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Reconsidering Regime Type and Growth: Lies, Dictatorships, and Statistics*

Christopher S. P. Magee and John A. Doces
Bucknell University

Some recent papers have concluded that authoritarian regimes have faster economic growth than democracies. These supposed growth benefits of autocracies are estimated using data sets in which growth rates rely heavily on data reported by each government. Governments have incentives to exaggerate their economic growth figures, however, and authoritarian regimes may have fewer limitations than democracies on their ability to do so. This paper argues that growth data submitted to international agencies are overstated by authoritarian regimes compared to democracies. If true, it calls into question the estimated relationship between government type and economic growth found in the literature. To measure the degree to which each government's official growth statistics are overstated, the economic growth rates reported in the World Bank's World Development Indicators are compared to a new measure of economic growth based on satellite imaging of nighttime lights. This comparison reveals whether or not dictators exaggerate their true growth rates and by how much. Annual GDP growth rates are estimated to be overstated by 0.5–1.5 percentage points in the statistics that dictatorships report to the World Bank.

China's economic ascent has revived the idea that authoritarian political systems are best suited to promote rapid economic growth. As Halper (2012:xii) argues, "The Chinese have refined the Asian growth model to develop a fast growth, stable 'market-authoritarian' governance that is admired in the world. . .particularly among Third World leaders." A crucial assumption, however, underlying this argument is that the growth data reported by authoritarian regimes, like China's, are accurate and not systematically overstated. In the case of China, several commentators have questioned this assumption. Scissors (2012), for example, argues that, "China's economic statistics are usually inconsistent, occasionally wildly inconsistent, and do not seem to be improving in quality." So, is China's economic growth as rapid as their government claims? More generally, do authoritarian regimes overstate the economy's true rate of growth thus creating a favorable yet false impression of authoritarian models of growth? This paper presents a way to answer these questions empirically.

Here, we argue that the data used in the debate about regime type and growth are misleading because authoritarian regimes overstate their reported rates of growth. Accordingly, we believe the growth benefits of authoritarianism are exaggerated if not altogether wrong. To test this claim, we compare the results from a simple growth model using official GDP statistics to those using a measure of growth based on satellite images of nighttime lights. Growth in nighttime lights is an imperfect measure of economic expansion, but unlike GDP data, it is a measure of growth that authoritarian regimes have no reason to manipulate. We find that authoritarian regimes have slightly faster growth in nighttime lights than do democracies. The gap between democracies and autocracies is smaller for nighttime lights growth than for reported GDP growth, however, suggesting that the use of GDP data has exaggerated the benefits of authoritarianism.

In the rest of the paper, we examine the argument that authoritarian regimes overstate their true economic growth rates when they report data to the World Bank. While both democracies and dictatorships have incentives to exaggerate their growth rates, democracies have institutional constraints that limit their ability to do so. Dictatorships, on the other hand, face a relative absence of constraints on executive authority and thus have greater freedom to lie about their economic success. We test this argument empirically by comparing countries' reported GDP growth rates to the growth in nighttime lights.

Our empirical analysis demonstrates that authoritarian regimes overstate their true economic growth rates by about 0.5–1.5 percentage points in the data they report to the World Bank. These results have important policy implications especially for developing countries looking to promote growth and reduce poverty. While we do not argue authoritarian regimes cannot promote growth, we do argue that they are not as good as advertised and may be no better than democracies in the first place.

To date, we are unaware of any research that has measured the extent to which dictatorships overstate growth rates. Hollyer, Rosendorff, and Vreeland (2011) provide a complement to part of our work as they ask if democracies are more transparent than dictatorships in reporting economic data. Democracies, they note, have incentives

Christopher S. P. Magee is professor of economics at Bucknell University. His areas of interest include international trade, trade policies, and political economy. His current research is on the trade effects of regional trade agreements and the relationship between trade and democracy. His published articles have appeared in *Journal of International Economics*, *Journal of Peace Research*, and *Economics & Politics*.

John A. Doces is assistant professor of political science at Bucknell University. His areas of interest are in development and growth and how institutions affect these processes. His current work is on the relationship between trade and democracy; the spatial effects of foreign aid; and democracy and growth in Africa. His research has appeared in *International Interactions*, *Polity*, and *Swiss Political Science Review*.

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to be less than fully transparent, hiding the truth about important economic and political matters from voters. Using missing data from the World Bank's economic indicators, Hollyer et al. (2011) find that, controlling for income per capita, IMF lending, and fixed effects, democracies are less likely to have missing data than autocracies. They conclude that democracies are more transparent than dictatorships. Here, we extend Hollyer et al. (2011) by asking the following question: when they do report data to the World Bank, are dictatorships more likely than democracies to exaggerate their economic success? Our results complement their work by showing that democratic regimes not only report more data, they also report more truthful data. By providing honest data, democracies offer their citizens the information they need to make informed decisions and to live full and prosperous lives.

In the subsequent text, we first reconsider the effect of political regime type on growth, and then we conduct an empirical analysis testing the effect of regime type on the degree to which growth rates are overstated. We conclude with a few comments and implications for future research on regime type and economic growth.

Reconsidering Regime Type and Economic Growth

Our first question considers the effect of regime type on growth: do dictatorships grow faster than democracies? Answers to this question often compare China and India, noting that the former has outgrown the latter, thus concluding that authoritarian regimes are better suited to promoting growth than democracies. A common argument is that authoritarian regimes, with special political advantages unavailable to relatively free countries like India, grow faster than democracies, which are slowed by an inefficient and cumbersome political process.[1] With less red tape and fewer sources of friction, authoritarian regimes can efficiently provide key resources necessary for rapid growth. In short, authoritarian regimes manage the growth process with more precision and efficiency than do democracies.

The academic research, using primarily quantitative analyses, provides mixed evidence as to whether or not authoritarian regimes grow faster than democracies. We extend Przeworski and Limongi's (1993:61) literature review and examine 32 studies of growth and democracy, shown in Table 1. Of these studies, eight provide evidence that authoritarianism promotes higher rates of economic growth, 15 favor democracies, and nine are inconclusive. Przeworski, Alvarez, Cheibub and Limongi (2000) fall into the latter category: dictatorships do not achieve higher rates of total income growth than democracies, but they also do not produce lower rates. Our contention, however, is that authoritarian regimes overstate their true growth rates, which, if true, means that statistical estimates of the impact of regime type on growth rates are biased in favor of dictatorships.

To see this bias more formally, consider a simple bivariate regression model with economic growth as the dependent variable and dictatorship the independent variable:

$$y^* = \beta_0 + \beta_1 x_1 + u. \tag{1}$$

In this equation, y^* represents the true annual rate of economic growth and x_1 equals one for dictatorship.[2] If y is the reported rate of economic growth, then the measurement error (e), or difference between the observed value and actual value, can be defined as follows:

$$e = y - y^*. \tag{2}$$

To estimate the model, we can solve for y^* and then substitute into equation (1) to get the following equation:

$$y = \beta_0 + \beta_1 x_1 + u + e. \tag{3}$$

The ordinary least squares (OLS) estimator of β_1 is:

$$\widehat{\beta_1} = \frac{\sum_{i=1}^{n} (x_i - \bar{x}) y_i}{\sum_{i=1}^{n} (x_i - \bar{x})^2}. \tag{4}$$

Substituting for y_i provides the following expected value:

$$\begin{aligned} E(\widehat{\beta_1}) &= \beta_1 + E\left[\frac{\sum_{i=1}^{n} (x_i - \bar{x}) u_i}{\sum_{i=1}^{n} (x_i - \bar{x})^2}\right] + E\left[\frac{\sum_{i=1}^{n} (x_i - \bar{x}) e_i}{\sum_{i=1}^{n} (x_i - \bar{x})^2}\right] \\ &= \beta_1 + E\left[\frac{\sum_{i=1}^{n} (x_i - \bar{x}) e_i}{\sum_{i=1}^{n} (x_i - \bar{x})^2}\right]. \end{aligned} \tag{5}$$

If dictatorships routinely exaggerate the growth rates they report, then there will be a positive correlation between the measurement error e_i and the dictatorship variable x_i. Thus, the last term on the right hand side of equation (5) is positive and the OLS estimator of β_1 is biased upwards, which means the estimated coefficient likely overstates the true effect of dictatorships on economic growth. We next test this claim.

