_i = 3yrs$) drops out of the negative significant list because with the lag specification he gets credit for +7.5% growth in 1995 after Aristide was returned to power and the sanctions on Haiti were lifted. Intuitively, leaders with a long tenure or in countries with less volatile growth have contributions that are more robust to changes in timing assumptions.[7]

Appendix Figure 6



Notes: Orange lines mark the border of statistical significance, where 1.96*SD=abs(leadereffect) Each LS leader effect is a dot/cross. Open circles are named leaders. Sample with tenure>=3yrs and complete growth data. Leaders in SE(SW) corner are significantly positive (negative).

[7] Lon Nol (KHM, $T_i = 4yrs$), previously the second lowest contribution leader, also drops out of the significant list. He still has a very negative estimated contribution, but one that becomes marginally insignificant.

Appendix Table 9: Leaders with a Statistically Significant Growth Contribution (tenure≥3yrs, complete growth data) - 1 year lag											
	Name	Country	LS Leader Estimate	RMS Error	Raw Growth PC Average	Shrinkage (ψ)	Sig 99%	Tenure	Dem	1st Year	Rank (Incl. Insignificant)
Panel A: leaders with a significant POSITIVE growth contribution											
1	Kishi	JPN	3.67%	0.72%	8.72%	0.57	1	4	1	1957	#1
2	Khama	BWA	3.01%	0.99%	9.70%	0.39	1	15	0	1966	#2
3	Sato	JPN	2.87%	0.59%	7.94%	0.71	1	8	1	1965	#3
4	Chun Doo Hwan	KOR	2.39%	0.87%	8.76%	0.53	1	7	0	1981	#4
5	Yen Chia-Kan	TWN	2.31%	0.93%	9.92%	0.47	0	3	0	1975	#5
6	Kubitschek	BRA	2.17%	0.87%	5.88%	0.53	0	5	0	1956	#6
7	Medici	BRA	2.17%	0.92%	8.29%	0.48	0	4	0	1970	#7
8	Raab	AUT	2.15%	0.52%	6.07%	0.78	1	8	1	1953	#8
9	Ikeda	JPN	2.13%	0.72%	7.18%	0.57	1	4	1	1961	#9
10	Panday	TTO	2.02%	0.88%	6.63%	0.36	0	6	1	1996	#10
11	Lee Kuan Yew	SGP	1.95%	0.73%	6.24%	0.67	1	30	0	1961	#11
12	Cristiani	SLV	1.94%	0.78%	4.14%	0.62	0	5	0	1989	#12
13	Anerood Jugnauth	MUS	1.86%	0.76%	4.26%	0.52	0	17	1	1982	#14
14	Veiga	CPV	1.80%	0.87%	4.53%	0.53	0	10	0	1991	#15
15	Santer	LUX	1.55%	0.67%	4.48%	0.62	0	10	1	1985	#21
16	Zhivkov	BGR	1.54%	0.70%	4.29%	0.70	0	19	0	1971	#22
17	Chiang Ching-Kuo	TWN	1.50%	0.71%	6.40%	0.69	0	10	0	1978	#25
18	Manmohan Singh	IND	1.38%	0.69%	5.99%	0.60	0	10	1	2004	#29
19	Hee Park	KOR	1.37%	0.69%	6.19%	0.70	0	19	0	1961	#30
20	Ahern	IRL	1.20%	0.61%	4.05%	0.69	0	11	1	1997	#37
Panel B: leaders with a significant NEGATIVE growth contribution (rank from last)											
-1	Amin	UGA	-3.30%	0.90%	-5.00%	0.495	-1	8	0	1971	-#1
-2	Ferenc Gyurcsany	HUN	-2.78%	0.77%	-0.30%	0.636	-1	4	0	2005	-#2
-3	Romero Mena	SLV	-2.46%	0.89%	-3.39%	0.510	-1	3	0	1977	-#3
-4	Junichiro Koizumi	JPN	-2.46%	0.65%	1.40%	0.654	-1	6	1	2001	-#4
-5	Gouled Aptidon	DJI	-2.29%	0.86%	-3.19%	0.544	-1	22	0	1977	-#5
-6	Mobutu	COD	-2.09%	0.83%	-3.58%	0.577	0	31	0	1966	-#7
-7	Pizano	COL	-2.09%	0.75%	-1.12%	0.653	-1	4	0	1995	-#8
-8	Sukarno	IDN	-1.92%	0.98%	-1.09%	0.405	0	5	0	1961	-#9
-9	Arbenz Guzman	GTM	-1.61%	0.75%	-0.73%	0.651	0	4	0	1951	-#12
-10	Eisenhower	USA	-1.60%	0.56%	0.98%	0.739	-1	8	1	1953	-#13
-11	van Acker	BEL	-1.16%	0.50%	1.34%	0.793	0	4	1	1954	-#42
-12	Berlusconi	ITA	-1.11%	0.51%	-0.18%	0.787	0	10	1	1994	-#51
-13	Chirac	FRA	-0.78%	0.35%	1.73%	0.898	0	12	1	1995	-#99

