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Autocrats and Skyscrapers: Modern White Elephants in Dictatorships*

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Abstract

Political leaders often have private incentives to pursue expensive and socially wasteful "white elephant" projects. Our argument highlights that weak accountability mechanisms allow autocratic leaders to more easily realize such projects, whereas democratic leaders are more constrained from doing so. We subsequently test different implications from this argument by drawing on a global dataset recording various features of skyscrapers, a prominent type of modern white elephant. We find that autocracies systematically build more new skyscrapers than democracies, and this result is robust to controlling for income level, state control over the economy, and country- and year-fixed effects. Further, autocratic skyscrapers are more excessive and wasteful than democratic. Autocratic regimes also pursue skyscraper projects no matter if they preside over rural or urban societies. In contrast, skyscrapers are fewer and – when first built – associated with less waste in democracies, and they are more frequently built urbanized democracies than in rural.

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1 Introduction

Democracies outperform autocracies on several policy and development outcomes, including school enrollment (Lake and Baum 2001), infant mortality rates (Gerring, Thacker and Alfaro 2012), and productivity change (Knutsen 2015). Yet, recent analysis suggests that autocracies systematically outpace democracies on various investment and infrastructure variables (Gerring, Gjerløw and Knutsen 2017). There exist quite different explanations for this pattern. Some highlight more benevolent motives combined with the high capacity of autocratic regimes in undertaking large investment projects, suggesting that autocrats pursue productivity-enhancing investments (see Przeworski and Limongi 1993). The large literature on East Asian development states, for example, highlight how autocratic regimes bent at increasing income growth have displayed the autonomy to drive up savings rates, invest in infrastructure, and subsidize capital for export-producing industrial firms (Leftwich 2000; Wade 1990; Young 1995)

Another explanation, which we elaborate on in this paper, contends that many investments made in autocracies are actually not very productivity-enhancing, and rather reflect less sanguine motivations on the part of leaders. Historically, numerous autocrats have funded, subsidized, or otherwise encouraged large-scale investment and infrastructure projects for reasons such as vanity, one example being Mussolini building the exceedingly expensive EUR district in Rome in the 1930s, planned for a World Fair that would celebrate 20 years of fascist rule in Italy in 1942. Such projects can also provide cronies of the regime with opportunities for reaping excessive profits or bribes. One recent example is the profiteering of private contractors with ties to the Putin regime before the 2014 Sochi Winter Olympics, as many contractors were heavily subsidized through the state bank Vnesheconombank (see, e.g., Yaffa 2014). Extravagant projects such as the EUR and Sochi Olympics can also be used to signal the regime's capabilities and strength to foreign allies and competitors. No matter what the more specific motivation is, autocratic leaders have personal reasons to pursue costly, but mostly unproductive (from a societal point of view), investments – often referred to as white elephant projects.

A large theoretical political-economy literature has highlighted how various institutional features that affect either vertical accountability, horizontal accountability, or control of corruption – all of which are typically present to a larger extent in democracies than in autocracies – could limit the "rents" that leaders appropriate (e.g., Ferejohn 1986; Lake and Baum 2001; Przeworski 2000). But despite this, and despite the numerous examples of historical and contemporary autocrats undertaking white elephant projects, we lack comprehensive and systematic evidence on whether autocratic leaders are, in fact, more likely than democratic leaders to pursue such projects.[1] This is likely the result of the lack of measures of white elephant projects that are amenable to comparison across space and time. We thus contribute to the literature by conducting a systematic empirical analysis of how autocratic and democratic countries differ on one prominent modern type of white elephant, namely skyscrapers (which, as we discuss below, often constitute a substantial net drag on public resources). Our empirical analysis employs a global dataset with extensive time series, drawing from an impressive online archive of buildings created by The Skyscraper Center (CTBUH 2016*a*).

We find that when countries become more autocratic, they subsequently build more new skyscrapers, controlling for other relevant factors, such as level of income and urbanization. This result is neither due to skyscrapers being more popular in particular countries (e.g., China or Kuwait) that happen to be autocratic, nor to skyscrapers being

[1]Several cross-national measures of political and administrative corruption exists, and have been used to asses links with democracy (e.g., Rock 2009). However most measures rely on perceptions of corruption, which may be artificially inflated in democratic countries with a free press and higher transparency, thus generating biased estimates (see, e.g., Knutsen 2010). Some recent empirical studies with relevance for the topic of leaders and rents have employed creative designs and satellite data on nighttime light activity to investigate how local economic activity in a region increases when the chief executive comes from that region (Hodler and Raschky 2014). Yet other studies, more directly related to ours, have investigated how (local) political leaders and elite coalitions manage to expend public resources on excessively costly sports stadiums (e.g., Delaney and Eckstein 2003).

built with greater frequency in certain time periods where autocracies proliferate, as the results are clear even when controlling for country- and year-fixed effects. The result is robust to employing alternative estimation techniques, omitting countries that have never built any skyscrapers, and controlling for different sets of confounders. It is also robust to employing different operationalizations of our dependent variable such as counting the number of new skyscrapers, number of additional meters of skyscrapers, including or excluding industrial structures and telecommunications masts in our measures, etc. The result holds up when we investigate sub-samples, for instance only using data from more recent decades. We also control for state involvement in the economy and conduct validity checks on our data in order to ensure that results are not simply driven by differential propensities of democratic and autocratic private sector actors to build skyscrapers (that are unrelated to political factors). The validity checks involve gauging the state- or regime ties of contracting firms and public financing for 100 randomly selected skyscraper projects.

Different extensions of this analysis corroborate the theoretical notion that autocrats encourage the building of skyscrapers for reasons of self-interest rather than for the reason that skyscrapers fill any vital economic function: We introduce more targeted measures capturing the "vanity" of building projects, such as the number or percentage of excessive meters of skyscrapers – i.e. the distance from the top of the building to the highest occupied floor – and show that autocracies are systematically associated with these measures. These results are even stronger when we conduct matching analysis at the building level, allowing us to only compare otherwise similar types of buildings in democracies and autocracies. Yet, not all skyscrapers are white elephants and skyscrapers are more likely to be socially productive investments in, for instance, wealthy and highly urbanized societies than in poor and largely rural. We thus conduct interaction tests, and these results also corroborate our argument: whereas the building of skyscrapers in democracies closely follows income and urbanization, autocratic regimes build (more) skyscrapers regardless of whether they preside over a rich or poor, or an urban or rural, society. When investigating the mechanisms, we find suggestive evidence that the relationship between regime type and skyscrapers is, to a large extent, driven by vertical accountability mechanisms and well-informed democratic voters disciplining politicians into not pursuing skyscraper projects. We do not find clear evidence that democracies build fewer skyscrapers due to stronger horizontal checks on leaders or because they are less corrupt.

In the next section, we provide some illustrative examples of white elephants and discuss leaders' motivations for pursuing them, before we discuss why skyscrapers can be considered white elephants. Thereafter, we lay out the more general argument on why autocratic leaders expectedly pursue more (costly) white elephant projects than democratic. In the following section, we discuss our data and empirical design. In the penultimate section, we present our empirical results on different features of skyskcrapers, before we conclude.

2 Autocrats and White Elephants

Why would any leader want to expend public resources on projects that cost more than the revenue they are expected to bring in? After all, such projects funnel scarce resources away from productive investments or goods and services widely desired by citizens. One straightforward answer is that white elephants could enhance the (private) utility of political leaders:

2.1 White elephants, and why leaders want them

White elephants come in different forms. Take, for example, excessively expensive palaces. Among the most prominent palaces is the Versailles, the luxurious residency of French royalty (and selected aristocrats) up until the French revolution. The cost of the Versailles is uncertain, but records such as the "Comptes des Batiments du roi sous le regne de Louis XIV" indicate a pricetag of more than 2 billion 1994 US Dollars (Guiffrey 1901). French peasants and other taxpayers were stuck with an enormous cost, while the palace and parks were privately enjoyed by their leaders. A more recent example is the presidential palace in Ankara, initiated by Turkish President Erdogan. This building holds 1150 rooms extending over 300 000 m^2, and is estimated to cost Turkish tax payers

$615m. While the costs of such projects are substantial – and has to be covered by increased taxes, reduced public spending in other areas, or debt – they yield obvious private gains for leaders.

Leaders could pursue white elephants also for other reasons than direct personal consumption. Leaders, as other people, are motivated by a number of things. Put differently, the utility function of leaders can incorporate various arguments other than private consumption, and the weight of these arguments vary with the leader in question. Some leaders may be strongly motivated by religious convictions, and large and expensively decorated religious buildings constitute another type of historically prominent white elephant.[2]

Further, many leaders – like other people – want to be famous and talked about, and prefer being viewed as powerful, capable or affluent. Large buildings – but also other remarkable projects and events such as high-speed trains, enormous dams, and major sports events where leaders can attend and lead ceremonies – function as expensive symbols. These symbols can help leaders shape the perceptions of their country's, and by extension their own, affluence, capabilities or power. In other words, buildings may serve as specific and identifiable representations of the country and its leadership that

[2]For example, Binnya U, conveniently nicknamed the "Lord of White Elephant" (he actually had a white elephant as a pet), rebuilt the Shwedagon Pagoda to 20 meters in the 14th century. Burmese heads of state have later added 80 more meters and golden plating around the whole structure, put a crown on top with 5448 diamonds and 2317 rubies, and a final bud on the top in 15 grams 76 carat diamond (Wikipedia 2016). In 2009, the Burmese military regime completed a replica of the Shwedagon Pagoda in their ("artificial", recently erected) capitol Naypyidaw, but this latter structure is completely hollow on the inside – The Lord of White Elephant would probably have been proud. To take another example, President Félix Houphouët-Boigny built the "Basilica of our Lady of Peace" in Yammasoukrou, Cote d'Ivoire, which was to replicate the Peter's Basilica in Rome in terms of architectural style but with an extra 30 meters to its size. This cathedral is estimated to have doubled the country's national debt (Mark 2015), in a country where only about 20 percent of the population are Catholic (CIA 2016).

help make them visible and alter their reputation abroad or among certain domestic audiences. Illustratively, many expensive buildings are aptly named after the leader. Projecting power through expensive white elephants can also be an effective strategy for dictators seeking to establish and secure their own position, or for an authoritarian party to further establish its hold on power. As Svolik (2012, p. 80) notes, "[u]nder established autocracy, the dictator's outward appearance of invincibility is as important as his actual power." Insofar as white elephants signal affluence and power, they can contribute to co-opt opposition members, or at least deter potential uprisings, by altering beliefs about the chances of successfully contesting the regime (Kuran 1995; Fearon 1995).

2.2 Skyscrapers as white elephants

One type of modern-day white elephant that fits such a power-projecting purpose is the skyscraper. Being visible and impressive modern structures, skyscrapers provide an easily recognizable symbol for a city, or even a country and its regime, and bring international attention and legitimacy (in a similar fashion to the palaces and churches of older days). As suggested by a description of the Jeddah Tower – the 1000 meter tall building under construction in Saudi Arabia – extravagant skyscrapers can serve to "emanate the growth, prosperity, and regional emergence of its homeland on the global stage" (CTBUH 2016*b*). Thus, leaders may prefer building skyscrapers in order to physically display the country's – and by extension its leadership's – wealth, power and capabilities.

Regarding the cost-effectiveness of skyscrapers, this admittedly depends on a range of factors, including how the building is constructed but also the land value in the particular location – more floors allow for more square meters of office or residential space per square meter of land. Building a given skyscraper may carry net economic gains in Manhattan, but not in Dubai or Kigali. Yet, building very tall skyscrapers is, in general, very costly. To take one extreme example, the mentioned Jeddah Tower is projected to cost about $ 1.2 billion upon completion in 2019 – a back-of-the-envelope calculation suggests that this sum is equivalent to the total annual public expenditures for a country such as Rwanda (in 2014).