Data and Empirical Methods

The data used in this study come primarily from replication data for Henderson, Storeygard and Weil (2012, HSW).[3] Their study shows that satellite data on nighttime lights can be used to predict the level of a country's GDP because there is a very strong correlation between growth in the average intensity of nighttime lights and growth in the country's GDP. The GDP variable is measured in real local currency units based on data from the World Bank's World Development Indicators.[4] The data on nighttime lights come from satellites in the United States Air Force Defense Meteorological Satellite Program. The satellite images are used to generate a digital number between 0 and 63 that reflects the intensity of the man-made light in each area of the earth. These digital numbers are averaged over the land area in each country and year to generate a measure of the country's average intensity of man-made nighttime lights during the year. The data cover the years from 1992 to 2008.

[1] For an overview of this debate see Acemoglu and Robinson (2012), especially chapter 5.

[2] We base this discussion on Wooldridge (2009).

[3] The countries used in the main regression analysis are listed in the Appendix.

[4] The World Bank publishes the World Development Indicator (WDI) data set and makes it available online. Data are not reported in the WDI data set when the available data are considered unreliable or do not follow international standards. Nonetheless, it is clear that the World Bank receives most of the data from the national governments since they are the most authoritative source. The preface to the World Bank's report about the data states that it "relies heavily on statistics produced by national authorities and agencies" (World Bank 2012:v).

Table 1. Existing Studies of Democracy and Economic Growth

Author	*Sample*	*Time frame*	*Growth data*	*Conclusion*
Przeworski (1966)	57 countries	1949–1963	Unavailable	Dictatorships at medium development level grew fastest
Adelman and Morris (1967)	74 underdeveloped countries	1950–1964	Agency for International Development, Statistics and Reports Division	Authoritarianism helped less and medium developed countries
Dick (1974)	59 underdeveloped countries	1959–1968	OECD (1970) and UN (1970–71)	Democracies develop slightly faster
Huntington and Dominguez (1975)	35 poor nations	1950s	Wilcox, Weatherford, and Hunter (1962)	Authoritarian regimes grew faster
Marsh (1979)	98 countries	1955–1970	Unavailable	Authoritarian regimes grew faster
Weede (1983)	124 countries	1960–1974	World Bank	Authoritarian regimes grew faster
Kormendi and Meguire (1985)	47 countries	1950–1977	IMF's *International Financial Statistics*	Democracies grew faster
Kohli (1986)	10 underdeveloped countries	1960–1982	World Bank's *World Development Report*, 1984	No difference in 1960s; authoritarian slightly faster in 1970s
Landua (1986)	65 countries	1960–1980	IMF's *International Financial Statistics* and World Bank's *World Tables*	Authoritarian regimes grew faster
Sloan and Tedin (1987)	20 Latin American countries	1960–1979	Statistical Abstract of Latin America and Statistical Bulletin of the O.A.S.	Bureaucratic-authoritarianism regimes grow faster than democracies; traditional dictatorships do worse
Marsh (1988)	55 countries	1965–1984 and 1970–1978	World Bank	No difference between regimes
Pourgerami (1988)	92 countries	1965–1984	World Development Report	Democracies grew faster than authoritarian regimes (regime type measured by protection of human rights)
Scully (1988)	115 countries	1960–1980	Penn World Table (Summers and Heston 1984)	Democracies grew faster
Grier and Tullock (1989)	113 countries	1961–1980	Penn World Table (Summers and Heston 1984)	Democracies perform better in Africa and Latin America; no regime difference in Asia
Remmer (1990)	11 Latin American countries	1982–1988 1982, 1988	Official sources as reported to the Economic Commission on Latin American and the Inter-American Development Bank	Democracy grew faster, but result is statistically insignificant
Barro (1991)	72 countries	1960–1985	Penn World Table (Summers and Heston 1988)	Democracies grew faster
Pourgerami (1991)	106 less developed countries	1986	Unreported	Democracies grew faster
Helliwell (1994)	Up to 125 countries	1960–1985	Penn World Table (Summers and Heston 1988)	Democracy has a negative, but statistically insignificant effect on growth; democracy indirectly affects growth via education and investment
Barro (1996)	Approximately 100 countries	1960–1990	Penn World Table (v 5.5) with World Bank supplements	Democracy has a weak negative (and non-linear) effect on growth
Feng (1996)	40 sub-Saharan African countries	1960–1992	Penn World Table (v 5.6)	Democracy has a positive effect on growth
Leblang (1996)	Up to 50 countries	1960–1990	Penn World Table (Mark 5)	Democracy indirectly affects growth through protection of property rights
Leblang (1997)	Approximately 70 countries	Decade analysis (1960, 70, 80)	Penn World Table (Mark 5)	Democracy positively affects growth
Feng (1997)	96 countries	1960–1980	Penn World Table (v 5.6)	Democracy has an indirect but positive effect on growth
Przeworski et al. (2000)	141 countries	1950–1990	Penn World Table (v 5.6)	No evidence in favor of either democracy or dictatorships
Tavares and Wacziarg (2001)	65 industrial and developing countries	1970–1989	Penn World Table (Mark 5)	Overall effect of democracy on growth is negative and moderate; democracy increases human capital accumulation but decreases

Table 1. (Continued)

Author	*Sample*	*Time frame*	*Growth data*	*Conclusion*
				physical investment rates; democracy lowers inequality but increases government consumption. Negative effect via capital accumulation dominates effect of democracy on growth
Rivera-Batiz (2002)	59 countries	1960–1990	Penn World Table (v 5.6)	Democracy increases quality of governance, including controlling corruption, and this leads to technological change and economic growth. Empirically, democracy is associated with higher total factor productivity
Krieckhaus (2004)	Up to 112 countries	1960–1999	Multiple sources: World Bank & Penn World Table (v 5.5 & v 6.1)	Democracy reduced growth rates in 1960s, increased growth in 1980s, and there was no effect in the 1970s and 1990s
Rodrik and Wacziarg (2005)	Up to 154 countries	1950–2000	Penn World Table (v 6.1)	Transition to democracy does not lead to less growth and in many cases produces a positive growth effect. No advantage for transitions to authoritarian rule
Gerring, Bond, Barndt and Moreno (2005)	Up to 187 countries	1950–2000	World Bank's *World Development Indicators* and Penn World Table (v 6.1) for 1950s data	The stock of democracy has a cumulative or long-run effect on growth
Krieckhaus (2006)	Regional Analysis	Various years	Penn World Table (v 6.1)	Democracy reduces growth in Asia and Latin America, but increases it in Africa
Feng, Kugler, Swaminathan and Zak (2008)	108 countries	1960–2004	Penn World Table (v 6.2)	Political freedom triggers a demographic transition leading to sustained economic growth
Doucouliagos and Ulubaşoğu (2008)	Meta-Analysis	Population of 483 estimates derived from 84 studies	Various sources	Democracy does not have a direct effect on growth; but it has an indirect effect via higher human capital, lower inflation, less political instability, and more economic freedom. Effect also varies by country and region

The first question we investigate is whether using the change in nighttime lights as a measure of economic growth affects the estimated relationship between regime type and economic growth. To answer this question, we first estimate a simple model of growth in which the change in log GDP from 1992/93 to 2005/06[5] is regressed on log GDP at the start of the period and on dummy variables for regime type.[6]

$$\ln\left(\frac{\text{GDP}_{i05/06}}{\text{GDP}_{i92/93}}\right) = \beta_0 + \beta_1 \ln \text{GDP}_{i92/93} + \beta_2 \text{Regime Type}_i + e_i \quad (6)$$

The political variables come from the Polity IV database, which gives each country (in each year) a polity score ranging from −10 to 10. In addition to measuring democracy using the polity score, we also create two dummy variables for regime type. Countries whose polity scores fall between −6 and −10 are classified as autocracies, those with polity scores from 6 to 10 are democracies, and those with polity scores between −5 and 5 are labeled anocracies.

