

How Much Should We Trust the Dictator's GDP Growth Estimates?

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Do autocracies overstate GDP growth more than democracies?

- The state of the economy is a major determinant of political turnover in both democracies and autocracies (Leigh, 2009; Burke and Leigh, 2010; Bruckner and Ciccone, 2011)
- All governments would like to overstate GDP growth, but do the checks and balances provided by democracy constrain their ability to do so?
- Overstatement of GDP growth:
 - Exemplifies the manipulation of information that characterizes modern authoritarian regimes (Guriev and Treisman, 2019, 2022)
 - Hinders political accountability, causes resource misallocation, and biases economic research

I use night-time lights to detect overstatement of GDP growth in autocracies

- I compare two measures of economic activity that aren't equally prone to manipulation:
 - Self-reported GDP figures
 - Night-time lights (NTL) recorded by satellites from outer space
- Is the same amount of NTL growth associated with higher GDP growth in autocracies than in democracies?
- Baseline strategy: Panel regressions for 184 countries between 1992 and 2013

Body of evidence suggests sizable overstatement of GDP growth in autocracies

- There is an autocracy gradient in the NTL elasticity of GDP, which is not explained by differences in a large number of observable characteristics
 - Only present in GDP sub-components that rely on the government for information
 - Larger gradient when the incentive to overstate GDP growth is stronger
- Findings imply that autocracies overstate GDP growth by a factor of 1.35 on average
- Adjustment of GDP growth figures affects our understanding of countries' comparative economic performance in recent decades

This paper contributes to several strands of academic literature

- **Manipulation of information and media in autocracies:**

Egorov et al., 2009; Hollyer et al., 2011; Edmond, 2013; King et al., 2013, 2017; Gehlbach and Sonin, 2014; Lorentzen, 2014; **Magge and Doces, 2015**; Gehlbach et al., 2016; Wallace, 2016; Guriev and Treisman, 2020

- **Accuracy of China's official statistics:**

Mehrotra and Paakkonen, 2011; Nakamura et al., 2016; Chen et al., 2019; Clark et al., 2020

- **Credibility of official statistics:**

Cavallo, 2013; Michalski and Stoltz, 2013; Alt et al., 2014; Sandefur and Glassman, 2015; Kerner et al., 2017

- **National accounts vs other sources on living standards:**

Deaton, 2005; Chen and Nordhaus, 2011; Henderson et al., 2012; Young, 2012; Pinkovskiy and Sala-i Martin, 2014, 2016

- **Forensic economics:** Fisman and Wei, 2004, 2009; Olken, 2007; Zitzewitz, 2012

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Checks and balances reduce the manipulation of information in democracies

- A strong democracy is characterized by a system of checks and balances that limits the power of the executive (Montesquieu, 1748)
 - Free elections, legislative/judicial oversight, freedom of the press/information
- These checks and balances are largely absent in authoritarian regimes
- Modern autocracies are increasingly reliant on alleged success as source of legitimacy (Guriev and Treisman, 2019, 2022)
 - Manipulation of art and photography in USSR (King, 1997)
 - Fabrication of social media content in China (King et al., 2013, 2017)
 - Manipulation of 1937 Soviet census (Merridale, 1996)
 - Unreliability of China's GDP figures (Clark et al., 2020)

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I build a panel on GDP, NTL, and democracy for 184 countries between 1992 and 2013

- National statistical agencies report yearly GDP growth to World Bank (WDI: Nov. 2014)
- Data on night-time lights is provided by NOAA based on USAF's DMSP-OLS:
 - Processing of satellite data yields a lights Digital Number (DN): 0-63
 - Data available at pixel-year level ($\approx 0.86 \text{ km}^2$ at equator) for period 1992-2013
 - I calculate an area-weighted DN average per country-year
- I classify regimes using Freedom House's 'Freedom in the World' (FiW) index
 - FiW rates countries from most (0) to least democratic (6)
 - Broad concept of democracy: sub-indices for 'civil liberties' and 'political rights'
 - FiW has 15% more countries than Polity IV