Thus, cost-inefficient skyscrapers are – as we provide evidence of below – often built or part-financed by states, or by actors with access to public resources such as state-owned enterprises or nominally private firms with strong (family or other) ties to the leader. To name examples, the estimated 400 million US Dollar Khan Shatyr Entertainment Centre in Astana, Kazakhstan and the estimated 306 million USD SOCAR Tower in Baku, Azerbaijan, were both fully government financed, and so were the Gunma Prefectural Government Building in Maebashi, Japan, and the Euromast in Rotterdam, the Netherlands. In other cases, owners, CEOs and other key operative in the main contractor company has strong government connections; the key figures in many of the Chinese skypscraper contractors we investigated, for example, have histories from the Chinese Communist Party. In some instances, skyscrapers are even built without being used for any further revenue-generating purpose.[3] One example is the Ryugyong Hotel – also known as The Tower of Doom – in Pyongyang; a 330 meters towering pyramid on which construction started in 1987, but which remains unoccupied even today. In sum, skyscrapers often constitute white (or at least whitely shaded) elephants.

2.3 Why democracies may build fewer and less expensive skyscrapers than autocracies: Three potential mechanisms

Our main hypothesis is that autocracies build more skyscrapers than democracies, everything else equal. A second hypothesis is that autocracies build more wasteful skyscrapers than democracies. We outline three different types of mechanisms which, if operative, should all contribute to generating these relationships:

First, well-functioning vertical accountability mechanisms – notably related to regular, competitive elections linking the fortunes of leaders to the preferences of their electorates

[3]Granted, there may be (hard-to-measure) economic benefits to building skyscrapers in countries that are potential tourist destinations. Some structures, such as the Eiffel Tower, have likely yielded net benefits to the domestic economy by attracting tourists. If both democratic and autocratic leaders and populations in potential tourist countries recognize this, it should contribute to attenuate any relationship between regime type and skyscrapers.

(see, e.g., Ferejohn 1986) – should mitigate the pursuit of white elephant projects in democracies. Contested multi-party elections provide dissatisfied citizens with a channel for removing incumbents that expend resources on costly and ineffective projects. Democratic leaders will thus more likely anticipate future personal costs from pursuing white elephants, because such projects mitigate their chances of re-election. Yet, well-functioning vertical accountability mechanisms presume not only that principals (i.e., citizens) are able to freely select and remove their agents (i.e., leaders), but also that the principals are well-informed about the agents' actions (Besley 2006). One key feature of democratic politics is thus that it often provides a richer and more critical information environment than in autocracies. Political competition and arenas for free public debate help inform voters about the costs and benefits of various policies (e.g., Dahl 1971). Opposition parties or independent media outlets, with the opportunities *and* incentives to spread information on the costs of, e.g., large-scale construction projects, will make citizens better aware of the dark side of white elephants. Forward-looking leaders should under these conditions rather channel public resources to presumably more popular items such as primary education, health clinics and local roads (e.g., Harding 2015).[4]

[4]Skyscrapers may be conceptualized not only as white elephant projects, but also as a particular instance of rent (conceived broadly as any type of personal gain for the leader, not only monetary). Numerous theoretical models – formal and informal – address rent-seeking by political leaders, highlighting the conditions under which leaders can select policies for private gain despite the wider social costs (see, e.g., Rowley, Tollison and Tullock 1988). A key insight is that this "moral hazard" problem is exacerbated under circumstances of weak or no institutionalized mechanisms of accountability and when information is asymmetric and opaque (see, e.g., Laffont and Martimort 2002). Other scholars address how these circumstances also amplify issues of "adverse selection" (Besley 2006). In our context, if citizens are able to screen and select "better" and more honest leaders, or leaders that hold basically similar policy preferences as themselves, there would be less of an agency problem associated with leaders pursuing white elephant projects. Given that competitive elections and institutions ensuring transparent information to voters are perceived to mitigate not only moral hazard but also adverse

Second, well-functioning checks and balances in democracies – stemming from institutions and actors outside the executive being empowered to affect policy making and veto executive decisions – provide horizontal accountability mechanisms restraining leaders. These relate, for instance, to requirements of passing spending bills through the legislature; even though a democratically elected prime minister may prefer to spend on a white elephant, legislators accountable to voters in their district may be less eager to do so (particularly when the elephant is located outside their district). Hence, a legislature empowered to constrain the chief executive is one key institutional feature for mitigating wasteful projects in democracies (see North and Weingast 1989), but many democracies display also other constraining institutions, such as an independent judiciary. In contrast, the relatively weaker institutional constraints placed on autocratic leaders should enable autocrats to pursue various policies that they privately prefer with less interference, including white elephant projects.

Third, autocracies may observe more skyscrapers due to the nature of links between political leaders and their core supporters. All leaders rely on the support of some key constituencies, but in autocracies these constituencies tend to be less encompassing (Bueno de Mesquita et al. 2003) and often dominated by economic elites (e.g., Acemoglu and Robinson 2006). Large-scale construction projects is one helpful tool for autocratic leaders wanting to please their rich and relatively few key supporters, as over-priced building contracts can be used to secretively transfer resources. Even in the absence of such corruption, business elites may prefer public resources being spent on financing or subsidizing skyscrapers – for example through direct transfers, tax breaks, or the government providing cheap inputs – rather than financing, say, primary schools or clinics in rural areas. Indeed, political power concentration with economic elites may lead to more skyscrapers in autocracies *even if* these skyscrapers are fully financed by private actors. This is because economic elites may influence leaders into pursuing regulatory and other

selection, this bolsters the prediction that democracies, due to stronger vertical accountability mechanisms, should observe fewer white elephants than autocracies.

policies of relevance for the building of (also privately financed) skyscrapers. One specific regulatory policy of obvious relevance pertains to maximum height limits on buildings in major cities, but also the implementation of zoning plans and provision of complementary infrastructure may affect the possibility for private actors to build skyscrapers.

If *at least one* of these three mechanisms are operative, we should observe that fewer – and less expensive – skyscraper projects are initiated in democracies than in autocracies. Yet, the three mechanisms that might connect regime type to skyscrapers are presented in a stylized fashion, and there are plausible counter-arguments, or at least caveats, to all of them:

Regarding vertical accountability, also autocrats may be restricted in their actions by the broader public, if not through free and fair elections then through anticipated reactions such as protests, riots and revolts (e.g., Acemoglu and Robinson 2006; Svolik 2012). Further, vertical accountability mechanisms may operate with varying degrees of strength also in democracies.[5] Notably, even when freedom of speech and media are formally ensured, the true costs of grand projects may sometimes be hidden from the public by democratic governments, thereby mitigating the unpopularity of white elephant projects. This is particularly pertinent in democracies where independent or opposition newspapers or broadcast media are negligible. Regarding horizontal accountability, autocratic leaders are seldom all-powerful, as their decision-making powers are restricted by, e.g., regime parties and multi-party legislatures (e.g., Gandhi 2008; Svolik 2012; Wright 2008). Likewise, some democratic leaders operate within systems that have relatively few institutional veto players (Tsebelis 2002). Regarding links with key supporters, also democratic leaders, more than occasionally, engage in corrupt activities (e.g., Rock 2009), and economic elite groups may carry disproportionately large influence over politics also in democracies (Przeworski 2010; Albertus and Menaldo 2014). These caveats imply that

[5] Vertical accountability may, e.g., be weaker in cases such as South Africa where the ANC has not faced any major opposition party or realistic prospects of government alternation.

the link between regime type and skyscrapers remains an open empirical question. They also imply that we may observe a systematic correlation between measures of media and the information environment, horizontal checks on leaders, corruption, and the concentration of political power with economic elites, on the one hand, and measures pertaining to skyscraper projects, on the other, even when controlling for degree of democracy.

3 Data

3.1 The skyscraper database and dependent variable operationalizations

We collected the data on skyscrapers from The Skyscraper Center. This impressive online database, which is constantly updated by the Council for Tall Buildings and Urban Habitats (CTBUH 2016*a*), includes all known human constructions taller than 150 meters (plus numerous lower buildings). The database also includes proposed buildings, buildings on hold, buildings under construction, and demolished constructions. With varying coverage, buildings are accompanied with information on, e.g., their function, construction materials, number of floors, elevators (and their speed), etc. We developed and employed an automated data-scraping technique to convert the information into formats amenable to our purpose (see Appendix A.1 for details), resulting in one country-year and one building-level dataset. The former is our main dataset, while the latter is used for robustness tests.

Since coverage is incomplete for buildings lower than 150 meters, and the selection criteria are unclear, we restrict our operationalization of skyscrapers to buildings taller than 150 meters where we (at least in principle) have full coverage. There are 7853 such structures in our dataset. Several of these are only unrealized plans or visions, and after removing these and buildings that were never completed or put on hold, we are left with 5048 structures $\geq$ 150 meters. This criterion sets a fairly high threshold for counting a building as a skyscraper, which has another notable benefit: Shorter buildings are generally both far less costly to construct and less impressive structures. Hence, buildings of, say, about 100 meters tall are less likely to constitute white elephant projects of theoretical interest than buildings exceeding 150 meters. Further, our baseline excludes industrial structures (e.g., factories with very tall chimneys) and telecommunications masts, as categorized by CTBUH (2016*a*), to obtain a more homogeneous measure. We consider these constructions to be quite different from the other tall structures included, and our theoretical notion of skyscrapers as modern white elephants, as they (and their height) have a specific economic function related to, respectively, industrial manufacturing and telecommunications. This leaves us with 4925 relevant skyscrapers. Yet, we show in Appendix Table A.4 that including industrial plants and telecommunication masts or experimenting with alternative cut-offs on skyscraper height only marginally affects results.

Figure 1 plots meters and completion year for *all* tall structures recorded in the CTBUH database. It illustrates that tall buildings become more frequent in recent decades, and that the very tallest buildings have become taller. Construction technologies have improved since the early 20th century, and previous "World's tallest" such as the 170 meter Washington Monument or even the 300 meter Eiffel Tower fade in the shadow of today's tallest structures. When excluding towers and masts, three current buildings exceed 600 meters, and these "mega-structures" are located in Mecca, Shanghai and Dubai.[6] This points to the importance of accounting for time-period effects in our regressions – particularly since also the share of relatively democratic countries has changed over time.

For certain buildings, information is available on both year when the construction began, and when the building was completed. We leverage this to inform the time-lag used for our covariates. A few buildings took several decades to build, but for almost the entire time-period, the typical skyscraper took between 3 and 4 years to construct (see Appendix Figure A.1). Thus, in our main specifications, we lag all independent variables with 3 years to reflect the time it takes for deciding on a building project to it being finalized.[7] This should also contribute to mitigate potential reverse causality issues

[6]Interestingly, while all "mega-structures" have come after the "third wave of democratization" (Huntington 1991), only political regimes without competitive national elections have (so far) built them.

[7]While there is no clear theoretical rationale for preferring 3-year to 4-year lags, this

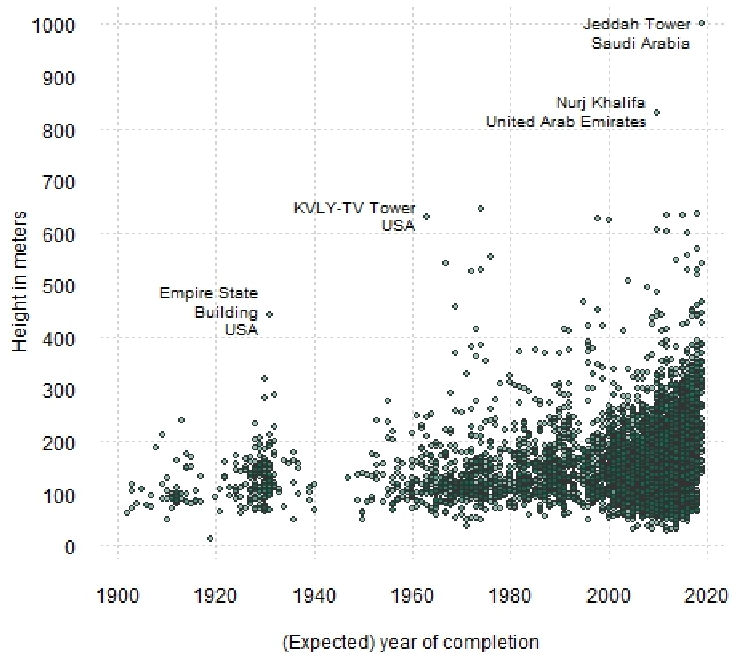

Figure 1: Evolution of tall structures during the 20th century

(which we, in any case, assume are minor for this particular relationship): There is little reason to expect that the number of new skyscrapers built, e.g., in the year 2000 should strongly affect the level of democracy in 1997.