Column 1 in Table 2 shows the estimates of equation (6), which reveal that countries with a higher polity score have slower GDP growth on average over the 1992/93 to 2005/06 time period. Each one point increase in the polity score is associated with a 0.8 percent decrease in growth over the 13-year time period, or <0.1 percentage points slower growth per year. A pure democracy (polity = 10) is predicted to have 15% slower growth than a pure dictatorship (polity = −10) over the full time period. Column 2 uses the growth in nighttime lights (instead of reported GDP) as the measure of economic growth. Using lights as the measure of economic growth, the coefficient on the polity variable is much smaller in magnitude and is not significantly different from zero. The point estimate

[5] Missing data reduce the number of observations if the time period extends beyond 2006.

[6] We use this model for purposes of illustration only since more fully developed growth models could generate different results depending on the assumptions made in setting up the model.

TABLE 2. Estimated Relationship Between Regime Type and Economic Growth, 1992/93 to 2005/06

	GDP growth	*Lights growth*	*GDP growth*	*Lights growth*
Constant	0.486***	0.326***	0.494***	0.324***
	(0.106)	(0.041)	(0.108)	(0.042)
Log GDP in 1992/93	0.001		−0.005	
	(0.011)		(0.010)	
Log Lights in 1992/93		−0.055**		−0.067***
		(0.021)		(0.021)
Polity score	−0.008**	−0.003		
	(0.004)	(0.006)		
Autocracy			0.225***	0.161*
			(0.070)	(0.097)
Anocracy			−0.008	−0.097
			(0.046)	(0.080)
Observations	146	146	146	146
R^2	0.038	0.085	0.094	0.120

(*Notes.* Models estimated using ordinary least squares. Standard errors are robust to heteroskedasticity.
*, **, *** indicate that the coefficient is statistically significant at the 10%, 5%, 1% levels.)

indicates that each one point increase in the polity score reduces growth by 0.3 percentage points, and pure democracies are predicted to have 6% slower growth than pure dictatorships. Similar results emerge in columns 3 and 4, where we use autocracy and anocracy indicator variables for regime type. In column 3, the coefficient on the autocracy variable indicates that reported GDP growth was about 25% greater for autocracies than for democracies over the 13-year time period. This difference means that dictatorships grew about 1.8 percentage points faster per year. When the lights growth is used as the measure of economic growth (column 4), the coefficient on autocracies declines somewhat and is only marginally statistically significant (at the 10% level as opposed to the 1% level in the GDP equation). The coefficient in the lights growth equation remains positive, and it indicates that economies with dictatorships grew about 1.3 percentage points faster per year than democracies. There is not a statistically significant difference between the autocracy coefficient in column 3 and that in column 4 (or between the polity coefficients in columns 1 and 2). Nonetheless, in both cases the evidence in favor of faster growth for dictatorships in the 1990s and 2000s is weakened if growth is measured using a variable that is beyond the reach of the governments to manipulate.

We next test to see if there is evidence that authoritarian regimes overstate their reported rates of growth. Establishing this point is the key to our larger contention that arguments favoring dictatorships rest on weak foundations. The advantage attributed to authoritarian governments is overstated precisely because the outcome of interest, growth, is manipulated by regimes with an incentive to exaggerate their own success.

Because the change in nighttime lights is largely beyond the control of governments to manipulate, it provides a way of determining whether the reported GDP growth rates from each country are inflated. Following HSW, we set up a simple model of the relationship between the growth in man-made lights over time in a country and growth in national output. Let GDP in country i at time t be predicted by nighttime lights according to the following equation:

$$\ln(\text{GDP}_{it}) = \lambda_0 + \lambda_1 \ln(\text{lights}_{it}) + \alpha_i + \gamma_t + e_{it} \qquad (7)$$

The term α_i captures any factors such as geography that affect GDP and are specific to country i but are constant over the time period in our sample (1992–2008). The term γ_t captures other factors such as changes in technology that affect GDP in time period t and are relatively constant across all countries. Taking the first difference of equation (7) yields the growth equation:

$$\Delta\ln(\text{GDP}_{it}) = \lambda_1 \Delta\ln(\text{lights}_{it}) + \delta_t + \varepsilon_{it}. \qquad (8)$$

In equation (8), the first differencing removes the country fixed effect α_i, while the first differences in the time fixed effects, $\delta_t = \Delta\gamma_t$, and in the residual, $\varepsilon_{it} = \Delta e_{it}$, remain. Equation (8) is not specifying a causal relationship in which man-made lights affect GDP growth rates. Rather, as Henderson et al. (2012:1007) explain "[it is] a best-fit relationship to be used in producing proxies for income growth."

To equation (8), we add the autocracy and anocracy variables indicating regime type:

$$\Delta\ln(\text{GDP}_{it}) = \lambda_1 \Delta\ln(\text{lights}_{it}) + \lambda_2 \text{autocracy} + \lambda_3 \text{anocracy} + \delta_t + \varepsilon_{it}. \qquad (9)$$

The coefficients λ_2 and λ_3 measure the effect of regime type on a government's tendency to exaggerate its economic growth in reports to the World Bank.[7] A positive coefficient estimate of λ_2 means that, relative to the GDP growth rates one would predict based on the growth in the country's nighttime lights, dictatorships have higher reported GDP growth rates than democracies. Part of the difference between reported GDP growth and nighttime lights growth may be due to difficulties in accurately measuring the size of the economy, and it may be that countries with less political freedom are less able to measure their economies accurately. Inaccurate measurements would increase the magnitude of the residuals in equation (9), both positive and negative, but if the measurement errors are truly random, they would not bias the estimates of λ_2 and λ_3. Measurement error in the dependent variable (caused by random measurement errors in GDP growth and cross-country variations in how GDP growth and growth in nighttime lights are related) will not bias the coefficient estimates as long as the error is uncorrelated with a country's political openness.[8]

In addition to regime type, it is also plausible that a free press limits the government's ability to exaggerate its GDP growth. We investigate this possibility by including in equation (9) variables from Freedom House measuring press freedom. Freedom House provides a score measuring the independence of the press for 208 countries going back to 1980, and it also classifies the press in each country into one of three categories: free, partially free, and not free. We create dummy variables for these cate-

[7] In an earlier version of the paper, we used the residual from equation (8) as a measure of the degree to which each country exaggerated its GDP growth and examined how regime type affected this residual. As a reviewer pointed out, that method is identical to including regime type variables as we do in equation (9).

[8] We examine the relationship between GDP growth and energy use in order to investigate whether the relationship between GDP growth and lights growth is correlated with regime type. When we estimate a regression of log GDP growth on log growth in energy use, there are no significant differences in how GDP growth is related to the growth in energy use across different types of political systems.

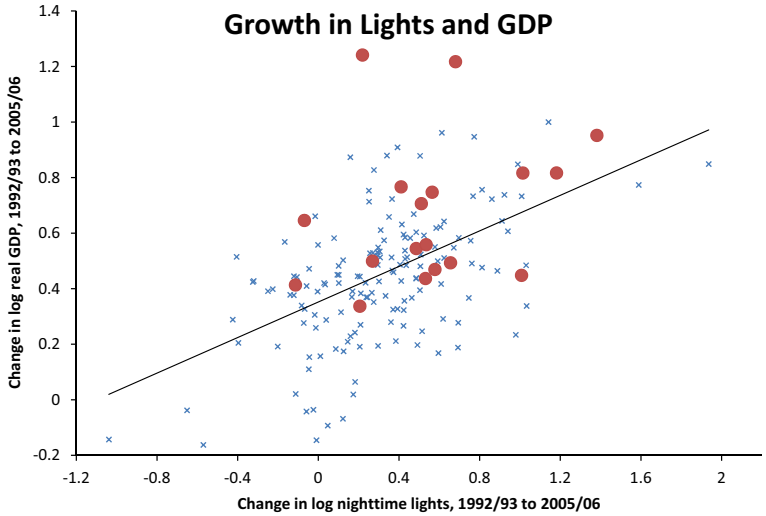

FIGURE 1. Long-run difference in GDP and nighttime lights.

gories, though the conclusions are similar when we use the score Freedom House assigns to each country's press freedom.