Model: GDP and NTL correlate with true growth, but only GDP can be manipulated

- True economic growth in democracies is given by baseline rate $y_{i,t}^d$, which may be different from the growth rate of autocracies by shifter α

$$\tilde{y}_{i,t} = y_{i,t}^d + \alpha a_{i,t} \quad (1)$$

- Recorded GDP growth is a noisy measure of true growth ($\beta > 0$)

$$\text{gdp}_{i,t} = \beta \tilde{y}_{i,t} + \epsilon_{i,t} \quad (2)$$

- Reported growth may be inflated additively or proportionally in autocracies ($\sigma, \theta \geq 0$)

$$\widehat{\text{gdp}}_{i,t} = (1 + \sigma a_{i,t}) \text{gdp}_{i,t} + \theta a_{i,t} \quad (3)$$

- NTL growth is also a noisy measure of true growth, that can't be manipulated but may not capture growth equally well across political regimes ($\gamma^d \neq \gamma^a$)

$$\text{lights}_{i,t} = \gamma^d y_{i,t}^d + \gamma^a \alpha a_{i,t} + u_{i,t} \quad (4)$$

Proportional exaggeration can be detected through the interaction of NTL and autocracy

- Combining (1)-(4) we obtain:

$$\widehat{\text{gdp}}_{i,t} = \frac{\beta}{\gamma^d} \text{lights}_{i,t} + \frac{\beta\sigma}{\gamma^d} (\text{lights}_{i,t} \times a_{i,t}) + (\lambda + \theta) a_{i,t} + \sigma \lambda a_{i,t}^2 + \nu_{i,t} \quad (5)$$

$$\text{where } \lambda \equiv (1 - \frac{\gamma^a}{\gamma^d})\beta\alpha$$

- I rewrite (5) in log-linear form in levels + use FiW as measure of autocracy + disaggregate error term into country, year and idiosyncratic components

$$\ln(\text{GDP})_{i,t} = \mu_i + \delta_t + \phi_0 \ln(\text{NTL})_{i,t} + \phi_1 \text{FiW}_{i,t} + \phi_2 \text{FiW}_{i,t}^2 + \phi_3 (\ln(\text{NTL})_{i,t} \times \text{FiW}_{i,t}) + \xi_{i,t} \quad (6)$$

$$\Rightarrow \hat{\sigma} = \frac{\hat{\phi}_3}{\hat{\phi}_0} \times \text{IQR of FiW (bootstrapping for S.E. and 95\% C.I.)}$$