We construct three different types of dependent variables from these data. The first pertains to the number of new skyscrapers in a country in a given year. While we also test models using the raw number of new skyscrapers, the right-skewed nature of this dependent variable means that we mainly employ the natural logarithm of (change in number of skyscraper from one year to the next +1). Formally,

$$ln(\Delta S_{i,t} + 1) = ln(S_{i,t} - S_{i,t-1} + 1) \quad (1)$$

where S is the number of skyscrapers, i denotes the country, and t denotes the year. For

allows us to incorporate more observations. Appendix Table A.9 shows that results are stable to using the alternative lag structure.

more than 90 percent of our country-years, this variable takes the value 0 (which is also the theoretical minimum value). Thus, we test various specifications – including zero-inflated negative binomial and Tobit regressions – that are attentive to this aspect of the distribution of the dependent variable, in addition to our benchmark OLS specifications.

Second, we employ the (log-transformed) number of skyscraper-meters built in a given year. This measure allows us to capture that some countries may not only build more skyscrapers, but also taller (and thus more expensive) skyscrapers than others. We again mainly rely on the logarithmic transformation (equivalent to in Equation 1) in order to deal with the skewed distribution, but complement this with analysis on the raw count of new skyscraper-meters.

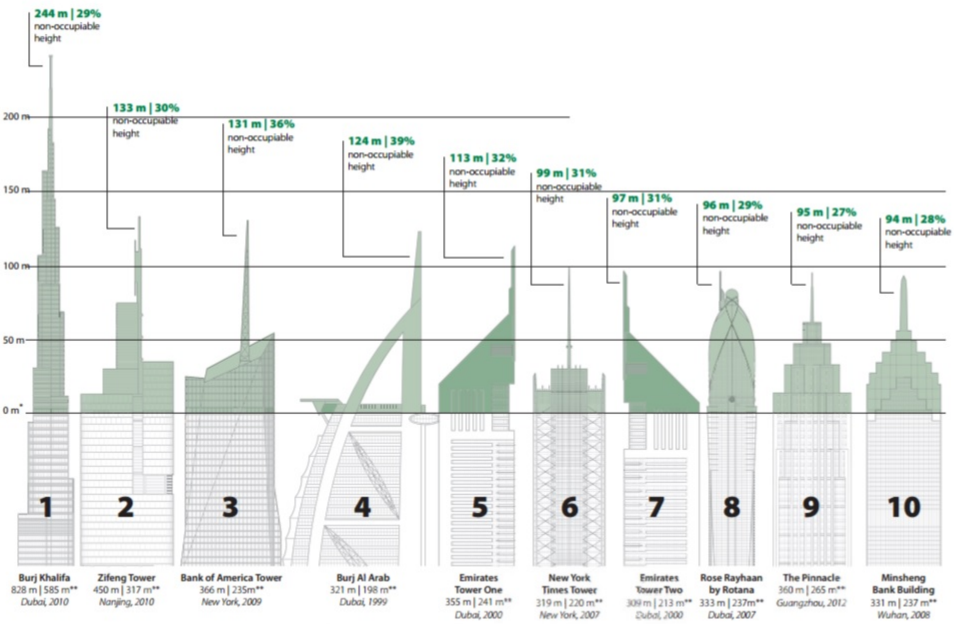

Figure 2: The ten buildings in the world with the highest number of vanity meters. Notes: Vanity meters are represented by the colored (top) part of the buildings. Please note that the scale differs on the non-vanity (bottom) part of the buildings. Source: The illustration is taken from CTBUH (2013).

Third, we employ measures of "vanity height", defined as the distance between the highest occupiable floor and the architectural top of the structure, as illustrated by Figure 2. These are spires or empty spaces on the top of a structure, which can comprise a large part of some skyscrapers. The 828 meter tall Burj Khalifa in Dubai carries 244 meters of vanity height – 29 % of the total height. If these 244 meters were a separate building in Europe, they would be the 11th tallest structure on the continent (CTBUH 2013). With this variable, we aim to capture height that has a symbolic function – which could still be in leaders' private interest according to our theoretical argument – but no clear economic function except, perhaps, attracting some extra tourists. We try out different specifications, including ln (vanity meters+1), absolute number of vanity meters, and vanity meters as percentage share of total building height, both for the entire building mass of skyscrapers and only for "signal buildings" such as the tallest skyscraper constructed that year.

3.2 Independent variables

Our baseline measure of political regime type is Polyarchy (Teorell et al. 2016) from V-Dem (Coppedge et al. 2016a,b; Pemstein et al. 2015). This is a carefully constructed measure of the (core) electoral aspect of democracy. It builds on the Polyarchy concept from Dahl (1971), which considers the extent of competitiveness of elite selection and how broad popular participation is in this selection process. More specifically, Polyarchy includes indicators on whether or not the chief executive is (directly or indirectly) elected, "cleanness" of elections, freedoms of association and speech, and suffrage extension. A weighted combination of additive and multiplicative aggregation is used in order to capture the partial substitutability between these indicators (Teorell et al. 2016), and the measure ranges from 0–1.

We control for different factors that may plausibly affect the building of skyscrapers and correlate with regime type – as for Polyarchy, all controls are lagged by three years (see Appendix Table A.2 for descriptive statistics). First, we control for income, measured by log (real, PPP-adjusted) GDP per capita (from Bolt and van Zanden 2014). Higher income levels could make some skyscraper projects economically beneficial despite the costs of erecting them, and income correlates strongly with democracy. Further, we control for log population size (also from Bolt and van Zanden 2014) and urbanization (from World Development Indicators, via Coppedge et al. 2016a); larger and more urban countries should contain more high-rise buildings simply due to scale and pressures for area-intensive housing. We also control for income per capita from natural resources production (fuels and minerals), as coded by Haber and Menaldo (2011). Natural resources revenue constitutes a particular source of income that leaders can more easily monopolize and use for pet projects, including the building of skyscrapers, and such income is widely hypothesized to reduce democratization chances (e.g., Ross 2012).

Our baseline is a simple Ordinary Least Squares (OLS) regression with the above-listed covariates. The baseline also includes country- and year-fixed effects to account for omitted country-specific factors (e.g., related to geography or some cultural affinity for building tall structures) as well as global factors (for instance related to building technology and architectural trends) that vary over time and may affect the propensity to build sky-scrapers. We highlight that our results turn out very robust to dropping different controls (thus further mitigating possible post-treatment bias) and to including additional controls such as GDP per capita growth in recent years (thus further safeguarding against omitted variable bias). We also employ alternative estimation techniques, including zero-inflated negative binomial models and Tobit regressions. These models provide us with important sensitivity tests as they account, e.g., for the skewed distribution of our dependent variables, coming from the fact that several countries in our data material do not build skyscrapers, and that there is a lower bound (0) to our dependent variables. We discuss the rationale for testing these more complex (and inherently more sensitive) specifications in the next section right before the relevant results.

4 Empirical Analysis

4.1 Main tests: Number and Meters of Skyscraper

Model 1 in Table 1 is our benchmark OLS specification, using ln(number of new skyscrapers in given year + 1) as dependent variable. As expected, Polyarchy, measured three years prior, is negatively signed and precisely estimated ($p < 0.01$). This provides initial support for the hypothesis that autocracies build more skyscrapers than democracies. The signs on the controls are also mostly in the expected direction: As countries become richer, more urbanized, or more populous, they tend to build more skyscrapers. However, increased natural resource income is associated with fewer skyscrapers, holding the other covariates constant.[8] Figure 3 plots all coefficients from Model 1 with 95 percent confidence intervals.

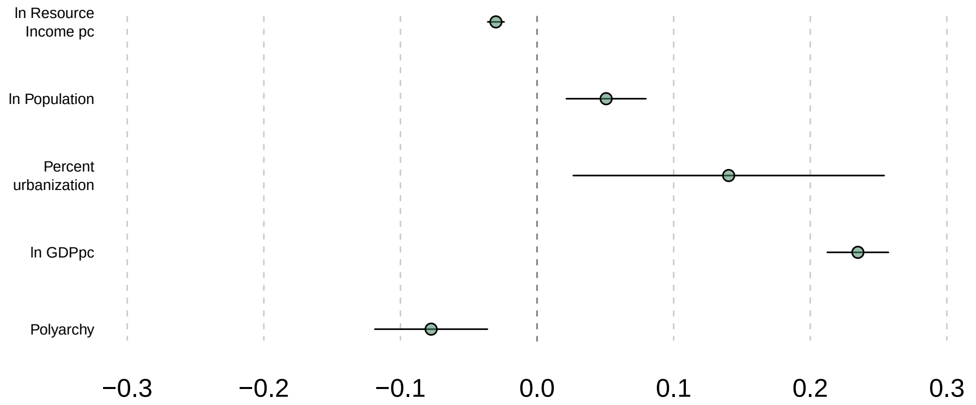

Figure 3: Model 1 – Point estimates and 95% confidence intervals on number of new skyscrapers logged

Our benchmark includes country-fixed effects, thus disallowing any information to be drawn from comparisons across countries. This makes our very clear results extra noticeable, since they only draw information from changes to regime type within countries across time. Model 2 shows that results are fairly similar if we omit the country-fixed effects. While the Polyarchy coefficient is somewhat attenuated in Model 2, it remains negative and statistically significant at 1 percent. Hence, autocracies build more skyscrapers also when we include comparisons across countries, and results are further strengthened if we exclude USA – which is somewhat of an anomaly by being a democracy with numerous

[8] Yet we note that one resource-rich country with several tall skyscrapers, namely the United Arab Emirates, is excluded from the benchmark because of missing data on Polyarchy.