Results

Figure 1 largely duplicates a figure from Henderson et al. (2012) showing the relationship between the change in the log of nighttime lights between 1992–93 and 2005–06 and the change in log GDP over those years. In the figure, we identify the countries classified as autocracies with a large round dot. As the figure reveals, the autocracies tend to lie above the regression line, which means that their reported GDP growth over the 13-year time period is above the level predicted by the growth in their nighttime lights. The two countries with the largest deviation between their growth in nighttime lights and reported growth in GDP are China and Myanmar.

Table 3 presents estimates of equation (9) with regime type variables and time fixed effects included.[9] The estimates show the strong positive correlation between the growth in nighttime lights and a country's GDP growth. As HSW argue, and the highly significant positive coefficient on the lights variable reveals, changes in the lights visible to satellites at night provide a good predictor of economic growth. The change in nighttime lights is also a predictor of economic growth that is undistorted by deliberate misreporting of economic statistics.

The coefficient on the autocracy variable is consistently positive and is statistically significant at the 1% level in Model 1. These coefficient estimates reveal that the governments classified as dictatorships have GDP growth rates reported in the World Development Indicators that are significantly higher than the growth predicted by the country's nighttime lights. The coefficient estimate of 0.015 on the autocracy variable in Model 1 indicates that if democracies report their GDP growth rates truthfully, then dictatorships overstate their yearly growth rate by about 1.5 percentage points on average. If democracies also overstate their true growth rates, then dictatorships exaggerate their yearly growth statistics by about 1.5 percentage points more than do democracies. The results are virtually identical if the absolute value of the country's latitude is added into the regression. The conclusion that authoritarian regimes overstate GDP growth rates relative to democracies does not depend on our use of the polity score to classify regimes into autocracies, anocracies, and democracies. If we replace the autocracy and anocracy variables with the Cheibub, Gandhi and Vreeland (2010) measure of democracy, the coefficient on democracies is negative and statistically significant.

If authoritarian regimes are overstating their GDP growth in official reports, a natural question is whether they exaggerate growth rates more during recessions or crises. To investigate this issue, we created a variable (crisis) that equals one if nighttime lights decline in the country during the year and an interaction term between the autocracy and crisis variables. As Model 2 shows, the coefficient on the interaction term was negative but not statistically significant, so there is no significant evidence that exaggerations of GDP growth differ between periods of economic growth and downturns. The point estimates suggest that autocracies overstate annual GDP growth by 1.9% on average during expansions and by 0.8% during years of decline.

Model 3 investigates whether greater press freedom limits any exaggeration of reported GDP growth rates. The estimates provide some preliminary evidence that a free press limits a government's ability to exaggerate its growth rates. Relative to the growth rate predicted by the increase in nighttime lights, countries with a press that is not free have reported GDP growth rates 0.9 percentage points higher than countries with a free press. There is a strong correlation between authoritarian regimes and the lack of a free press, however, and Model 4 shows that it is primarily the government type rather than press freedom that affects exaggerations of GDP growth statistics. When both the regime type and press freedom variables are included in the regression, the coefficient on the autocracy variable remains positive and statistically significant at the 5% level while the press freedom variable loses its statistical signifi-

[9] One concern with using lights as a predictor of economic growth might be that the relationship between lights and economic growth could depend on how densely populated the country is. We have investigated this issue by including population density and an interaction term between population density and nighttime lights in the regressions. When we do this, the population density and interaction term variables are not statistically significant, either individually or jointly, and none of the key conclusions from the regressions change.

Table 3. Overestimates of GDP Growth Rates and Regime Type

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*
ΔLn(lights)	0.100***	0.108***	0.075***	0.100***	0.128***
	(0.027)	(0.037)	(0.025)	(0.027)	(0.045)
Autocracy	0.015***	0.019***		0.015**	0.007
	(0.005)	(0.005)		(0.007)	(0.005)
Anocracy	0.001	0.001		0.001	−0.002
	(0.003)	(0.003)		(0.004)	(0.004)
Press Not Free			0.009***	−0.00002	
			(0.003)	(0.005)	
Press Part Free			0.003	0.001	
			(0.003)	(0.003)	
Crisis		0.006			
		(0.007)			
Crisis*Autocracy		−0.011			
		(0.007)			
Americas					−0.001
					(0.004)
Asia					0.012***
					(0.004)
Europe					−0.005
					(0.004)
Oceania					−0.007
					(0.005)
ΔLn(lights)*Americas					−0.030
					(0.037)
ΔLn(lights)*Asia					−0.053
					(0.040)
ΔLn(lights)*Europe					−0.066
					(0.043)
ΔLn(lights)*Oceania					−0.071
					(0.067)
Observations	2345	2345	2706	2344	2345
R^2	0.140	0.142	0.108	0.141	0.158
Year fixed effects	Yes	Yes	Yes	Yes	Yes

(*Notes.* Crisis = 1 if the nighttime lights declined during the year. Models estimated using ordinary least squares. Robust standard errors (in parentheses) allow correlation between residuals across observations within a country. Regressions use annual data from 1992 to 2008.
*, **, *** indicate that the coefficient is statistically significant at the 10%, 5%, 1% levels.)

cance. Controlling for freedom of the press, Model 4 estimates that dictatorships exaggerate their GDP growth by about 1.5 percentage points per year.

One concern in Models 1–4 is that lights growth may have a different relationship to GDP growth across the different regions of the world. Model 5 investigates this issue by including interaction terms between continent dummy variables and the nighttime lights variable. As a group, the interaction terms are not jointly significant at the 10% level. The coefficient on autocracy indicates that dictatorships' GDP growth rates are overstated by about 0.7 percentage points per year relative to the level we would expect given the growth in nighttime lights in the country. It is not statistically significant at the 10% level ($p = .16$). The coefficient on the anocracy variable is not statistically significant in any of the regressions, so there is no significant difference between democracies and mixed government types.

The overall conclusion from the estimates in Table 3 is that, compared to democracies, dictatorships exaggerate their GDP statistics but that the press is less important than government type in ensuring accurate reporting of economic statistics. One explanation for the conclusion about the press is that consumers of the news in most countries may not be very interested in the accuracy of economic reports provided to the World Bank. As a result, a profit-oriented press corps would have little reason to spend money on investigative reports verifying the truth of information in the World Development Indicators. Press investigations into the accuracy of economic data may also come from media sources that are external to the country, in which case, the freedom of the press inside a country would have little impact on the government's incentive to provide honest data.

Why, then, might authoritarian governments exaggerate growth rates more than democracies or mixed government types? All regimes, including democracies, have an incentive to overstate growth since reports of positive growth serve as a means of cultivating support and preserving power. Without constraints, politicians can utilize information to their advantage and personal gain (for example, see Adserà, Boix, and Payne 2003). In democracies, checks-and-balances, or institutional constraints, limit executive authority much more than in dictatorships. A defining characteristic of authoritarian regimes, in fact, is the relative absence of constraints on executive authority. As a result, dictatorships face less punishment for providing overstated growth rates. Low-level officials in authoritarian regimes may also have more incentive to overstate economic growth than do employees in legally independent agencies like the Bureau of Labor Statistics and the Federal Reserve.

Autocorrelation is always a concern in panel data, and there is evidence of autocorrelation in the Table 3 esti-

mates ($\hat{\rho} = .37$ in Model 1). We correct for the autocorrelation by using robust standard errors that are clustered by country, which allows the residuals to be correlated within each country over time. Estimating the models in Table 3 by the Prais–Winsten method does not alter any of the conclusions.

Table 3 includes only countries that report GDP growth rates to the World Bank, but this means there is sample selection. Sample selection might be a particular concern in this case since Hollyer et al. (2011) show that democracies are less likely to have missing data in the World Development Indicators than are dictatorships. Table 4 accounts for sample selection by estimating a sample selection model from Heckman (1979). The selection variable in the Heckman model equals one if we observe the GDP growth rate for the country (which means that the country reported GDP levels to the World Bank for two consecutive years). In order to estimate the selection model, we need to identify at least one variable that affects whether a country reports GDP data to the World Bank but that does not directly affect whether the country exaggerates its growth rates. The variable we use to identify selection is the number of international governmental organizations (IGOs) that the country belongs to. This variable comes from the Correlates of War data set, which follows 496 IGOs annually up to the year 2005. Since our growth and lights data runs up to 2008, we use the 2005 value in each country for the 2006–08 period. The IGO data are described more fully in Pevehouse, Nordstrom and Warnke (2004). Greater participation in IGOs means that the country is more engaged with worldwide organizations such as the World Bank and hence it should increase the likelihood that the country will report its GDP data. Being a part of IGOs does not place meaningful constraints on a country's ability to fudge its GDP statistics, however, and thus there is no strong theoretical reason why IGO participation will be correlated with a country's exaggeration of its growth rate. The coefficient on the IGO variable is never statistically significant in affecting the reported GDP growth rate if the IGO variable is included in the Table 3 regressions.