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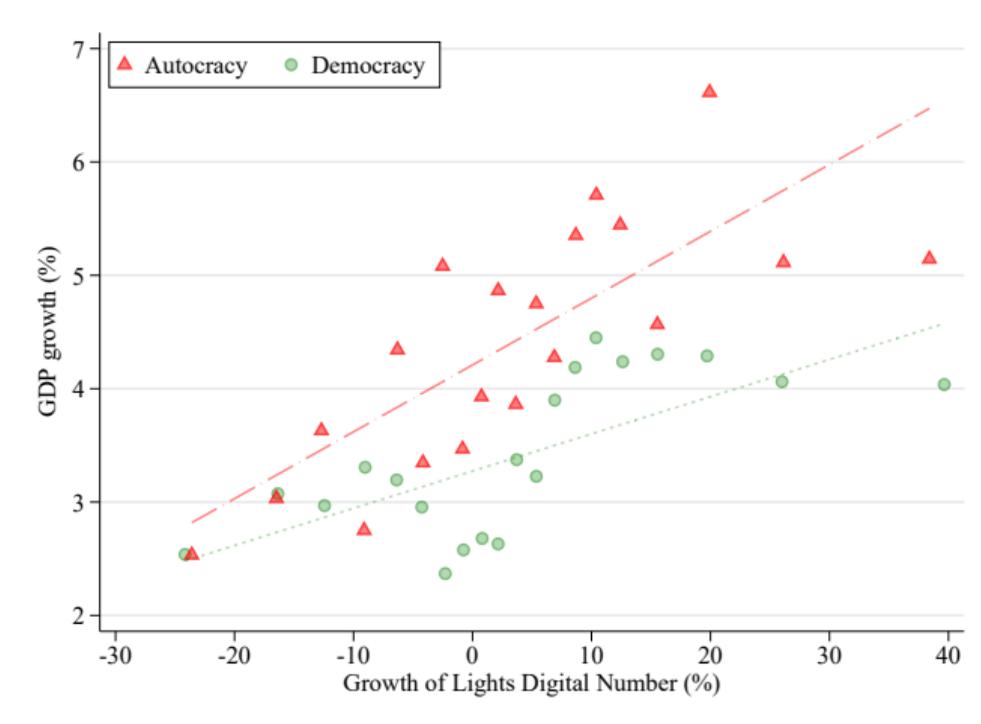
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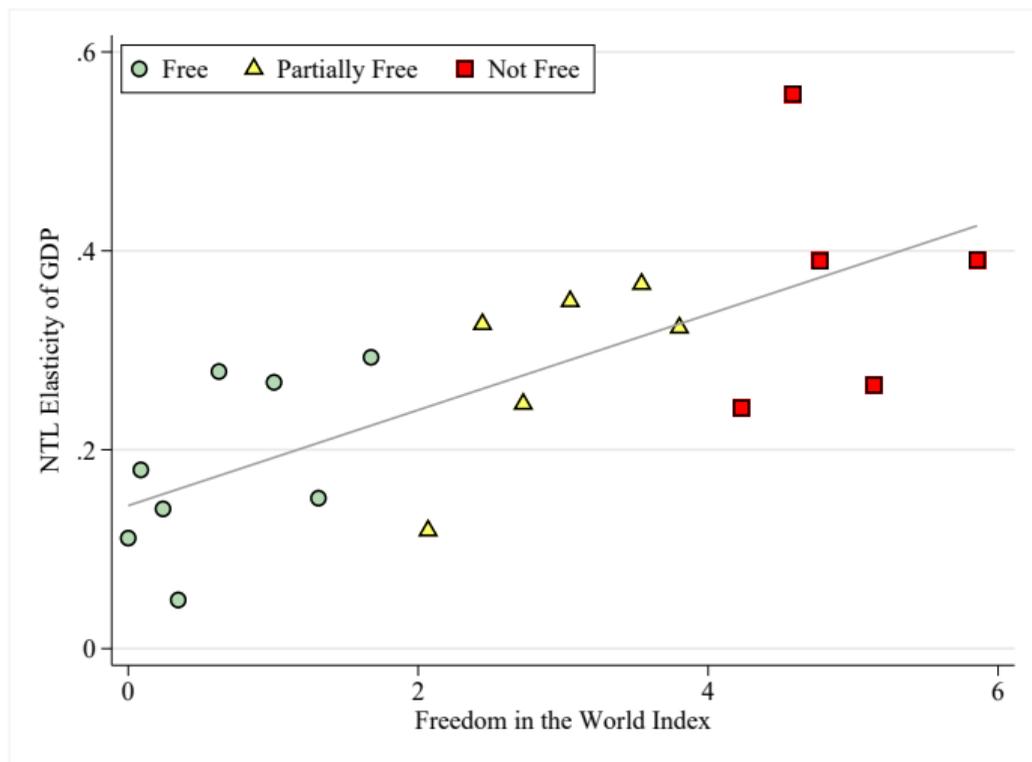
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Raw averages of GDP and NTL growth suggest presence of autocracy gradient



Notes: Figure shows separate binned scatter plots of yearly growth in real GDP (constant local currency) and NTL for country-years classified as democracies and autocracies. Classification based on the binary measure of Electoral Democracy produced by Freedom House. Figure also shows separate lines of best fit, which are estimated using the disaggregate data without binning. Sample size: 3,432. Sample period: 1993-2013.

Country-specific NTL elasticities of GDP suggest presence of autocracy gradient



Notes: Figure shows a binned scatter plot of disaggregate estimates of the NTL elasticity of GDP by country against countries' average FiW index. The regression used to estimate the country-specific NTL elasticity of GDP includes country and year fixed effects. Sample size: 3,895. Sample period: 1992-2013.