Table 1: Main results: Regime type and the number and meters of Skyscrapers

	Ln Skyscrapers OLS	**Ln Skyscrapers OLS w.o. country FE**	**Skyscrapers OLS**	**Ln Skyscrapers OLS, w.o. zero-obs.**	**Skyscrapers Zeroinflated**	**Skyscrapers Tobit**	**Ln Meters OLS**	**Meters OLS**
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Polyarchy	−0.08***	−0.05***	−0.77***	−0.71	−1.63***	−0.45***	−0.16*	−143.10***
	(0.02)	(0.02)	(0.14)	(0.44)	(0.39)	(0.17)	(0.09)	(26.52)
ln GDPpc	0.23***	0.12***	1.24***	2.34***	0.72***	1.43***	0.89***	229.18***
	(0.01)	(0.01)	(0.08)	(0.33)	(0.15)	(0.10)	(0.05)	(14.40)
Percent urbanization	0.14**	−0.17***	0.21	−1.49	−0.84	0.90***	0.77***	35.09
	(0.06)	(0.03)	(0.39)	(1.59)	(0.66)	(0.29)	(0.24)	(73.28)
ln Population	0.05***	0.07***	0.18*	0.31	0.62***	0.82***	0.27***	36.14*
	(0.01)	(0.002)	(0.10)	(0.59)	(0.05)	(0.04)	(0.06)	(18.75)
ln Resource Income pc	−0.03***	−0.01***	−0.12***	−0.16*	−0.35***	−0.14***	−0.12***	−22.24***
	(0.003)	(0.002)	(0.02)	(0.09)	(0.05)	(0.02)	(0.01)	(3.85)
logSigmaMu						−0.0001		
						(0.05)		
logSigmaNu						0.20***		
						(0.03)		
Constant	−2.25***	−1.90***	−10.54***	−22.17**	−31.95	−28.34***	−9.73***	−1996.40***
	(0.27)	(0.10)	(1.82)	(9.78)	(2073.04)	(0.60)	(1.12)	(340.95)
Country FE	Yes	No	Yes	Yes	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Continent FE	No	No	No	No	Yes	No	No	No
N	8414	8414	8414	428	8414	8414	8414	8414
R-squared	0.43	0.17	0.30	0.70			0.40	0.29

***p < .01; **p < .05; *p < .1
All covariates lagged by 3 years
Standard error in paranthesis

skyscrapers – from the sample.[9]

In the baseline, we logged the number of new skyscrapers due to the skewed distribution. But, Model 3 shows that our main result is robust to using the simple count of new skyscrapers. The point estimate for Polyarchy suggests that a country going from a high-quality democracy (1) to a harsh autocracy (0) increases the predicted number of additional skyscrapers built three years later with 0.8, which is more than twice the mean number of skyscrapers built in our sample (0.3). The low sample mean reflects the many country-year observations where no single skyscraper is built. Reassuringly, Polyarchy remains basically unchanged, dropping by less than ten percent in size, when excluding all such country-year observations in Model 4, although the t-value in this very reduced sample is 1.6.

Model 4 thus tries to deal with the issue of numerous zero observations on our dependent variable, but does so in a crude manner. OLS models, in principle, assume an underlying continuous scale on the dependent variable, and our dependent variable only measures integral numbers; a country can build 14 or 15 new skyscrapers in a given year, but not 14.3. We thus tested a Zero-Inflated Negative Binomial model, which is run in two stages. The first stage separates among the observations that are not building skyscrapers from those that build *at least* one; this specification deals with the large number of 0-observations. The second stage further separates between observations that build at least one skyscraper, and models a *count process* for how many they will build, thus capturing the integral nature of our dependent variable. Interestingly, we do not find clear evidence that democracies are more (or less) likely than autocracies to be in the group that builds 0 skyscrapers (see Appendix Table A.13). However, the second

[9]The result for urbanization is sensitive to omitting the country-fixed effects. When allowing for comparing across relatively urban and relatively rural countries, the urbanization coefficient is now negatively signed. This could stem from omitted variable bias; countries that are relatively rural in large parts of the time series may be associated with other political, historical, or cultural features that enhance the propensity to build skyscrapers.

stage, reported as Model 5 in Table 1, yields clear evidence that – within the group of observations building skyscrapers – autocracies build more skyscrapers. Polyarchy is significant at 1 percent, and a harsh autocracy (0 on Polyarchy) is predicted to build 1.6 more skyscrapers in year $t + 3$ than a high-quality democracy (1 on Polyarchy). Model 6 presents an alternative way of dealing with the fact that a country cannot build a negative number of skyscrapers, namely a Random Effects Tobit model with 0 as lower-bound censoring value. Also in this model, autocracies are predicted to build more skyscrapers, and Polyarchy is significant at 1 percent.[10]

Returning to our baseline OLS specification, Model 7 employs the logarithmic transformation of the more fine-grained measure capturing additional *meters* of skyscrapers built in $t + 3$. Again, the Polyarchy coefficient is in the expected direction, although only significant at 10 percent. Once employing the untransformed version of this measure in Model 8, the result again turns highly significant. The point estimate from this model suggests that going from a high-quality democracy to a harsh autocracy increases skyscraper meters built by almost 150 meters in year $t + 3$, controlling for country- and year-fixed effects and holding income level, urbanization, population, and resource income constant.

4.2 Robustness tests

The results in Table 1 do not seem to be driven by omitted variable bias, despite our relatively sparse baseline specification (see Appendix Section A.4). For example, short-term economic booms might increase the propensity to build skyscrapers, and such episodes come more frequently in autocracies (Przeworski et al. 2000). Yet, controlling for economic growth in the prior 5-/10-year period does not alter the results. Controlling for other variables, such as international autonomy of the country or occurrence of civil war, does not weaken results either. For some specifications, such as when adding participation

[10]We see no theoretical reason to count demolished skyscrapers as negative values on our dependent variable, nor for excluding demolished buildings from our data. Yet, Appendix Table A.5 shows that results are robust to excluding demolished buildings.

in international wars alongside the baseline set of controls, results become somewhat clearer. Results are also stable to omitting any single control or subsets of controls, including models only keeping the country- and year-fixed effects, suggesting that the baseline results are not driven by post-treatment bias either.

Our results are robust to employing alternative measures of democracy, such as Polity2 (Marshall, Gurr and Jaggers 2013) and the dichotomous electoral democracy measure from Boix, Miller and Rosato (2012). Further, results are robust to making different operationalization decisions on the dependent variables (Appendix Section A.3), such as excluding demolished buildings, or excluding data on a few skyscrapers that we suspect – but cannot ensure, since skyscrapers with identical names and features are sometimes built as part of complexes – might be duplicates in the dataset. Results are also robust to omitting the early part of our sample and re-running our models on, e.g., post-1945, post-1960, and post-1980 samples (Appendix Section A.5).

One key issue remains: The results would not reflect our argument well if they are primarily driven by systematic differences between democratic and autocratic countries in the preferences and capabilities of private businesses and real-estate developers to build skyscrapers that are unrelated to political decisions. We find this unlikely, especially since we see no clear theoretical reason for why such (non-political) private business incentives and capabilities to build skyscrapers should be systematically higher in autocracies than in democracies, especially when conditioning on income level, urbanization, natural resource income, and country- and year-specific effects. Our argument rests on the premise that state actors, regulatory policies and/or public resources influence decisions to build skyscrapers, and that the influence varies according to regime type. Hence, we first wanted to check that our results are not driven simply by state-controlled economies building more (or less) skyscrapers, and that state ownership and control over the economy, more generally, happens to differ between democracies and autocracies. However, our results are stable when controlling for the indicator on state ownership and control of the economy from V-Dem (see Appendix Table A.7).[11]

To more directly investigate our key assumption on political involvement in the building of skyscrapers, we scrutinized a (stratified) random sample of 100 skyscrapers – 50 each in below- and above-median Polyarchy observations. While comparable measures on the exact amount of state subsidies do not exist, the CTBUH data contain information, for some observations, on firms involved in the construction process, and for many other projects such information is available from other online sources.[12] More specifically, we investigate whether skyscrapers are fully or partly publicly funded, whether the involved firms are state-owned, and whether involved firms are otherwise linked to the political regime (e.g., owned by a close relative of the leader or a party member). We employed a conservative routine, only coding state involvement if this was explicitly identifiable from credible sources.

Among the 50 skyscrapers in relatively democratic countries, we were able to retrieve information for 46 (92%), whereas the corresponding number is 32 (64%) for autocracies – this difference dovetails nicely with extant research on regime type and transparency (Hollyer, Rosendorff and Vreeland 2011). For the skyscrapers where we did find information on ownership or financing, we identified state- or regime-affiliated ownership or financing in 50% of the autocratic skyscrapers, and in 28% of the democratic. Yet, our conservative coding rules for identifying and registering state involvement, and our informed guess – also based, e.g., on the majority of autocratic skyscrapers with missing information being located in China, where state financing presumably dominates – is that our numbers almost certainly underestimate the extent of state involvement, especially in autocracies. In any case, these findings further corroborate the notion that politics and

[11]The reason we excluded this variable from our benchmark is that the coding of state involvement in the economy may be post-treatment to V-Dem country experts observing that leaders chose to build skyscrapers with state resources.

[12]Yet, the lack of easily available and transparent information for many buildings, and especially the ownership status of involved companies, makes this time-consuming to code (which explains why we investigate only a sample).

the role of the regime is driving the higher propensity of autocracies to build skyscrapers.

4.3 Which types of skyscrapers do autocrats build and in what contexts do autocrats build skyscrapers?

So far we have focused on the hypothesis that autocracies build more skyscrapers than democracies. However, our argument on how autocratic leaders more freely can pursue projects that yield personal benefits such as glory, recognition or projection of power, but that are socially very costly, yields other observable implications: *First*, we expect autocratic regimes to be systematically associated with economically more wasteful skyscrapers than democracies. Conditional on skyscrapers being built, autocrats should be freer to spend more resources on buildings being tall and elegant, and care less about their economic costs. While we do not have high-quality, comparable data on building costs and revenue streams generated, we do have proxies that should provide *fairly strong signals* on the vanity of skyscraper projects. *Second*, certain contextual factors should make building skyscrapers socio-economically more beneficial – or, at least, less wasteful – and our argument suggests that democratic leaders need to be more attentive to this than autocratic. Urbanization is an important such contextual factor: Skyscrapers should make more socio-economic sense in a highly urbanized- than in a rural society. We first investigate the relationship between regime type and vanity of skyscrapers, before we turn to the interaction between regime type and urbanization.

To reiterate, our vanity measures leverage information on the distance in meters between the top of the skyscraper and the highest occupied floor. This is a proxy for the part of the skyscraper where there is no economic activity. (If autocrats also tend to build skyscrapers where lower floors are left unoccupied to boost total height of their constructions, our analysis will thus underestimate the relationship between autocracy and skyscraper vanity.) Our first specification, Model 1 in Table 2, aggregates the number for all skyscrapers built in a particular year, and takes the natural logarithm of this number+1. Otherwise, this model is equivalent to the benchmark from Table 1. As expected, Polyarchy is negative and significant at 1 percent.[13]

Table 2: Regime type and excessiveness of skyscrapers

	Ln vanity meters	**Absolute vanity meters**	**Vanity percent**	**Max vanity percent**
	Model 1	**Model 2**	**Model 3**	**Model 4**
Polyarchy	−0.17***	−4.99***	−0.08	−0.17*
	(0.04)	(1.09)	(0.08)	(0.09)
Ln GDPpc	0.27***	6.26***	0.02	0.12**
	(0.02)	(0.57)	(0.04)	(0.05)
Percent urbanization	0.02	−2.19	0.12	0.22
	(0.11)	(2.92)	(0.22)	(0.24)
Ln Population	0.06**	0.97	0.06	0.07
	(0.03)	(0.77)	(0.06)	(0.06)
Ln Resource Income pc	−0.03***	−0.57***	−0.004	−0.01
	(0.01)	(0.15)	(0.01)	(0.01)
Constant	−2.57***	−55.64***	−1.02	−1.74
	(0.50)	(13.87)	(1.05)	(1.16)
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	7353	7353	7353	7353
R-squared	0.26	0.18	0.03	0.05

***p < .01; **p < .05; *p < .1
All covariates lagged by 3 years
Standard error in paranthesis

This result is robust to using the absolute meters of vanity height built (as always measured 3 years after the independent variables) in Model 2. When rather using the percentage of the total new building mass that is vanity height, however, the result turns statistically insignificant at conventional levels in Model 3. Yet, the percentage share vanity meters variable is somewhat stronger when we consider only "signal buildings" rather than the total building mass. The measure used in Model 4 is constructed to capture that leaders may focus on particular buildings to gain recognition or project power. More specifically, the measure used in Model 4 is the percentage share of vanity meters for the tallest skyscraper built in that year, and Polyarchy is negative and weakly significant in this specification. We conducted various robustness tests, for example altering the set of covariates, and results often turn clearer for alternative set-ups than that displayed in Table 2. In sum, there is some, though not entirely robust, evidence that the skyscrapers built in autocracies are associated with more vanity than those built in democracies.

[13]We note that the sample is truncated, relative to in Table 1, because of missing data on our vanity measure.