Notes: list of leaders (tenure >=3yrs) which have significantly LS leader effect at the 5% level (two-tailed). That is where (LS leader estimate)-1.96*(RMS Err)>0 or (LS leader estimate+1.96*(RMS Err)<0. Sig at 99% is analagous.

Online Appendix 6: Data Sources

Leader Data

Leader data comes from Archigos 4.1 (described in Goemans et al 2009), downloaded from http://privatewww.essex.ac.uk/~ksg/archigos.html (data file: arch_annual.txt, accessed 15 March 2017). In the case there are multiple leaders in office in a particular year, the year is allocated to the leader in office for the most number of days.[8]

Polity IV Data (Established Democracy vs Autocracy/Transition Country)

Polity IV data comes from: http://www.systemicpeace.org/inscr/p4v2015.xls (accessed 15 March 2017). We calculated the average Polity score over our sample, with established democracies having an average polity score >=7.5, and autocracies/transition countries have an average polity score <7.5. Countries with no Polity data for the whole sample were dropped.

PWT Growth Data

We use two versions of PWT data: PWT 9 and PWT 7.1. PWT 9 is our main dataset and uses the sample 1951-2014. PWT 7.1 use the sample 1951-2010. Data downloaded from http://www.rug.nl/ggdc/productivity/pwt/. (Accessed 15 March 2017) For PWT9, the GDP per capita growth series is calculated as the log growth rate of national accounts real GDP divided by population; using PWT9 variable names: $ln(rgdpna_t/pop_t) - ln\,(rgdpna_{t-1}/pop_{t-1})$. For PWT7.1: 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 Indicators Growth Data

We use GDP per capita growth (annual %) (NY:GDP.PCAP:KD.ZG). Data can be downloaded from: http://data.worldbank.org/data-catalog/world-development-indicators
(accessed 17 March 2017) We convert ppt actual growth rates G into log growth rates: growth=log(1+G/100)

Data Sample and Cleaning

WDI growth data was only available starting in 1961 (and so the sample runs 1961-2014, with an end date to match that in PWT9). We drop observations where |growth|>0.4 as described in the text, as well as Kuwait in 1990/91, Liberia, and Myanmar (see Section 3 and Appendix Table 2).[9] We drop countries with less than 30 years of growth data (combined across all our data sources).

[8] 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. An earlier version of this paper used leader data from Jones and Olken (2005) – we thank Ben Jones and Ben Olken for sharing their data.

[9] We drop data for Myanmar because the measures of GDP per capita in PWT9 trebles in 1970, which might be due to a change in methodology that makes measured GDP before and after 1970 incomparable. Before opening to international organizations around 2011, there were few external checks on Myanmar's economic statistics. In the 2013 IMF Myanmar Article IV, the IMF estimates growth rates in 2009 and 2010 to be around half that of the official numbers (Table 1 of that report).