The results in Table 4 are very similar to those in Table 3, with dictatorships estimated to overstate economic growth by between 0.8 and 1.5 percentage points per year. In Model 9, the autocracy coefficient using the Heckman selection model is slightly smaller than the equivalent coefficient in the OLS regressions in Table 3, and it narrowly misses being statistically significant at the 10% level ($p = .11$).

Estimates from the selection equation are presented in Table 4a. As the table shows, data on GDP growth are much more likely to be observed for countries that belong to many international organizations and for more recent years. We included the lights growth in the country to see if countries with faster economic growth were more likely to report the data to the World Bank. The coefficient on the lights growth variable was not statistically significant, however, and was actually negative. The negative signs on the autocracy and anocracy coefficients are consistent with the result in Hollyer et al. (2011) that democracies are more likely to report economic data, but the two coefficients are not statistically significant. The estimates of rho, the correlation between the error in the selection equation and the error in the growth equation, are also not statistically significant. This result suggests that the selection correction may be unnecessary in this case.

TABLE 4. Overestimates of GDP Growth Rate, Sample Selection Correction (a): Sample Selection Equation from Table 4

	Model 6	*Model 7*	*Model 8*	*Model 9*
Growth Equation Estimates				
ΔLn (lights)	0.099***	0.101***	0.100***	0.128***
	(0.028)	(0.028)	(0.028)	(0.045)
Autocracy	0.015***		0.016**	0.008
	(0.005)		(0.007)	(0.005)
Anocracy	0.002		0.003	−0.001
	(0.003)		(0.004)	(0.004)
Press Not Free		0.007**	−0.001	
		(0.003)	(0.005)	
Press Part Free		0.001	0.000	
		(0.003)	(0.003)	
Americas				−0.0004
				(0.004)
Asia				0.012***
				(0.004)
Europe				−0.004
				(0.004)
Oceania				−0.003
				(0.004)
ΔLn (lights)*Americas				−0.030
				(0.037)
ΔLn (lights)*Asia				−0.053
				(0.040)
ΔLn (lights)*Europe				−0.066
				(0.043)
ΔLn (lights)*Oceania				−0.142***
				(0.053)
Observations	2401	2400	2400	2401
Year fixed effects	Yes	Yes	Yes	Yes

	Model 10	*Model 11*	*Model 12*	*Model 13*
Selection Equation				
Constant	0.799	0.816	0.795	0.791
	(0.792)	(0.800)	(0.794)	(0.793)
International organizations	0.029**	0.029**	0.029**	0.029**
	(0.013)	(0.013)	(0.013)	(0.013)
ΔLn (lights)	−0.205	−0.222	−0.212	−0.202
	(0.216)	(0.202)	(0.214)	(0.219)
Autocracy	−0.560	−0.565	−0.558	−0.558
	(0.385)	(0.390)	(0.386)	(0.386)
Anocracy	−0.167	−0.163	−0.165	−0.166
	(0.428)	(0.429)	(0.428)	(0.429)
Year	−0.028*	−0.030*	−0.028*	−0.028*
	(0.017)	(0.017)	(0.017)	(0.017)
Wald test, independent equations	0.21	0.33	0.17	0.85

(*Notes.* Models estimated using Heckman selection model. Robust standard errors (in parentheses) allow correlation between residuals across observations within a country. Regressions use annual data from 1992 to 2008.
*, **, *** indicate that the coefficient is statistically significant at the 10%, 5%, 1% levels.)

In Table 5, we present estimates from regressions using a cross-section data set, where the dependent variable is the change in log GDP from 1992/93 to 2005/06.[10] The change in the log lights variable also represents the change in nighttime lights over the 13-year time period. The autocracy variable is equal to one if the average pol-

[10] We take the average GDP from 1992 and 1993 as the starting point and the average GDP from 2005 and 2006 as the ending point.

Table 5. Overestimates of GDP Growth Rate, Long Difference Models of ΔLn(GDP)

	Model 14	*Model 15*	*Model 16*	*Model 17*
Constant	0.351***	0.341***	0.372***	0.377***
	(0.024)	(0.025)	(0.027)	(0.050)
ΔLn(lights)	0.307***	0.319***	0.312***	0.305***
	(0.040)	(0.038)	(0.040)	(0.068)
Autocracy	0.151**		0.190*	0.043
	(0.064)		(0.098)	(0.068)
Anocracy	−0.013		0.024	−0.058
	(0.037)		(0.063)	(0.044)
Press Not Free		0.052	−0.063	
		(0.047)	(0.091)	
Press Part Free		−0.025	−0.060	
		(0.042)	(0.054)	
Americas				−0.037
				(0.082)
Asia				0.089
				(0.064)
Europe				−0.040
				(0.062)
Oceania				−0.020
				(0.115)
ΔLn(lights)*Americas				−0.062
				(0.138)
ΔLn(lights)*Asia				0.069
				(0.100)
ΔLn(lights)*Europe				−0.024
				(0.097)
ΔLn(lights)*Oceania				−0.356
				(0.246)
Observations	148	168	148	148
R^2	0.342	0.302	0.347	0.406

(*Notes.* Models estimated using ordinary least squares. Robust standard errors in parentheses. Regressions use a cross-section of countries with the change in log GDP, 1992/93 to 2005/06.
*, **, *** indicate that the coefficient is statistically significant at the 10%, 5%, 1% levels.)

ity score for the country between 1992 and 2006 was <−5.5. Anocracy equals one if the average polity score falls between −5.5 and 5.5. These regressions allow us to examine how regime type is related to reported GDP growth over a relatively long time period, which helps smooth out the effects of yearly fluctuations in GDP growth and lights growth.

In two of the three regressions in which the regime type variables are included, countries that are autocracies report significantly faster GDP growth than the level predicted by their growth in nighttime lights. Only in column 4, where lights growth is interacted with dummy variables for each continent, is the coefficient on autocracy statistically insignificant. The coefficient on autocracy in Model 14 is 0.151. This estimate indicates that autocracies overstate GDP growth by about 1.2 percentage points on average each year over the 13-year time period. The smallest coefficient estimate on the autocracy variable (Model 17) suggests that autocracies overstate GDP growth by about 0.3 percentage points per year relative to democracies. Just as in Table 3, the results in Table 5 do not support the view that anocracies overstate GDP growth relative to democracies. The coefficients on the anocracy variable are statistically insignificant in all of the regressions. A free press also does not appear to limit the ability of the government to report inflated economic statistics to the World Bank.

Table 6. Overestimates of GDP Growth Rate, Long Difference Model Sample Selection Correction; (a) Sample Selection Equation from Table 6

	Model 18	*Model 19*	*Model 20*	*Model 21*
Constant	0.354***	0.371***	0.377***	0.375***
	(0.023)	(0.027)	(0.027)	(0.048)
ΔLn(lights)	0.304***	0.317***	0.309***	0.306***
	(0.039)	(0.041)	(0.039)	(0.066)
Autocracy	0.147**		0.189*	0.049
	(0.065)		(0.097)	(0.064)
Anocracy	−0.016		0.024	−0.056
	(0.036)		(0.062)	(0.042)
Press Not Free		−0.008	−0.068	
		(0.050)	(0.089)	
Press Part Free		−0.065	−0.065	
		(0.049)	(0.054)	
Americas				−0.035
				(0.079)
Asia				0.090
				(0.061)
Europe				−0.038
				(0.059)
Oceania				0.134***
				(0.052)
ΔLn(lights)*Americas				−0.062
				(0.133)
ΔLn(lights)*Asia				0.069
				(0.097)
ΔLn(lights)*Europe				−0.025
				(0.093)
ΔLn(lights)*Oceania				−0.674***
				(0.112)
Observations	147	147	147	147

	Model 22	*Model 23*	*Model 24*	*Model 25*
Constant	1.138	1.720	1.137	1.128
	(1.062)	(1.148)	(1.062)	(1.071)
International organizations	0.020	−0.006	0.020	0.020
	(0.015)	(0.015)	(0.015)	(0.015)
ΔLn(lights)	0.012	0.163	0.013	−0.005
	(0.449)	(0.793)	(0.450)	(0.455)
Autocracy	−1.226**	−0.636	−1.225**	−1.223**
	(0.502)	(1.385)	(0.502)	(0.502)
Anocracy	−0.077	0.833***	−0.075	−0.075
	(0.522)	(0.292)	(0.525)	(0.517)
Wald test, independent equations	0.02	1208.85***	0.04	0.32

(*Notes.* Models estimated using Heckman selection model. Robust standard errors in parentheses. Regressions use a cross-section of countries with the change in log GDP, 1992/93 to 2005/06.
*, **, *** indicate that the coefficient is statistically significant at the 10%, 5%, 1% levels.)