We also employed a very different design to assess this relationship. More specifically, we constructed a dataset with buildings rather than country-years as units of analysis, and conducted Coarsened Exact Matching (CEM) at the skyscraper-level (see Iacus, King and Porro 2011). Thus, we only compare otherwise similar buildings that are built in relatively autocratic and in relatively democratic countries, and test whether the former is systematically associated with more vanity height. This allows controlling for the possibility that different *types* of buildings, for various reasons not related to regime type, are associated with differences in what we here count as excessive height. Specifically, we match buildings based on meters (from the ground) to the highest occupied floor, decade completed, being part of a building complex, and being completely or partly used for office and/or residential functions. Observations are divided into two groups after the median Polyarchy value in our dataset.

The estimated average treatment effects from the CEM analysis, for three different dependent variable operationalizations, are presented in Table 3. Models 1, 2, and 3 employ, respectively, vanity meters as percentage share of skyscraper meters, ln(vanity meters +1), and vanity meters as dependent variable. The results reinforce the country-year regression results – Polyarchy is consistently negative and statistically significant at 1 percent. We also tried out very different proxies of the excessiveness of skyscrapers. Drawing on available information on number of floors and ground floor area, similar CEM models show that that autocratic skyscrapers have more *meters per floors* and *meters per ground floor area* than otherwise similar democratic skyscrapers (see Appendix Table A.16). Hence, when we compare particular buildings in autocracies with otherwise similar buildings constructed in democracies, we find that skyscrapers constructed in autocracies are more excessive, on various proxies of excessiveness.

The discussion so far has focused on how skyscrapers are often a waste of resources (although to differing degrees, following our discussion of vanity meters). Yet, some skyscraper projects are associated with economic benefits that outweigh costs, notably in metropolitan city areas with limited space and high property prices, such as Manhattan,

Table 3: Robustness test of skyscraper excessiveness: CEM-matching at the building-level

	Percent	**Ln meters**	**Absolute meters**
	Model 1	**Model 2**	**Model 3**
Polyarchy (above or below median)	−1.48***	−0.14***	−4.09***
	(0.56)	(0.05)	(1.58)
Constant	13.70***	3.99***	53.91***
	(4.18)	(0.40)	(11.76)
matched subclass FE	Yes	Yes	Yes
N	549	549	549
R-squared	0.26	0.23	0.26

***p < .01; **p < .05; *p < .1
All covariates lagged by 3 years
Standard error in paranthesis

New York or downtown Tokyo. While more fine-grained measures on property prices in the exact areas where skyscrapers are built would be a great measure for capturing the relative economic benefits of skyscrapers, comparable such data across countries and time are unavailable. We thus use a cruder proxy, the extent of urbanization in the country in question, to investigate whether autocracies are less responsive to such economic calculations when building skyscrapers. The underlying notion is that skyscrapers are likely more economically efficient in urbanized societies, as they, on average, have higher demands for offices, retail, hotel rooms, and housing in geographically limited spaces.

Model 1 in Appendix Table 14 extends our baseline specification with the logged number of new skyscrapers as dependent variable by including a multiplicative interaction term between Polyarchy and urbanization. The negative and highly significant linear term for Polyarchy suggests that autocracies systematically build more skyscrapers than democracies in very rural societies, and the positive and highly significant interaction term suggests that the difference is reduced once countries urbanize.[14] Figure 4 further illustrates the results from this model: The leftmost diagram shows that autocracy is associated with more skyscrapers being built not only in very rural societies, but also fairly urban up until where about two-thirds of the population live in cities. For the most urbanized societies, there is no clear relationship between regime type and skyscrap-

[14]This clear pattern is robust to employing alternative dependent variables, such as (ln) new skyscraper meters.

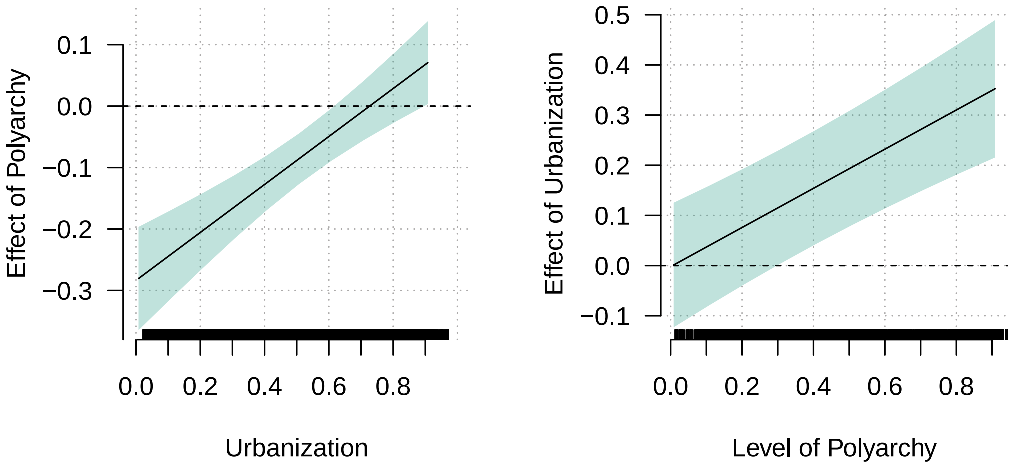

Figure 4: Interaction between Polyarchy and urbanization, marginal effects.
Notes: Point estimates and 95% confidence intervals are based on Model 1 of Appendix Table A.14, with ln(skyscrapers+1) as dependent variable.

ers, as the 95 percent confidence intervals overlap zero. The rightmost diagram shows that whereas urbanization is associated with more skyscrapers being built in "mixed" and democratic regimes (i.e., regimes scoring about 0.3 or higher on Polyarchy), there is actually no systematic relationship between urbanization and skyscrapers under more autocratic regimes. Harsh dictatorships seem equally eager to build skyscrapers independent of whether they preside over rural or urban societies.[15]

4.4 Investigating the proposed mechanisms

Finally, we assess which (if any) of the proposed mechanisms that generate the clear link between regime type and skyscrapers. To recapitulate, we proposed, *first*, that democracy may mitigate the building of expensive skyscrapers due to vertical accountability mechanisms. Well-informed voters could penalize politicians expending scarce

[15]In Appendix Section A.7 we show that results are similar when interacting Polyarchy with GDP per capita instead of urbanization; autocracies build more skyscrapers in poor countries, whereas the coefficient actually flips signs for very high income levels (where there are very few observed autocracies).

resources on wasteful project, thus disciplining politicians seeking re-election into not pursuing these projects. *Second*, the typically stronger institutional checks on democratic leaders could restrain the building of skyscrapers, even if leaders personally want them. *Third*, white elephant projects such as skyscrapers may be one means by which leaders can please their core supporters, for example because such projects allow (in particular autocratic) leaders to funnel resources to their core supporters, e.g. through providing artificially inflated contracts, in corrupt countries.

Disentangling these mechanisms and coming up with definite answers to which one is relatively more important is, admittedly, very hard. Yet, we can provide suggestive evidence. While features such as institutional checks on the leader and control of corruption are generally more prevalent in more democratic regimes, regimes display quite different combinations of institutional features. There are corrupt (Indonesia) and non-corrupt (Denmark) democracies, and autocracies with relatively weak (Zaire under Mobutu) and relatively strong (Mexico under the PRI) institutional checks on leaders. The V-Dem dataset allows us to capture such nuances, and track fine-grained institutional developments for countries across our entire time period. We employ V-Dem indicators proxying for the different mechanisms in a very simple set-up, adding these variables *seriatim* to our baseline model. If Polyarchy drops markedly in size and significance once a mechanism is controlled for, and the variable proxying for this mechanism is systematically linked to the skyscraper measures, this provides suggestive evidence that the mechanism is operative.[16]

Model 1, Table 6 replicates the baseline Model 1, Table 1 on (log) number of new skyscrapers. The estimated Polyarchy coefficient is -0.08 and highly significant. Model 2 includes our favored proxy of the vertical accountability mechanism, highlighting that

[16]We write "suggestive evidence" since this kind of mediation test rests on strong assumptions (e.g., Imai and Yamamoto 2011; Imai and Tingley 2012), and results can be quite sensitive. This is particularly relevant here, since our argument suggests multiple plausible mechanisms, and omitting relevant mediators may lead to bias if the included and omitted mediators correlate.

Table 4: Investigating the mechanisms

	Baseline	**Vertical**	**Horizontal**	**Corruption**	**Support Coalition**	**All**
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Polyarchy	-0.08^{***}	0.01	-0.06^{*}	-0.09^{***}	-0.04^{*}	0.05
	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.04)
Alternative source of information		-0.07^{***}				-0.08^{**}
		(0.03)				(0.03)
Legislative constraints on executive			-0.03			-0.01
			(0.03)			(0.03)
Political corruption				-0.07^{**}		-0.10^{***}
				(0.03)		(0.03)
Power distributed by socioeconomic position					-0.03^{***}	-0.03^{***}
					(0.005)	(0.005)
ln GDPpc	0.23^{***}	0.24^{***}	0.25^{***}	0.23^{***}	0.23^{***}	0.24^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Percent urbanization	0.14^{**}	0.14^{**}	0.16^{***}	0.14^{**}	0.15^{***}	0.17^{***}
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
ln Population	0.05^{***}	0.06^{***}	0.04^{***}	0.05^{***}	0.06^{***}	0.07^{***}
	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)
ln Resource Income pc	-0.03^{***}	-0.03^{***}	-0.03^{***}	-0.03^{***}	-0.03^{***}	-0.03^{***}
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Constant	-2.25^{***}	-2.46^{***}	-2.11^{***}	-2.19^{***}	-2.45^{***}	-2.51^{***}
	(0.27)	(0.28)	(0.28)	(0.27)	(0.27)	(0.29)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	8414	8354	8336	8414	8414	8276
R-squared	0.43	0.43	0.44	0.43	0.44	0.44

$^{***}p < .01$; $^{**}p < .05$; $^{*}p < .1$
All covariates lagged by 3 years
Standard error in paranthesis

informed voters are a requisite for disciplining politicians into not pursuing wasteful skyscraper projects. This proxy is V-Dem's "Alternative Sources of Information" index (ASI), capturing the extent to which the media is "(a) un-biased in their coverage (or lack of coverage) of the opposition, (b) allowed to be critical of the regime, and (c) representative of a wide array of political perspectives" (Coppedge et al. 2016a). ASI correlates fairly strongly (.87), though not perfectly, with Polyarchy. Polyarchy actually flips sign, to 0.01, but is statistically insignificant once controlling for this index. Once accounting for differences in the information environment, democracies do not build more skyscrapers than autocracies. Further, ASI is significant at 1 percent. This suggests that informed citizens are critical for disciplining politicians into not pursuing skyscraper projects, and this could, to a large extent, account for why democracies build fewer skyscrapers than autocracies.

We do not find similar support for the other potential mechanisms. Model 3 includes our favored proxy for the horizontal accountability mechanism, V-Dem's index for Legislative constraints on the executive (LCI). Polyarchy only changes from -0.08 to -0.06 when accounting for democracies typically having stronger legislative constraints (the bivariate correlation is .81), and Polyarchy remains weakly significant. Further, LCI is not clearly separable from zero. Hence, there is little evidence that the proposed horizontal accountability mechanism drives the relationship between regime type and skyscrapers.

One might speculate that the institutions theorized to constrain executives from pursuing white elephants could fail to work, in practice, if they are populated by actors who themselves find such projects attractive. Our third mechanism points to situations where leaders pursue skyscraper projects exactly because they are beneficial to key supporters. One such instance is in environments that allow for embezzlement and bribes, as large building projects provide great opportunities for self-enrichment for those involved. If so, the association between autocracy and skyscrapers may be "explained" by autocracies being more corrupt. The bivariate correlation between Polyarchy and V-Dem's Political corruption index (PCI) is .47. However, Polyarchy actually *increases* slightly in size once accounting for PCI in Model 4, and more corrupt countries are – in contrast with expectations – predicted to build fewer skyscrapers.