A same-sized increase in NTL is associated with higher GDP growth in autocracies

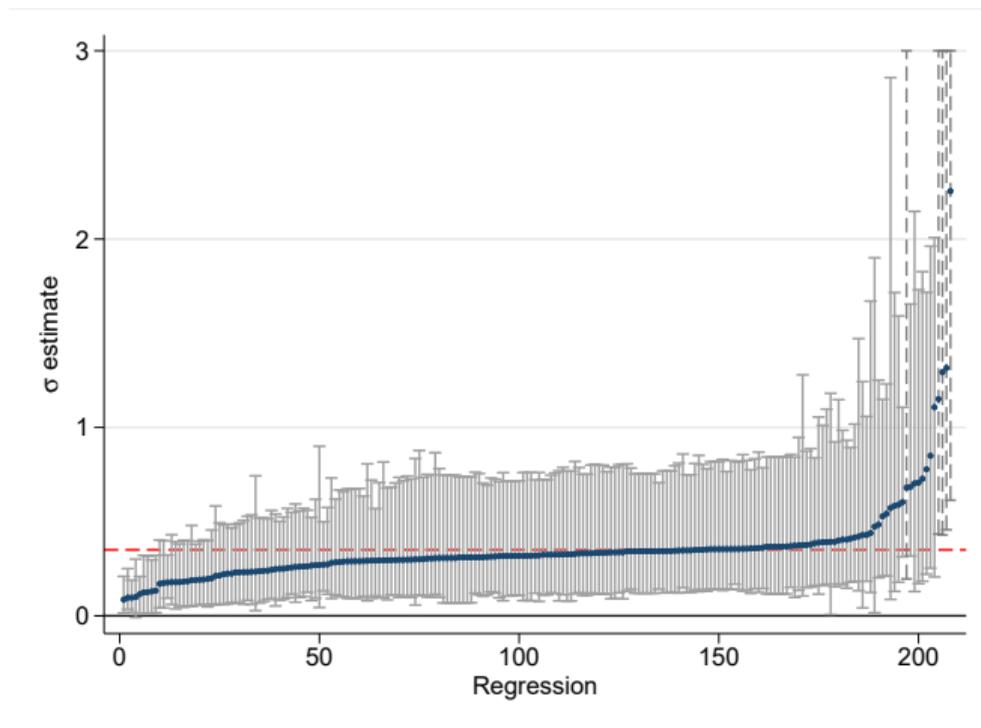
	Dependent variable: $\ln(\text{GDP})_{i,t}$				
	(1)	(2)	(3)	(4)	(5)
$\ln(\text{NTL})_{i,t}$	0.296*** [0.044]	0.292*** [0.042]	0.215*** [0.043]	0.214*** [0.043]	0.288*** [0.067]
$\text{FiW}_{i,t}$		-0.023** [0.010]	-0.006 [0.010]	-0.015 [0.025]	-0.086* [0.048]
$\text{FiW}_{i,t}^2$				0.002 [0.005]	0.012 [0.008]
$\ln(\text{NTL})_{i,t} \times \text{FiW}_{i,t}$			0.021*** [0.005]	0.022*** [0.005]	0.032*** [0.008]
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	3,895	3,895	3,895	3,895	332
Countries	184	184	184	184	166
(Within country) R^2	0.219	0.226	0.259	0.260	0.466
$\hat{\sigma}$			0.342	0.354	0.388
$\hat{\sigma}$ S.E.			(0.158)	(0.166)	(0.264)
$\hat{\sigma}$ 95% C.I.			[0.14,0.78]	[0.14,0.82]	[0.11,1.05]

Notes: Dependent variable is $\ln(\text{GDP})$ in constant local currency units. $\ln(\text{NTL})$ is the log of the area-weighted average of a country's cell-level night time lights (NTL) digital number. The Freedom in the World (FiW) index ranges from 0 to 6, with lower values corresponding to greater enjoyment of civil liberties and political rights. The sample in columns 1-4 includes country-years between 1992 and 2013. In column 5, two-year averages for 1992/93 and 2012/13 are used instead. All regressions include country and year fixed effects. Robust standard errors clustered by country in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The autocracy gradient in the NTL elasticity of GDP is very robust

- Results are not driven by heterogeneity in the NTL elasticity of GDP arising from cross-country differences in economic structure, characteristics of NTL, geography, level of development, or statistical capacity
- Results are robust to using alternative sources on democracy (e.g., Polity), NTL (e.g., VIIRS until 2018), or GDP (e.g., other vintages of WDI)
- Results are also unaffected by alternative econometric specifications or by changes in the composition of the sample (e.g., removing any country or subregion)

The autocracy gradient in the NTL elasticity of GDP is very robust



Notes: Figure plots the estimated value of σ and its bias-corrected 95% confidence interval from the regressions in Tables 1, 3, 4, 6, Appendix Tables D1-D16 and Appendix Figures D1, D3 and D4. The estimates in panels (a) and (b) of Figure D4, Figure D5, and columns 1-3 of Table D16 are not included. Confidence intervals based on 1,000 bootstrap samples, clustered by country. The average value of $\hat{\sigma}$ (dashed red line) is 0.351 (median is 0.320). The total number of estimates is 208. To facilitate visualization, the upper bound of the 95% confidence interval has been censored at 3 (five affected cases are denoted by dashed lines).