The results are very similar, as Table 6 shows, when we correct for sample selection using the Heckman selection model. Table 6a shows the estimates from the selection equation, and here the estimates are supportive of the results in Hollyer et al. (2011) that autocracies are significantly less likely to report GDP data to the World Bank. Changing the regime type from democracy to autocracy (holding the other variables at their mean values) would reduce the predicted probability of GDP being reported from 99% to 87%.[11]

[11] These probabilities are conditional on having observed the number of IGOs in which the country participates.

TABLE 7. Robustness Checks, Long Difference Models of ΔLn(GDP)

	Model 26	*Model 27*	*Model 28*	*Model 29*	*Model 30*
Constant	0.456***	0.349***	0.357***	0.387***	0.332***
	0.121	0.023	(0.024)	(0.034)	(0.023)
ΔLn(lights)	0.299***	0.315***	0.312***	0.317***	0.311***
	0.044	0.039	(0.054)	(0.037)	(0.037)
Autocracy	0.138**	0.075*	0.111*		
	0.065	0.042	(0.062)		
Anocracy	−0.034	−0.014	−0.017		
	0.042	0.037	(0.040)		
Ln(GDP per capita)	−0.013				
	0.013				
Democracy				−0.056	
				(0.036)	
Civilian dictatorship					0.038
					(0.049)
Military dictatorship					0.114*
					(0.060)
Royal dictatorship					0.030
					(0.049)
Observations	146	146	155	166	170
R^2	0.347	0.345	0.310	0.336	0.298

(*Notes.* Model 27 omits China and Myanmar from the regression in Model 14 of Table 5. Model 28 uses GDP growth data from Penn World Table, version 7.1. Models 29 and 30 use classifications of regime type from Cheibub et al. (2010). Models estimated using Heckman selection model. Robust standard errors in parentheses. Regressions use a cross-section of countries with the change in log GDP, 1992/93 to 2005/06.
*, **, *** indicate that the coefficient is statistically significant at the 10%, 5%, 1% levels.)

TABLE 8. Measures of Influential Observations

	Cooks D	*DF Beta*
Myanmar	0.185	0.805
China	0.097	0.548
Eritrea	0.058	−0.360

Table 7 includes some robustness checks to the conclusions in the paper. As in Tables 5 and 6, the dependent variable is the change in log GDP from 1992/93 to 2005/06. Model 26 includes the initial level of GDP per capita to control for the level of development in the country. The estimates show controlling for a country's development level does not alter the conclusions from Tables 5 and 6.

Figure 1 had suggested that China and Myanmar are potential outliers, and several different tests for the influence of individual observations confirm that they are. Table 8 shows the three most influential observations according to the Cook's distance and DF Beta statistics. Cook's distance was proposed by Cook (1977), and it measures the effect of deleting an observation on the predicted values from a regression. By this measure, Myanmar is the observation with the most leverage in affecting the outcome of the regression line. China is a distant second, and Eritrea is the third most influential observation. A second statistic measuring an observation's influence is DF Beta (Belsley, Kuh and Welsch 1980), which calculates how much a particular coefficient changes when an observation is deleted from the regression. The second column of Table 8 shows the DF Beta value for the coefficient on the autocracy variable. This measure also finds the same three observations to have the largest impact on this coefficient. The DF Beta value for Eritrea is negative, which means that including Eritrea in the regression pulls the estimated coefficient on autocracy down. Both the China and Myanmar observations raise the estimated coefficient on autocracy. As a way of determining whether the significant positive coefficient on autocracy in Model 14 of Table 5 is solely a result of the outliers, Model 27 in Table 7 presents the regression results when China and Myanmar are omitted. The coefficient on autocracy falls, but it remains positive and statistically significant at the 10% level even when those two countries are excluded from the regression.[12]

Model 28 uses the Penn World Table, version 7.1, measure of GDP growth as the dependent variable in order to investigate whether the evidence that dictatorships exaggerate GDP growth depends on the use of the World Development Indicators data set. The coefficient on autocracy is slightly smaller than in Model 14 of Table 5, but it remains positive and statistically significant at the 10% level. Thus, the tendency of dictatorships to overstate GDP growth rates appears to be reflected in both the World Development Indicators and Penn World Table data sets.

Models 29 and 30 in Table 7 explore the effect of using a different data set on regime types in the regression. Cheibub et al. (2010) define a democracy to require not just competitive elections but also transfers of power between parties. Model 29 replaces the autocracy and anocracy variables with a variable that equals the fraction of years between 1992 and 2006 that the country was considered a democracy by Cheibub et al. (2010). The coefficient on the democracy variable is negative and narrowly misses being statistically significant at the 10% level (the *p*-value is .13). The reason the coefficient is not statistically significant is that it is capturing the difference between democracies and all other government types, which includes both dictatorships and anocracies. While democracies overstate growth by much less than do dicta-

[12] The coefficient is larger and statistically significant at the 5% level ($p = .021$) if Eritrea is also excluded.

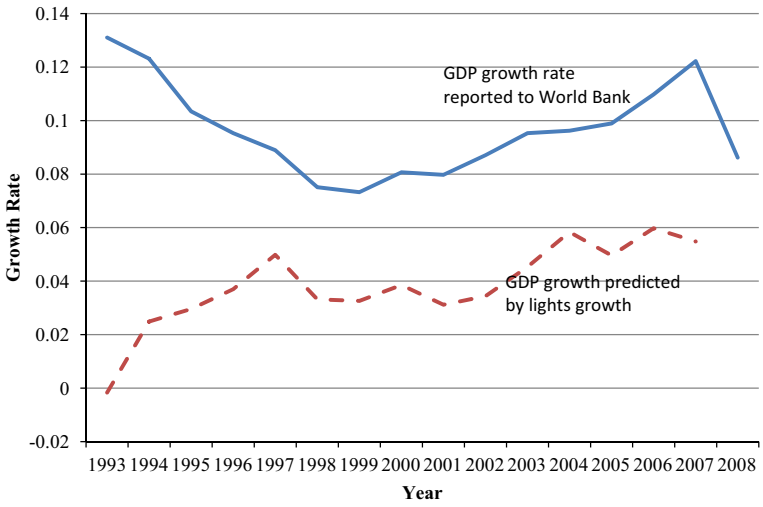

FIGURE 2. China's reported and predicted levels of economic growth.

torships, there is no difference between democracies and anocracies in their tendency to overstate economic growth. If we add in an indicator variable for anocracies, such as that in Table 5, the coefficients on both the democracy and anocracy variables are statistically significant at the 5% level and they indicate that dictatorship growth rates are overstated by 0.7 percentage points per year relative to both democracies and mixed government types.

Cheibub et al. (2010) also classify dictatorships into three types: civilian, military, and royal. Model 30 includes a dummy variable for each of these types of dictatorships. All three dictatorship variables have positive coefficients, but only the military dictatorship coefficient is statistically significant at the 10% level. The coefficient on the military dictatorship variable indicates that these regimes overstated the total GDP growth over the period from 1992/93 to 2005/06 by about 12%, or by about 0.9% per year on average.