We also tested whether autocracies build more skyscrapers because political power is more strongly skewed towards economic elites, who may prefer building fancy skyscrapers rather than prioritizing, e.g., schools or clinics for the wider population. As expected, Polyarchy correlates (.62) with V-Dem's indicator on how political power is distributed by socioeconomic position (PPSP), and Model 5 predicts that the more concentrated political power is with economic elites, the more new skyscrapers are built. The Polyarchy coefficient drops when controlling for PPSP, but remains sizeable (-0.04) and significant at 10 percent – it also lies well within the 95 percent confidence interval of Polyarchy from the baseline. Hence, the evidence on this mechanism driving the relationship between regime type and skyscrapers is not clear. Model 6 displays a model controlling for all four proxies simultaneously, and results are stable for all the mediators. As in Model 1, Polyarchy flips sign (0.05) but is statistically insignificant.

In sum, we find suggestive evidence for the notion that democracies build fewer skyscrapers due to vertical accountability mechanisms; well-informed voters may discipline democratic leaders interested in re-election from engaging in such projects. In contrast, there is little evidence that democracies build fewer skyscrapers because leaders are checked by alternative institutions or because democracies are typically less corrupt.

5 Conclusion

We have argued that the lack of meaningful accountability mechanisms in autocracies enable leaders to spend more freely on white elephants – costly and ineffective projects that these leaders prefer for personal reasons. Historically, grand castles and churches were the white elephants of choice. A more recent white elephant is the skyscraper. Often remarkable buildings that stand out in the landscape, skyscrapers are sometimes viewed as symbols of the power, glory, and greatness of countries and their leaders. But, building skyscrapers is also very costly, and fully funding or subsidizing such projects will often detract resources from more mundane investments in local roads, schools, or health clinics throughout the country. Hence, while leaders and elites may adore them, local populations have good reasons to be skeptical and limit the construction of large skyscrapers, especially in poor countries where resources are scarce.

Our empirical analysis shows that autocratic regimes are more likely than democratic to observe more new skyscrapers (and meters of skyscrapers) being built, even when we account for country- and year-fixed effects alongside other relevant covariates. Further analysis suggests that autocratic regimes tend to build more excessive such buildings, and, in contrast with democracies, they tend to build skyscrapers regardless of whether the country is urbanized or not. This further corroborates the notion that autocratic leaders are freer to pursue projects that generate "private rents", broadly conceived, at the expense of wider society. Going forward, more systematic empirical research on other types of white elephant projects and different proxies for rents, for instance assessing the private residencies of leaders, would allow us to better gauge the extent to which our findings on skyscraper projects are generalizable.

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A Online Appendix for "Autocrats and Skyscrapers: Modern White Elephants in Dictatorships"

In this online appendix we provide additional information about the data gathering process and the data material, before we present additional robustness tests that are mentioned, but not displayed in tables, in the paper.

The first section gives an overview of the automated data-scraping routine that we developed to gather the skyscraper data from CTBUH (2016*a*). The second section presents relevant descriptive statistics. The third section includes various tests where we have altered the criteria for counting a building as a skyscraper, and other tests pertaining to variations in our main dependent variables. The fourth section presents model specifications where we adjust the set of control variables. We present both more parsimonious and more extensive models to investigate whether our results could be influenced by, respectively, post-treatment bias and omitted variable bias. We thereafter present tests using alternative different measures of democracy. The fifth section displays regressions using the alternative 4-year lag specification, as well as results for (different) samples that only draw on information from more recent years instead of extending the analysis back to 1900. The sixth section displays the results from the first stage of the zero-inflated negative binomial model. The seventh section shows results for the interaction models, where Polyarchy is interacted with, respectively, urbanization and GDP per capita. The final section shows Coarsened Exact Matching results at the building level when we use alternative proxies on the excessiveness of skyscrapers.

A.1 Skyscraper data collection

All data on skyscrapers have been collected from the CTBUH's website skyscraper-center (CTBUH 2016*a*). This was done following a 3-step procedure:

1. We downloaded the webpage for each building with a so-called "wget-loop" in a Bash script.[17]

2. We constructed a R-script that extracted the different pieces of information from each page. All pages have the same setup, i.e., they have identical XML structures (although the pieces of information on particular variables differ), making it possible to create a generic script for all of them that recognizes whether a particular piece of information is available for each page. While any procedure using the XML-structure of the pages would work, this script relied on Hadley Wickham's "rvest" package in R (Wickham 2016).

3. We conducted a cleaning procedure on the information extracted. This included removing duplicate information, cleaning text (mostly related to encoding issues), and harmonizing vector-names.

All steps in this procedure are replicable. Please see WEBPAGE REMOVED FOR ANONYMITY REASONS for all replication materials.

[17]Notice that step one is not mandatory, since R could connect to each page without downloading them first. Step 1 simply makes it possible to work offline.

A.2 Descriptive statistics and sample

Table A.1: Descriptive statistics for main variables

	Min	Median	Mean	Max	S.D.
New skyscrapers	0.00	0.00	0.23	70.00	2.01
New meters of skyscrapers	0.00	0.00	43.02	13221.00	376.80
New vanity meters	0.00	0.00	1.09	448.70	12.82
Polyarchy	0.01	0.31	0.41	0.94	0.28
Ln GDP per capita	203.41	2604.57	4468.56	42916.24	5065.15
Urbanization, share	0.02	0.43	0.45	0.97	0.22
Population (here shown in 1000s)	25.00	8101.23	32041.68	1297687.68	103471.05
Total natural resource income per capita	0.00	36.67	450.14	81161.85	2478.13

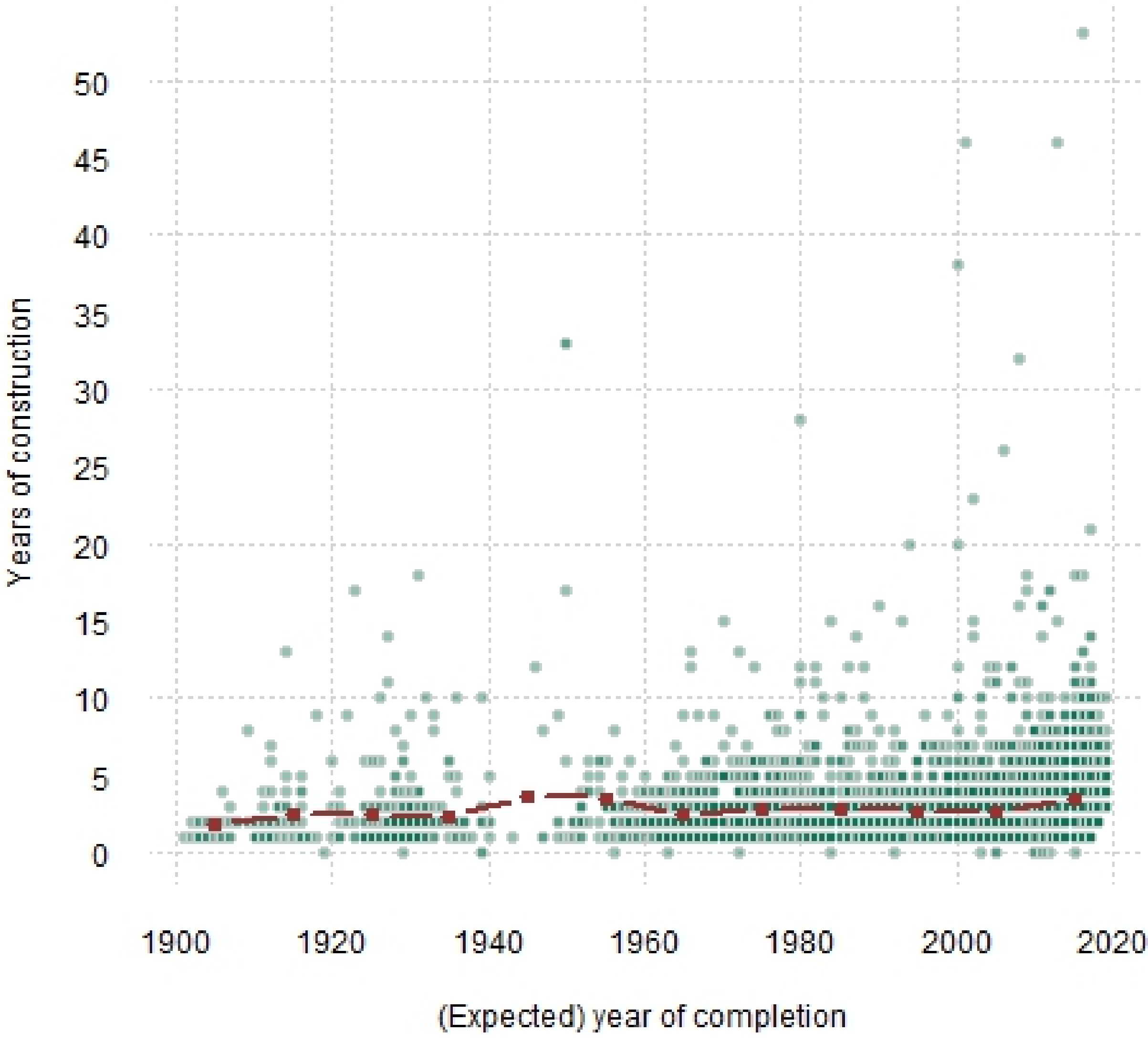

Figure A.1: Mean construction time of building projects during the 20th century

A.3 Alternative dependent variable specifications

The first table included in this section replicates our main results when we set the cut-off for considering a building to be a skyscraper to 125m rather than 150m. (We remind that the CTBUH database does not have full, global coverage for buildings shorter than 150m). The second table includes regressions counting only so-called "tall" (between 150m and 300m) and "super-tall" (more than 300m) buildings, respectively. The third table shows results from when the main regressions are re-run (keeping the 150m threshold for skyscrapers), but counting also industrial structures and telecommunication masts as skyscrapers. The fourth and final table displays regressions excluding all skyscrapers that have been demolished from the baseline.