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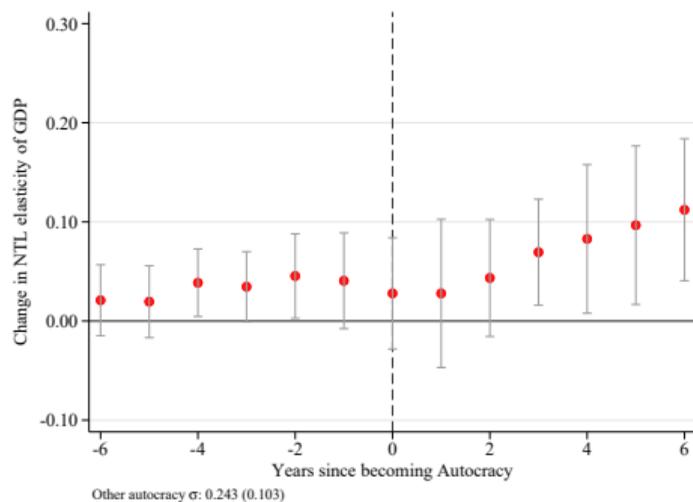
Several pieces of further evidence suggest overstatement of GDP growth as mechanism

- Event study estimates for episodes of regime change
- Disaggregate estimates for GDP subcomponents
- Heterogeneous effects:
 - Domestic economy underperforming
 - Eligibility for foreign aid (IDA)

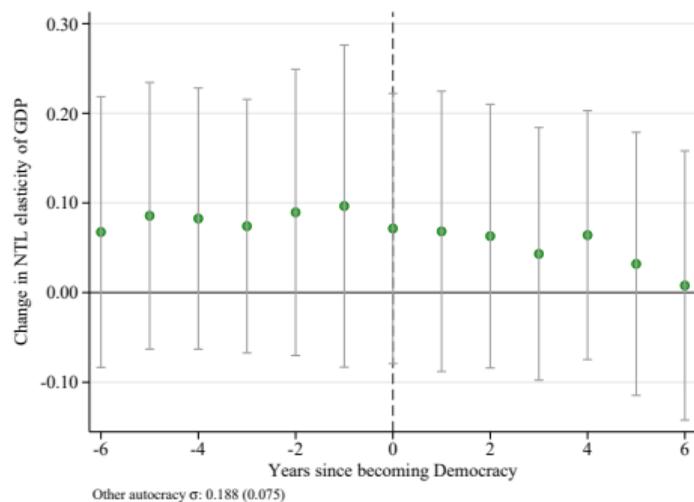
Does the NTL elasticity of GDP change with regime transitions?

- Main results are based on a combination of cross-country and within-country differences in political regime
- Data manipulation mechanism suggests that elasticity increases after countries transition into dictatorship and decreases when they transition into democracy
- I use FH's binary measure of autocracy and focus on episodes lasting at least 8 years
 - 24 transitions into autocracy and 20 out of it during sample period

NTL elasticity of GDP \uparrow (\downarrow) after countries transition into (out of) autocracy



(a) Democracy to Autocracy



(b) Autocracy to Democracy

Notes: Each panel shows point estimates and 95% confidence intervals from a regression of $\ln(\text{GDP})$ on interactions of dummies for the six years before and after a political transition with $\ln(\text{NTL})$. Additional interactions with dummies for years 7 and beyond on both ends not reported. Regression also includes $\ln(\text{NTL})$ and the respective transition year dummies, as well as a dummy for other autocracies (i.e., non-transitions) and its interaction with $\ln(\text{NTL})$ (estimates not reported). Country and year fixed effects also included. Standard errors clustered by country. Sample size: 3,895. Sample period: 1992-2013. To be included, a transition event must last at least four years. Also, the four years prior to the event and the four years after the event must take place during the sample period.

Which subcomponents of GDP drive the autocracy gradient of the NTL elasticity?