The conclusions in this paper are based on the pattern in the data across many countries, so while we conclude that autocracies, on average, overstate GDP growth, we cannot conclude with certainty that any individual country is misreporting its GDP data. If some dictatorships exaggerate their growth rates while others do not, as Figure 1 suggested, it could help explain why there are such large differences among dictatorial regimes in their measured economic performance.[13] Overstatement of GDP growth by some dictatorships could thus be a partial explanation for the result in Przeworski et al. (2000) and Besley and Kudamatsu (2007) that the variation in economic growth among dictatorships is much larger than the variation among democracies.

We now examine the model's predictions for several countries of interest. Figure 2 shows the reported GDP growth rates for China compared to the growth rates predicted by the increase in China's nighttime lights.[14] China had the second fastest reported GDP growth in the data set (after Myanmar) between 1992/93 and 2005/06, but the growth in its nighttime lights was only 28th fastest out of the 170 countries for which we have data on both variables. The figure shows that China's GDP growth in the World Bank's World Development Indicators is consistently higher than the level predicted by their growth in lights. Interestingly, however, the gap was considerably larger in the early to mid-1990s than it has been since then.

The conclusions about China are consistent with news reports such as Sabrie (2012) suggesting that China's economic indicators are typically inflated by an estimated one to two percentage points (in line with our average estimate for dictatorships). As Sabrie (2012) notes, "Officials at all levels of government are under pressure to report good economic results to Beijing as they wait for promotions, demotions and transfers to cascade down from Beijing." These pressures to report good economic numbers also exist in democracies, but the limits on executive authority make inflating the statistics more difficult.

Figure 3 shows a similar comparison for Indonesia, a country that between 1992 and 1997 had the same polity score as China (polity = −7), but that has been a democracy (polity = 6 or 8) since 1999. The dramatic effects of the Asian Crisis on Indonesia are visible in 1997–98, but it is interesting that in the years when Indonesia was an autocracy (1992–97), its growth rates consistently overstated what one would expect based on the growth in lights. After the country opened up its political system, its GDP growth rates much more nearly matched the predicted growth rates. Figures 4 and 5 show the model's predictions for democracies in Australia and Brazil. For these countries, the growth in lights tracks nearly perfectly the increase in GDP reported to the World Bank.

Finally, we look at Ethiopia. As Nega (2010) describes, the Ministry of Finance and Economic Development (MoFED) is the only data source for macroeconomic variables on Ethiopia used by the IMF and World Bank, and the data were considered relatively reliable until about 2005. Since 2005, however, the statistics reported by the MoFED have been called into question. Not only did reported GDP surge (growth averaged 10.7% per year from 2005–2009, up from 3.7% from 1991–2004) but the country also reported rapid growth (9.5% per year) in agricultural value added despite several years of severe drought and large food price increases that necessitated food aid

[13] Remember that there is no tendency for dictatorships to overstate growth more during periods of true economic decline than during periods of growth.

[14] For these figures, the predicted GDP growth rates come from a regression of ΔLn(GDP) on ΔLn(lights) and year fixed effects.

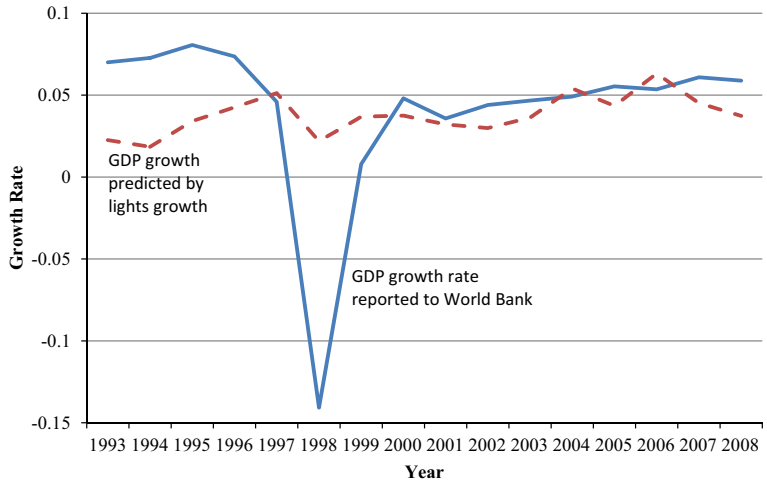

FIGURE 3. Indonesia's reported and predicted levels of economic growth.

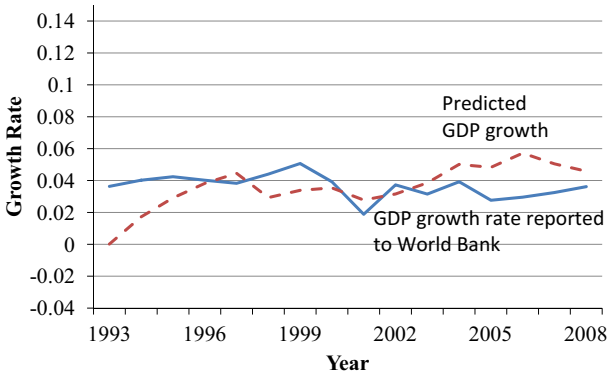

FIGURE 4. Australia's reported and predicted levels of economic growth.

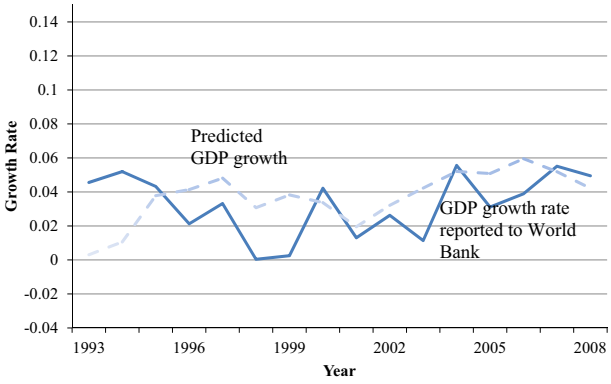

FIGURE 5. Brazil's reported and predicted levels of economic growth.

to about one-sixth of the population. Surveys from Gilligan, Hoddinott, Kumar and Taffesse (2009) suggest there were more food shortages in 2008 than in 2006, which contradicts the dramatic increase in agricultural output reported by the MoFED. A special report in the The Economist by Oliver August (2013:12) notes that, "Critics have long asked whether Ethiopia's success story can be believed. Even supporters do not have much faith in official numbers. Annual productivity gains in agriculture are probably not 5–6%, as the official statistics suggest, but more like 2–3%." The report further notes that, "An insider says: 'Officials are given targets and then report back what superiors want to hear.' International experts are suspicious of the GDP growth figures of 11% flaunted by the government. They say the actual growth rate is only half that, around 5–7%–which is still respectable." Thus, there seems ample reason to question whether the recent statistics are correct.

What does our model predict about this time period? Figure 6 shows that prior to 2004, GDP growth was not consistently higher or lower than the GDP growth rate predicted by the growth in Ethiopia's nighttime lights. Between 2004 and 2008, however, reported GDP growth dramatically overstated what one would normally expect GDP growth to be, given the increase in lights. Over this time period, Ethiopia's intensity of nighttime lights grew at only 1.7% per year (89th fastest out of 164 countries) while its reported GDP grew by 11.3% per year (5th fastest) on average. Compare that disparity to the period from 1992 to 2004, when Ethiopia's intensity of nighttime lights grew on average by 8% per year (23rd fastest among 168 countries with data) while its GDP grew by 5.4% per year (24th fastest). Thus, the predictions from the model are consistent with the arguments in Nega (2010) that Ethiopia's economic statistics were relatively reliable until around 2005 but that the country's economic successes have been exaggerated for political purposes since then. The recent GDP growth rates predicted by the increase in nighttime lights in Figure 6 are also consistent with the report in The Economist noting that the actual growth rate is around 5–7%.