Table A.2: Regime type and the number and meters of Skyscrapers: Cutoff at 125 meter

	OLS	Ln Skyscrapers OLS without country FE	Skyscrapers OLS	Ln Skyscrapers OLS, zero-obs. removed	Skyscrapers Zeroinflated	Skyscrapers Tobit	Ln Meters OLS	Meters OLS
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Polyarchy	-0.08^{***}	-0.04^{**}	-0.88^{***}	-0.45	-1.25^{***}	-0.28^{***}	-0.17^{*}	-157.67^{***}
	(0.03)	(0.02)	(0.19)	(0.32)	(0.30)	(0.11)	(0.10)	(32.83)
ln GDPpc	0.32^{***}	0.15^{***}	1.70^{***}	1.55^{***}	0.74^{***}	1.34^{***}	1.18^{***}	292.77^{***}
	(0.01)	(0.01)	(0.10)	(0.24)	(0.12)	(0.04)	(0.05)	(17.82)
Percent urbanization	0.28^{***}	-0.15^{***}	0.36	0.04	0.13	2.07^{***}	1.29^{***}	55.76
	(0.07)	(0.03)	(0.52)	(1.19)	(0.52)	(0.22)	(0.28)	(90.72)
ln Population	0.09^{***}	0.10^{***}	0.25^{*}	0.12	0.66^{***}	0.68^{***}	0.41^{***}	45.24^{*}
	(0.02)	(0.003)	(0.13)	(0.41)	(0.04)	(0.04)	(0.07)	(23.21)
ln Resource Income pc	-0.04^{***}	-0.01^{***}	-0.19^{***}	-0.11	-0.27^{***}	-0.08^{***}	-0.14^{***}	-31.69^{***}
	(0.004)	(0.002)	(0.03)	(0.07)	(0.03)	(0.02)	(0.01)	(4.76)
logSigmaMu						-0.17^{***}		
						(0.04)		
logSigmaNu						0.15^{***}		
						(0.02)		
Constant	-3.33^{***}	-2.59^{***}	-14.66^{***}	-14.28^{**}	-32.06	-25.79^{***}	-13.72^{***}	-2561.27^{***}
	(0.32)	(0.12)	(2.43)	(7.02)	(1489.10)	(0.77)	(1.28)	(422.09)
Country FE	Yes	No	Yes	Yes	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Continent FE	No	No	No	No	Yes	No	No	No
N	8414	8414	8414	638	8414	8414	8414	8414
R-squared	0.49	0.21	0.35	0.67			0.45	0.34

$^{***}p < .01$; $^{**}p < .05$; $^{*}p < .1$
All covariates lagged by 3 years
Standard error in paranthesis

Table A.3: Regime type and the number of tall (150m–300m) and supertall (350m+) skyscrapers

	Tall	**Supertall**
	Model 1	**Model 2**
Polyarchy	-0.07^{***}	-0.01^{**}
	(0.02)	(0.004)
Ln GDPpc	0.23^{***}	0.01^{***}
	(0.01)	(0.002)
Percent urbanization	0.13^{**}	-0.002
	(0.06)	(0.01)
Ln Population	0.05^{***}	0.01^{**}
	(0.01)	(0.003)
Ln Resource Income pc	-0.03^{***}	-0.001^{**}
	(0.003)	(0.001)
Constant	-2.19^{***}	-0.17^{***}
	(0.27)	(0.05)
Country FE	Yes	Yes
Year FE	Yes	Yes
N	8414	8414
R-squared	0.43	0.09

$^{***}p < .01$; $^{**}p < .05$; $^{*}p < .1$
All covariates lagged by 3 years
Standard error in paranthesis

Table A.4: Regime type and the number and meters of skyscrapers – including industrial structures and telecommunication masts

	OLS	Ln Skyscrapers OLS without country FE	Skyscrapers OLS	Ln Skyscrapers OLS, zero-obs. removed	Skyscrapers Zeroinflated	Skyscrapers Tobit	Ln Meters OLS	Meters OLS
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Polyarchy	−0.07***	−0.04**	−0.78***	−0.55	−1.43***	−0.23	−0.10	−145.66***
	(0.02)	(0.02)	(0.14)	(0.38)	(0.31)	(0.15)	(0.09)	(26.78)
Ln GDPpc	0.23***	0.12***	1.25***	1.28***	0.76***	0.99***	0.86***	232.69***
	(0.01)	(0.01)	(0.08)	(0.26)	(0.14)	(0.06)	(0.05)	(14.54)
Percent urbanization	0.13**	−0.17***	0.19	−0.19	−1.29**	2.30***	0.75***	37.69
	(0.06)	(0.03)	(0.39)	(1.33)	(0.62)	(0.31)	(0.26)	(74.00)
Ln Population	0.05***	0.07***	0.18*	0.21	0.60***	0.72***	0.25***	35.17*
	(0.02)	(0.002)	(0.10)	(0.47)	(0.05)	(0.04)	(0.07)	(18.93)
Ln Resource Income pc	−0.03***	−0.01***	−0.12***	−0.12*	−0.34***	−0.07***	−0.11***	−22.13***
	(0.003)	(0.002)	(0.02)	(0.07)	(0.04)	(0.02)	(0.01)	(3.89)
logSigmaMu						−0.11*		
						(0.06)		
logSigmaNu						0.19***		
						(0.03)		
Constant	−2.23***	−2.00***	−10.60***	−13.89*	−31.49	−24.11***	−9.50***	−2014.31***
	(0.28)	(0.10)	(1.83)	(7.78)	(1290.16)	(1.02)	(1.20)	(344.29)
Country FE	Yes	No	Yes	Yes	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Continent FE	No	No	No	No	Yes	No	No	No
N	8414	8414	8414	489	8414	8414	8414	8414
R-squared	0.43	0.18	0.30	0.69			0.39	0.31

***p < .01; **p < .05; *p < .1
All covariates lagged by 3 years
Standard error in paranthesis

Table A.5: Regime type and the number and meters of skyscrapers – excluding demolished buildings

	OLS	**Ln Skyscrapers OLS without country FE**	**Skyscrapers OLS**	**Ln Skyscrapers OLS, zero-obs. removed**	**Skyscrapers Zeroinflated**	**Skyscrapers Tobit**	**Ln Meters OLS**	**Meters OLS**
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Polyarchy	-0.08^{***}	-0.05^{***}	-0.77^{***}	-0.71	-1.64^{***}	-0.21	-0.15^{*}	-143.33^{***}
	(0.02)	(0.02)	(0.14)	(0.44)	(0.39)	(0.18)	(0.09)	(26.42)
ln GDPpc	0.24^{***}	0.12^{***}	1.24^{***}	2.34^{***}	0.72^{***}	1.33^{***}	0.90^{***}	229.42^{***}
	(0.01)	(0.01)	(0.08)	(0.33)	(0.15)	(0.06)	(0.05)	(14.35)
Percent urbanization	0.14^{**}	-0.17^{***}	0.21	-1.49	-0.85	1.60^{***}	0.77^{***}	33.98
	(0.06)	(0.03)	(0.39)	(1.58)	(0.66)	(0.34)	(0.24)	(73.01)
ln Population	0.05^{***}	0.07^{***}	0.18^{*}	0.30	0.61^{***}	0.76^{***}	0.27^{***}	36.05^{*}
	(0.01)	(0.002)	(0.10)	(0.59)	(0.05)	(0.04)	(0.06)	(18.68)
ln Resource Income pc	-0.03^{***}	-0.01^{***}	-0.12^{***}	-0.16^{*}	-0.35^{***}	-0.12^{***}	-0.12^{***}	-22.18^{***}
	(0.003)	(0.002)	(0.02)	(0.09)	(0.05)	(0.02)	(0.01)	(3.84)
logSigmaMu						-0.06		
						(0.05)		
logSigmaNu						0.20^{***}		
						(0.03)		
Constant	-2.26^{***}	-1.89^{***}	-10.54^{***}	-22.26^{**}	-31.85	-27.16^{***}	-9.79^{***}	-1995.13^{***}
	(0.27)	(0.10)	(1.81)	(9.78)	(2051.86)	(0.88)	(1.12)	(339.71)
Country FE	Yes	No	Yes	Yes	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Continent FE	No	No	No	No	Yes	No	No	No
N	8414	8414	8414	425	8414	8414	8414	8414
R-squared	0.43	0.17	0.30	0.70			0.40	0.29

$^{***}p < .01$; $^{**}p < .05$; $^{*}p < .1$
All covariates lagged by 3 years
Standard error in paranthesis

A.4 Alternative independent variable specifications

The first table in this section shows regressions assessing sensitivity by omitting each of the controls from the benchmark model, seriatim. The second table displays regressions adding potentially relevant controls. The third table replicates the benchmark model, but using a variety of alternative measures of democracy.

Table A.6: Regime type and ln number of new skyscrapers – dropping controls

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Polyarchy	−0.08***	−0.07***	−0.08***	−0.08***	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Ln GDPpc	0.23***	0.20***	0.22***	0.24***	
	(0.01)	(0.01)	(0.01)	(0.01)	
Percent urbanization	0.14**	0.07	0.19***		0.34***
	(0.06)	(0.06)	(0.06)		(0.06)
Ln Population	0.05***	0.04**		0.06***	−0.07***
	(0.01)	(0.01)		(0.01)	(0.01)
Ln Resource Income pc	−0.03***		−0.03***	−0.03***	−0.01***
	(0.003)		(0.003)	(0.003)	(0.003)
Constant	−2.25***	−1.85***	−1.39***	−2.45***	0.82***
	(0.27)	(0.27)	(0.09)	(0.26)	(0.23)
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	8414	8414	8414	8414	8414
R-squared	0.43	0.43	0.43	0.43	0.40

***$p < .01$; **$p < .05$; *$p < .1$
All covariates lagged by 3 years
Standard error in paranthesis

Table A.7: Regime type and the ln number of Skyscrapers with extra controls

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Polyarchy	−0.04*	−0.10***	−0.07***	−0.09***	−0.11***	−0.10***
	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.04)
Ln GDPpc	0.23***	0.23***	0.24***	0.25***	0.27***	0.29***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Percent urbanization	0.15***	0.15**	0.17**	0.20***	0.20***	0.47***
	(0.06)	(0.06)	(0.08)	(0.06)	(0.07)	(0.10)
Ln Population	0.06***	0.05***	0.003	0.04***	0.03**	−0.05*
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)
Ln Resource Income pc	−0.03***	−0.03***	−0.03***	−0.03***	−0.03***	−0.03***
	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.01)
Power distributed by socioeconomic group	−0.03***					−0.02**
	(0.005)					(0.01)
State control over resources		0.01**				0.01
		(0.004)				(0.01)
Ln land area			−0.02			0.06
			(0.11)			(0.12)
International conflict				−0.06***		−0.06***
				(0.01)		(0.02)
Internal conflict					−0.02	−0.02*
					(0.01)	(0.01)
Constant	−2.45***	−2.30***	−1.39	−2.21***	−2.18***	−1.82
	(0.27)	(0.27)	(1.49)	(0.28)	(0.30)	(1.68)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	8414	8414	6239	8054	7107	5038
R-squared	0.44	0.43	0.50	0.44	0.44	0.51

***p < .01; **p < .05; *p < .1
All covariates lagged by 3 years
Standard error in paranthesis

Table A.8: Alternative democracy measures

	V-Dem Liberal	**V-Dem Participatory**	**V-Dem Deliberatory**	**V-Dem Egalitarian**	**BMR**	**Polity2**	**Vanhanen**	**DD**
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Democracy-measure	-0.065^{***}	-0.146^{***}	-0.065^{***}	-0.048^{*}	-0.022^{**}	-0.002^{***}	-0.002^{***}	-0.009
	(0.024)	(0.031)	(0.022)	(0.028)	(0.009)	(0.001)	(0.0005)	(0.011)
Ln GDPpc	0.234^{***}	0.236^{***}	0.234^{***}	0.232^{***}	0.259^{***}	0.257^{***}	0.213^{***}	0.283^{***}
	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.012)	(0.011)	(0.014)
Percent urbanization	0.136^{**}	0.137^{**}	0.136^{**}	0.133^{**}	0.160^{***}	0.176^{***}	0.036	0.214^{***}
	(0.058)	(0.058)	(0.058)	(0.058)	(0.060)	(0.061)	(0.058)	(0.075)
Ln Population	0.047^{***}	0.046^{***}	0.047^{***}	0.048^{***}	0.046^{***}	0.041^{***}	0.021	0.027
	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)	(0.016)	(0.015)	(0.023)
Ln Resource Income pc	-0.030^{***}	-0.031^{***}	-0.030^{***}	-0.030^{***}	-0.035^{***}	-0.035^{***}	-0.030^{***}	-0.032^{***}
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Constant	-2.195^{***}	-2.203^{***}	-2.207^{***}	-2.196^{***}	-2.212^{***}	-2.153^{***}	-1.633^{***}	-2.154^{***}
	(0.270)	(0.270)	(0.270)	(0.271)	(0.278)	(0.279)	(0.264)	(0.414)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	8414	8414	8414	8414	8370	8304	7469	6688
R-squared	0.433	0.434	0.433	0.433	0.426	0.429	0.423	0.510

$^{***}p < .01$; $^{**}p < .05$; $^{*}p < .1$
All covariates lagged by 3 years
Standard error in paranthesis

A.5 Alternative lag- and sample specifications

The first table in this section shows the main results when we employ a 4-year rather than a 3-year lag specification for all independent variables. The three following tables show the main regressions run on delimited samples, including only years after, respectively, 1945, 1960 and 1980.