- Expenditure decomposition: $Y = C + I + G + X - M$
- Subcomponents on general government final consumption (G) and investment (I, which includes public investment) rely on the government as a key source of information
 - Chen et al. (2019) find that the gap between local and aggregate GDP in China is driven by the overstatement of investment at the local level
- In contrast, household final consumption (C) and net exports (X-M) have some degree of third-party verification (i.e., household surveys, trade partners)

Autocracy gradient in NTL elasticity of GDP driven by gvt. spending and investment

	Consumption	Investment	Government	Exports	Imports
	(1)	(2)	(3)	(4)	(5)
$\ln(\text{NTL})_{i,t}$	0.184*** [0.041]	0.353*** [0.083]	0.210*** [0.060]	0.354*** [0.077]	0.253*** [0.054]
$\text{FiW}_{i,t}$	-0.003 [0.035]	0.023 [0.062]	-0.002 [0.041]	-0.007 [0.058]	-0.006 [0.042]
$\text{FiW}_{i,t}^2$	-0.002 [0.006]	-0.010 [0.012]	-0.001 [0.007]	-0.004 [0.011]	-0.005 [0.008]
$\ln(\text{NTL})_{i,t} \times \text{FiW}_{i,t}$	0.004 [0.006]	0.040*** [0.010]	0.030*** [0.007]	0.011 [0.012]	0.013* [0.008]
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	3,416	3,414	3,416	3,416	3,416
Countries	173	173	173	173	173
(Within country) R ²	0.081	0.141	0.128	0.095	0.099
$\hat{\sigma}$	0.078	0.400	0.505	0.105	0.174
$\hat{\sigma}$ S.E.	(0.126)	(0.245)	(0.362)	(0.188)	(0.156)
$\hat{\sigma}$ 95% C.I.	[-0.15,0.38]	[0.15,0.96]	[0.20,1.45]	[-0.17,0.45]	[-0.02,0.53]

Notes: Dependent variable in the header (natural logarithm of amount in constant local currency units): household final consumption expenditure in column 1; gross capital formation in column 2; general government final consumption in column 3; exports of goods and services in column 4; imports of goods and services in column 5. $\ln(\text{NTL})$ is the log of the area-weighted average of a country's cell-level night time lights (NTL) digital number. The Freedom in the World (FiW) index ranges from 0 to 6, with lower values corresponding to greater enjoyment of civil liberties and political rights. All regressions include country and year fixed effects. Robust standard errors clustered by country in brackets. Sample period: 1992-2013. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Is the autocracy gradient larger when the domestic economy is underperforming?

- Presumably the incentive to overstate GDP growth is stronger when the domestic economy is underperforming relative to the rest of the world
- I rely on the objective measure provided by NTL to measure economic underperformance
- i.e., country-year defined as underperforming if residual from regression of $\ln(\text{NTL})$ on country and year fixed effects is negative.