We conclude the results section by returning to our question of whether dictatorship exaggeration of growth rates has affected the results of the growth and democracy literature. In order to investigate this question, we duplicate a growth model used in Krieckhaus (2004). He develops a model in which GDP per-capita growth depends on the initial per-capita income level, the investment share of GDP, secondary education enrollment rates, population growth, and regime type. In order to match our lights data time period, we updated his data set using information from the Penn World Table version 7.1 to cover the time period from 1992 to 2006. Column 1 in Table 9 presents estimates of the Krieckhaus (2004) baseline model for this time period. The coefficient on

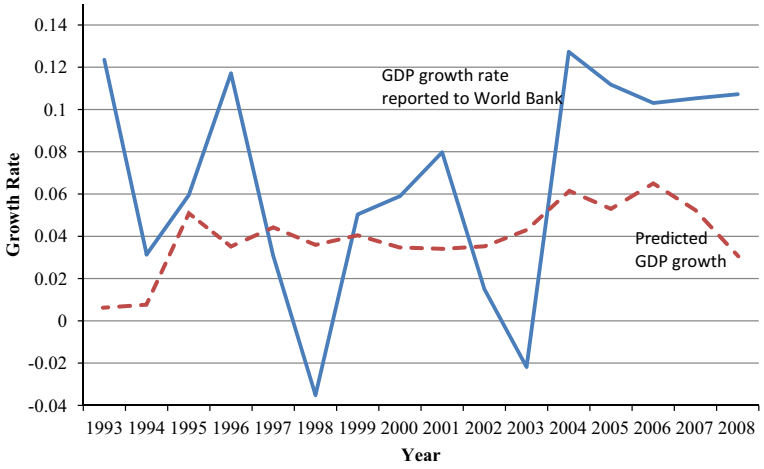

FIGURE 6. Ethiopia's reported and predicted levels of economic growth.

TABLE 9. Krieckhaus (2004) Model of Effect of Regime Type on Growth, 1992/93 to 2005/06

	GDPPC growth	*Lights growth*	*GDPPC growth*	*Lights growth*
Constant	1.218*	1.891*	1.160*	1.661
	(0.698)	(1.063)	(0.671)	(1.058)
1992/93 GDP per capita	−0.022		−0.037**	
	(0.017)		(0.018)	
1992/93 Lights per capita		−65.230***		−67.883**
		(23.759)		(27.495)
Investment share	0.081***	0.085**	0.074***	0.085**
	(0.025)	(0.039)	(0.021)	(0.038)
Secondary education	0.013	−0.035**	0.015	−0.035***
	(0.012)	(0.012)	(0.011)	(0.012)
Population growth	−0.597***	−0.707**	−0.587***	−0.760**
	(0.177)	(0.317)	(0.163)	(0.305)
Polity score	−0.038	−0.022		
	(0.039)	(0.048)		
Autocracy			1.514**	0.984
			(0.671)	(0.847)
Anocracy			−0.195	0.289
			(0.383)	(0.615)
Observations	132	132	132	132
R^2	0.246	0.101	0.297	0.108

(*Notes.* Models estimated using ordinary least squares. Standard errors are robust to heteroskedasticity. Regressions use a cross-section of countries with the change in log GDP, 1992/93 to 2005/06.
*, **, *** indicate that the coefficient is statistically significant at the 10%, 5%, 1% levels.)

the polity variable is negative, suggesting that democracies had slightly (but not statistically significantly) slower per-capita income growth than did dictatorships. The dependent variable is the average annual GDP per-capita growth, so the point estimate indicates that each one unit increase in the polity score reduces annual GDPPC growth by 0.04 percentage points. Column 2 replaces the GDP per-capita growth variable with per-capita lights growth as the dependent variable. As the estimates show, using lights growth reduces the magnitude of the coefficient on the polity variable (though the change is not statistically significant).

Columns 3 and 4 repeat this comparison using the autocracy and anocracy dummy variables. Column 3 shows that autocracies had 1.5 percentage point faster annual growth in GDP per capita than democracies between 1992 and 2006. The annual growth in lights per capita, on the other hand, was less than one percentage point faster for autocracies than for democracies. Since the change in the political coefficients between columns 3 and 4 (and between columns 1 and 2) is not statistically significant, the estimates do not provide conclusive evidence that the use of GDP data reported by the regimes is responsible for growth results in the literature favoring dictatorships. Nonetheless, the argument that authoritarian regimes provide growth benefits, which at first glance appears to be supported in the GDP growth equations in Tables 2 and 9, does not receive the same support when regressions use growth measures that regimes are less able to exaggerate.

Conclusion

In this paper, we question the superiority of authoritarian models of economic growth. We believe the existing literature on economic growth overestimates the impact of

dictatorships because it relies on statistics that are reported to international organizations, and as we show, dictatorships tend to exaggerate their growth. Accounting for the fact that authoritarian regimes overstate growth slightly diminishes the effect of these regimes on long-run economic growth. In light of this point, much of the evidence showing growth benefits associated with authoritarian regimes is less compelling and the case for democracy looks better than before.

Our results suggest that researchers should be especially cautious about using official data from dictatorships such as Myanmar, which reported the fastest GDP growth between 1992/93 and 2005/06 yet ranks in the bottom half of countries in its lights growth over the same time period. While previous scholars have questioned the accuracy of data reported by autocracies, none have provided specific measures as to how much dictatorships overstate growth rates. By using a new data set of satellite images of nighttime lights and comparing the growth in lights to the growth in GDP the countries report, we are able to provide the first empirical confirmation of the suspicion that dictatorships lie about economic growth. We are also able to provide the first estimates of how much dictatorships exaggerate their growth rates. We estimate that dictatorships consistently overstate the annual real GDP growth in their country by between 0.5 and 1.5 percentage points on average when compared to the growth rates predicted by satellite images of nighttime lights.

The relative credibility of growth data provided by democracies means their citizens are better informed about the true state of their economy, and as a result they can make more informed decisions about their lives and the lives of their children. Having more accurate information allows people to live more productive lives that reflect their ambitions and not those of politicians. This is a compelling reason to conclude that democracies are superior political systems than dictatorships.

Appendix

Table A1. List of Countries in the Analysis

Albania	Dominican Republic	Lebanon
Algeria	Ecuador	Lesotho
Angola	Egypt	Liberia
Argentina	El Salvador	Libya*
Armenia	Eritrea	Lithuania
Australia	Estonia	Luxembourg
Austria	Ethiopia	Macedonia, FYR
Azerbaijan	Fiji	Madagascar
Bangladesh	Finland	Malawi
Belarus	France	Malaysia
Belgium	Gabon	Mali
Benin	Gambia	Mauritania
Bhutan	Georgia	Mauritius
Bolivia	Germany	Mexico
Botswana	Ghana	Mongolia
Brazil	Greece	Morocco
Bulgaria	Guatemala	Mozambique
Burkina Faso	Guinea	Myanmar
Burundi	Guinea-Bissau	Namibia
Cambodia	Guyana	Nepal
Cameroon	Haiti	Netherlands
Canada	Honduras	New Zealand
Cape Verde	Hungary	Nicaragua
Central African Republic	India	Niger
Chad	Indonesia	Nigeria
Chile	Iran	Norway
China	Iraq*	Oman
Colombia	Ireland	Pakistan
Comoros	Israel	Panama
Congo	Italy	Papua New Guinea
Costa Rica	Jamaica	Paraguay
Côte d'Ivoire	Japan	Peru
Croatia	Jordan	Philippines
Cuba*	Kazakhstan	Poland
Cyprus	Kenya	Portugal
Czech Republic	Kuwait*	Qatar*
Democratic Republic of the Congo	Kyrgyzstan	Republic of Korea
Denmark	Laos	Republic of Moldova
Djibouti	Latvia	Romania
Russian Federation	Swaziland	Uganda
Rwanda	Sweden	Ukraine
Saudi Arabia	Switzerland	United Arab Emirates
Senegal	Syrian Arab Republic	United Kingdom
Sierra Leone	Tajikistan	United States
Slovakia	Tanzania	Uruguay
Slovenia	Thailand	Uzbekistan
Solomon Islands	Togo	Venezuela
South Africa	Trinidad and Tobago	Viet Nam
Spain	Tunisia	Yemen
Sri Lanka	Turkey	Zambia
Sudan	Turkmenistan	Zimbabwe

*Indicates that the country had missing data and was not included in the long differences regressions.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Data S1. Do-file replicating tables in Magee and Doces (2014).

Data S2. Stata dataset with yearly observations for each country from 1992 to 2008.

Data S3. Stata dataset with one observation per country, growth from 1992 to 2006.