The autocracy gradient is larger when the domestic economy is underperforming

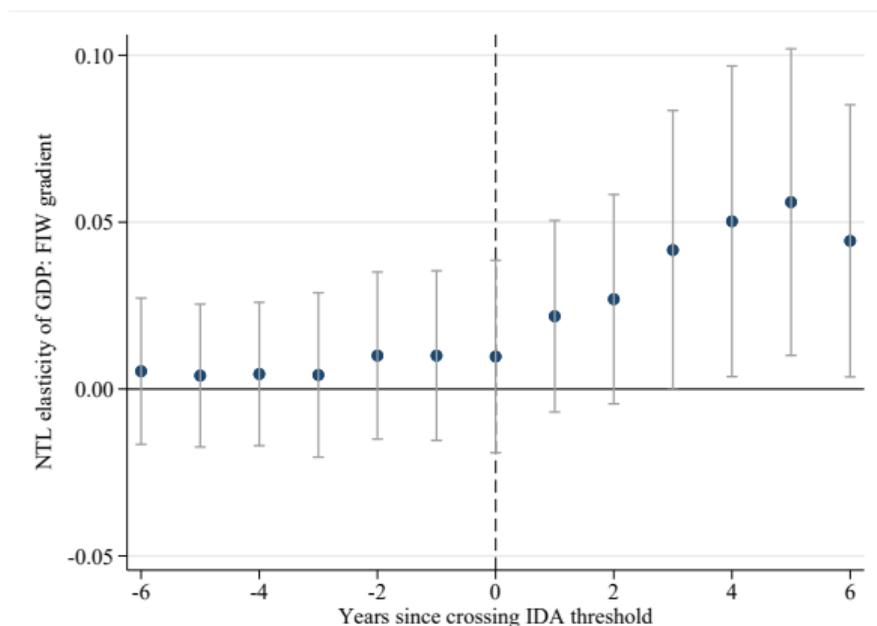
	Dependent variable: $\ln(\text{GDP})_{i,t}$				
	(1)	(2)	(3)	(4)	(5)
$\ln(\text{NTL})_{i,t}$	0.280*** [0.063]	0.203*** [0.055]	0.214*** [0.053]	0.239*** [0.060]	0.241*** [0.057]
$\ln(\text{NTL})_{i,t} \times \text{D}(\text{Low Growth})_{i,t}$	0.003 [0.005]	-0.001 [0.005]	-0.018*** [0.007]	0.000 [0.005]	-0.011* [0.006]
$\ln(\text{NTL})_{i,t} \times \text{FiW}_{i,t}$		0.022*** [0.005]	0.016*** [0.005]		
$\ln(\text{NTL})_{i,t} \times \text{FiW}_{i,t} \times \text{D}(\text{Low Growth})_{i,t}$			0.007** [0.003]		
$\ln(\text{NTL})_{i,t} \times \text{D}(\text{Partially Free})_{i,t}$				0.041*** [0.015]	0.035** [0.014]
$\ln(\text{NTL})_{i,t} \times \text{D}(\text{Not Free})_{i,t}$				0.067*** [0.021]	0.046** [0.020]
$\ln(\text{NTL})_{i,t} \times \text{D}(\text{Partially Free})_{i,t} \times \text{D}(\text{Low Growth})_{i,t}$					0.012 [0.009]
$\ln(\text{NTL})_{i,t} \times \text{D}(\text{Not Free})_{i,t} \times \text{D}(\text{Low Growth})_{i,t}$					0.034** [0.016]
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	3,895	3,895	3,895	3,895	3,895
Countries	184	184	184	184	184
(Within country) R^2	0.219	0.260	0.267	0.238	0.247

Notes: Dependent variable is $\ln(\text{GDP})$ in constant local currency units. $\ln(\text{NTL})$ is the log of the area-weighted average of a country's cell-level night time lights (NTL) digital number. The Freedom in the World (FiW) index ranges from 0 to 6, with lower values corresponding to greater enjoyment of civil liberties and political rights. Dummies for "Partially Free" and "Not Free" countries (columns 4-5, "Free" is the omitted category) also from Freedom House. $\text{D}(\text{Low Growth})_{i,t}$ is a dummy equal to one if the value of $\ln(\text{NTL})$ demeaned by country and year is negative. Estimates for single terms and lower order interactions not reported. Robust standard errors clustered by country in brackets. Sample period: 1992-2013. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Does foreign aid affect the autocracy gradient of the NTL elasticity of GDP?

- IDA provides concessionary loans and grants to countries with GNI per capita below a threshold value
- To the extent that higher GDP growth may precipitate graduation out of the program, IDA beneficiaries are arguably more reluctant to overstate growth
- I test this hypothesis using data for the 88 countries that were IDA beneficiaries during the sample period

The autocracy gradient only appears after countries become ineligible for IDA benefits



Notes: Panel shows point estimates and 95% confidence intervals from a regression of $\ln(\text{GDP})$ on triple interactions of (i) $\ln(\text{NTL})$, (ii) dummies for the six years before and after a country crosses the threshold value of GNI per capita for IDA eligibility, and (iii) the FiW index. Additional interactions with dummies for years 7 and beyond on both ends not reported. Regression also includes all lower order interactions and single terms, GNI per capita and its interaction with $\ln(\text{NTL})$, and the FiW index for countries not crossing the threshold and its interaction with $\ln(\text{NTL})$ (estimates not reported). Country and year fixed effects also included. Standard errors clustered by country. Sample includes 88 IDA beneficiaries at the start of the sample period. Sample size: 1,832. Sample period: 1992-2013.

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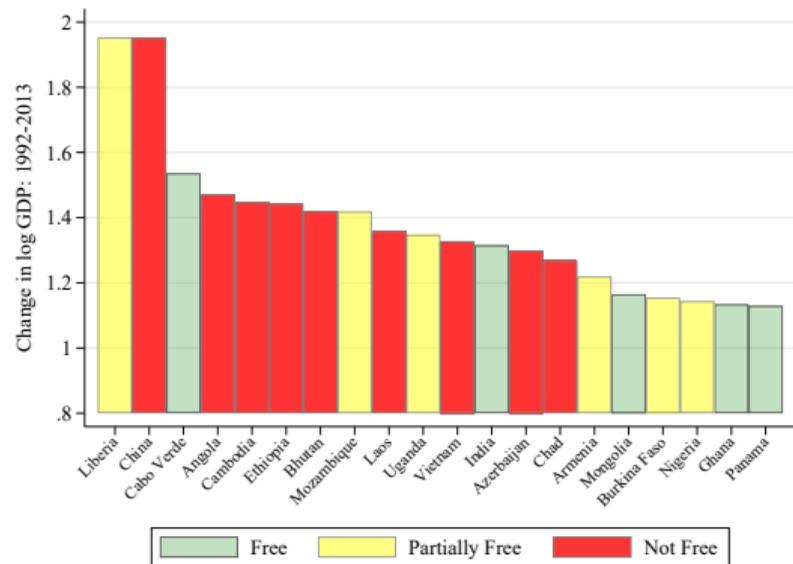
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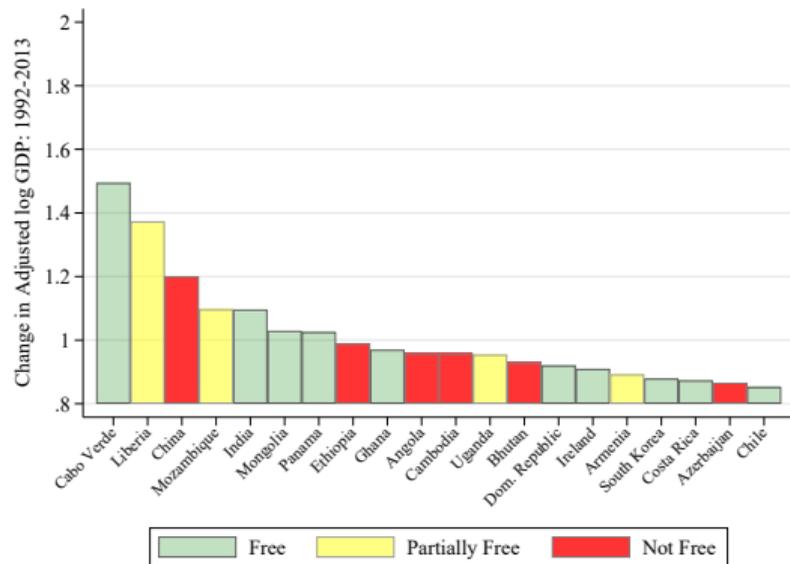
Does the overstatement of GDP growth in autocracies matter?

- I calculate aggregate growth over the sample period (1992/3-2012/3) and study how the performance of democracies and autocracies varies after adjusting for data manipulation
- I use the long-run estimates of σ and each country's average FiW over the sample period
 - Illustrative exercise that assumes that each country overstates GDP growth every year at a constant rate based on average FiW
- In the paper, I also show that estimates of the effect of foreign aid on GDP per capita (based on IDA threshold) are sensitive to adjustment of GDP data

Excess long-run GDP growth in autocracies diminishes after adjusting for exaggeration



(a) Top 20: Raw GDP



(b) Top 20: Adjusted GDP

Note: Panel (a) shows the 20 countries with the largest change in $\ln(\text{GDP})$ between 1992/3 and 2012/13 (two-year average in both cases), based on Nov 2014 release of WDI. Countries are classified according to their average FiW index during this period. Panel (b) shows the the 20 countries with the largest change in $\ln(\text{GDP})$ over the same period, once the GDP data has been adjusted for manipulation. See text for details on adjustment procedure.

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There is sizable overstatement of GDP growth in autocracies

- Governments of all kinds want to overstate how well their economy is doing, but autocracies are presumably better able to get away with it
- This paper presents a body of evidence based on the comparison of GDP growth and night-time lights which suggests that autocracies overstate economic growth by 35%
- Adjusting the GDP data for manipulation leads to a more nuanced view on the economic performance of non-democracies in recent decades