Table A.9: Regime type and the number and meters of Skyscraper - 4 years lag

	OLS	Ln Skyscrapers OLS without country FE	Skyscrapers OLS	Ln Skyscrapers OLS, zero-obs. removed	Skyscrapers Zeroinflated	Skyscrapers Tobit	Ln Meters OLS	Meters OLS
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Polyarchy	−0.08***	−0.05***	−0.85***	−0.72*	−1.65***	−0.21	−0.14	−158.53***
	(0.02)	(0.02)	(0.15)	(0.43)	(0.37)	(0.17)	(0.09)	(28.40)
ln GDPpc	0.25***	0.12***	1.37***	2.21***	0.76***	1.31***	0.93***	255.02***
	(0.01)	(0.01)	(0.08)	(0.30)	(0.15)	(0.06)	(0.05)	(15.42)
Percent urbanization	0.16***	−0.18***	0.28	−1.52	−0.74	1.60***	0.85***	50.54
	(0.06)	(0.03)	(0.41)	(1.46)	(0.62)	(0.32)	(0.25)	(78.49)
ln Population	0.06***	0.07***	0.21**	0.21	0.63***	0.76***	0.29***	41.73**
	(0.02)	(0.002)	(0.11)	(0.56)	(0.05)	(0.03)	(0.06)	(20.08)
ln Resource Income pc	−0.03***	−0.01***	−0.13***	−0.14	−0.35***	−0.12***	−0.12***	−23.95***
	(0.003)	(0.002)	(0.02)	(0.09)	(0.04)	(0.02)	(0.01)	(4.12)
logSigmaMu						−0.06		
						(0.04)		
logSigmaNu						0.19***		
						(0.02)		
Constant	−2.42***	−2.00***	−11.75***	−19.75**	−31.56	−27.01***	−10.32***	−2235.58***
	(0.28)	(0.10)	(1.93)	(9.25)	(1293.63)	(0.82)	(1.14)	(365.18)
Country FE	Yes	No	Yes	Yes	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Continent FE	No	No	No	No	Yes	No	No	No
N	8414	8414	8414	451	8414	8414	8414	8414
R-squared	0.44	0.17	0.30	0.70			0.41	0.30

***p < .01; **p < .05; *p < .1
All covariates lagged by 4 years
Standard error in paranthesis

Table A.10: Regime type and the number and meters of Skyscrapers post 1945

	Baseline	**No Country FE**	**Not logged**	**No zeroes**	**Zeroinflated**	**Tobit**	**Meters logged**	**Meters**
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Polyarchy	-0.07^{***}	-0.07^{***}	-0.80^{***}	-0.75^{*}	-1.67^{***}	-0.21	-0.12	-146.29^{***}
	(0.02)	(0.02)	(0.17)	(0.44)	(0.40)	(0.18)	(0.10)	(31.07)
ln GDPpc	0.26^{***}	0.12^{***}	1.37^{***}	2.37^{***}	0.75^{***}	1.30^{***}	0.99^{***}	253.36^{***}
	(0.01)	(0.01)	(0.09)	(0.33)	(0.16)	(0.06)	(0.05)	(16.61)
Percent urbanization	0.21^{***}	-0.18^{***}	0.87^{*}	-0.51	-0.89	1.62^{***}	0.80^{***}	153.27^{*}
	(0.07)	(0.03)	(0.48)	(1.63)	(0.68)	(0.36)	(0.30)	(90.17)
ln Population	0.05^{**}	0.08^{***}	0.14	-0.26	0.61^{***}	0.74^{***}	0.32^{***}	30.73
	(0.02)	(0.003)	(0.14)	(0.64)	(0.05)	(0.04)	(0.09)	(26.75)
ln Resource Income pc	-0.03^{***}	-0.01^{***}	-0.13^{***}	-0.15	-0.36^{***}	-0.13^{***}	-0.12^{***}	-23.54^{***}
	(0.004)	(0.002)	(0.02)	(0.09)	(0.05)	(0.02)	(0.01)	(4.53)
logSigmaMu						-0.06		
						(0.05)		
logSigmaNu						0.20^{***}		
						(0.03)		
Constant	-2.34^{***}	-2.04^{***}	-10.34^{***}	-12.87	-30.20	-26.63^{***}	-11.08^{***}	-1993.25^{***}
	(0.37)	(0.08)	(2.55)	(10.47)	(556.34)	(0.87)	(1.57)	(478.79)
Country FE	Yes	No	Yes	Yes	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Continent FE	No	No	No	No	Yes	No	No	No
N	6998	6998	6998	403	6998	6998	6998	6998
R-squared	0.49	0.17	0.36	0.69			0.43	0.35

$^{***}p < .01$; $^{**}p < .05$; $^{*}p < .1$
All covariates lagged by 3 years
Standard error in paranthesis

Table A.11: Regime type and the number and meters of Skyscrapers post 1960

	Baseline	**No Country FE**	**Not logged**	**No zeroes**	**Zeroinflated**	**Tobit**	**Meters logged**	**Meters**
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Polyarchy	−0.05*	−0.06***	−0.76***	−0.79*	−1.45***	0.05	0.01	−139.12***
	(0.03)	(0.02)	(0.19)	(0.43)	(0.40)	(0.16)	(0.11)	(35.15)
ln GDPpc	0.28***	0.12***	1.52***	2.16***	0.70***	1.30***	1.03***	283.00***
	(0.01)	(0.01)	(0.10)	(0.33)	(0.16)	(0.06)	(0.06)	(18.80)
Percent urbanization	0.42***	−0.17***	2.00***	1.88	−0.90	1.61***	1.58***	365.72***
	(0.08)	(0.03)	(0.57)	(1.82)	(0.70)	(0.34)	(0.35)	(106.53)
ln Population	0.03	0.08***	0.06	−0.91	0.61***	0.74***	0.22**	17.79
	(0.03)	(0.003)	(0.18)	(0.76)	(0.05)	(0.04)	(0.11)	(33.97)
ln Resource Income pc	−0.03***	−0.01***	−0.14***	−0.07	−0.34***	−0.12***	−0.11***	−24.79***
	(0.004)	(0.002)	(0.03)	(0.10)	(0.05)	(0.02)	(0.02)	(5.18)
logSigmaMu						0.001		
						(0.05)		
logSigmaNu						0.16***		
						(0.03)		
Constant	−2.19***	−2.14***	−10.28***	−3.85	−16.33***	−26.77***	−10.11***	−2032.18***
	(0.45)	(0.08)	(3.22)	(12.73)	(2.02)	(0.88)	(1.96)	(602.52)
Country FE	Yes	No	Yes	Yes	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Continent FE	No	No	No	No	Yes	No	No	No
N	6117	6117	6117	385	6117	6117	6117	6117
R-squared	0.56	0.18	0.42	0.70			0.48	0.42

***p < .01; **p < .05; *p < .1
All covariates lagged by 3 years
Standard error in paranthesis

Table A.12: Regime type and the number and meters of Skyscrapers post 1980

	Baseline	**No Country FE**	**Not logged**	**No zeroes**	**Zeroinflated**	**Tobit**	**Meters logged**	**Meters**
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Polyarchy	−0.01	−0.13***	−0.66**	−1.06**	−1.37***	0.45**	0.20	−120.39**
	(0.04)	(0.03)	(0.28)	(0.48)	(0.46)	(0.21)	(0.16)	(51.60)
ln GDPpc	0.28***	0.14***	1.84***	2.24***	0.72***	0.98***	0.97***	345.16***
	(0.02)	(0.01)	(0.18)	(0.40)	(0.17)	(0.08)	(0.10)	(33.32)
Percent urbanization	1.19***	−0.13***	8.48***	2.92	−1.21	3.37***	3.59***	1568.47***
	(0.17)	(0.04)	(1.25)	(2.66)	(0.78)	(0.45)	(0.74)	(234.27)
ln Population	−0.14**	0.11***	−0.91**	−2.10*	0.57***	0.50***	−0.38	−152.12**
	(0.06)	(0.004)	(0.41)	(1.20)	(0.06)	(0.05)	(0.24)	(75.90)
ln Resource Income pc	−0.04***	−0.01***	−0.18***	−0.14	−0.32***	−0.03	−0.12***	−33.76***
	(0.01)	(0.003)	(0.05)	(0.13)	(0.05)	(0.03)	(0.03)	(9.92)
logSigmaMu						0.04		
						(0.07)		
logSigmaNu						0.12**		
						(0.05)		
Constant	0.32	−2.58***	2.01	16.10	−17.13***	−21.32***	−0.60	84.40
	(0.97)	(0.10)	(7.12)	(20.36)	(2.47)	(1.07)	(4.19)	(1331.91)
Country FE	Yes	No	Yes	Yes	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Continent FE	No	No	No	No	Yes	No	No	No
N	3967	3967	3967	314	3967	3967	3967	3967
R-squared	0.62	0.20	0.52	0.69			0.54	0.52

***p < .01; **p < .05; *p < .1
All covariates lagged by 3 years
Standard error in paranthesis

A.6 First stage of zero-inflated negative binomial model (second stage reported as Model 5 in Table 1 of the paper)

Table A.13: First stage of zero-inflated model

Democracy-measure	-0.59
	(0.76)
Ln GDPpc	-1.52^{***}
	(0.29)
Percent urbanization	-4.14^{***}
	(1.31)
Ln Population	-1.09^{***}
	(0.12)
Ln Resource Income pc	-0.36^{***}
	(0.09)
Constant	34.93^{***}
	(4.01)
Decade FE	Yes
Continent FE	Yes
N	8414

$^{***}p < .01$; $^{**}p < .05$; $^{*}p < .1$
All covariates lagged by 3 years
Standard error in paranthesis

A.7 Interaction between Polyarchy and Urbanization/GDP per capita

This section includes, first, a table with the model (Model 1) that was used for generating Figure 4 of the paper, pertaining to the interactive effects of urbanization and regime type on ln(skyscrapers+1). The second column of this table displays a robustness tests run with ln(number of skyscaper meters+1) as the dependent variable. The next table displays equivalent interaction models, but now interacting Polyarchy with ln GDP per capita rather than Urbanization. The accompanying figure displays the interaction results from the first of those models graphically.

Table A.14: Interaction models: Regime type and urbanization

	ln number of skyscraper **Model 1**	**ln meters of skyscrapers** **Model 2**
Polyarchy	−0.28***	−1.24***
	(0.04)	(0.18)
ln GDPpc	0.23***	0.88***
	(0.01)	(0.05)
Percent urbanization	−0.002	0.02
	(0.06)	(0.26)
ln Population	0.08***	0.41***
	(0.02)	(0.06)
ln Resource Income pc	−0.03***	−0.11***
	(0.003)	(0.01)
Polyarchy*Urbanization	0.39***	2.06***
	(0.07)	(0.30)
Intercept	−2.62***	−11.67***
	(0.28)	(1.15)
Country FE	Yes	Yes
Year FE	Yes	Yes
N	8414	8414
R-squared	0.44	0.41

***p < .01; **p < .05; *p < .1
All covariates lagged by 3 years
Standard error in paranthesis

Table A.15: Interaction models: Regime type and ln GDP per capita

	Ln Skyscrapers	**Ln Meters**
	Model 1	**Model 2**
Polyarchy	-0.87^{***}	-4.41^{***}
	(0.13)	(0.55)
Ln GDPpc	0.19^{***}	0.67^{***}
	(0.01)	(0.05)
Percent urbanization	0.17^{***}	0.94^{***}
	(0.06)	(0.24)
Ln Population	0.09^{***}	0.49^{***}
	(0.02)	(0.07)
Ln Resource Income pc	-0.03^{***}	-0.11^{***}
	(0.003)	(0.01)
Polyarchy x Ln GDP per Capita	0.10^{***}	0.52^{***}
	(0.02)	(0.07)
Constant	-2.59^{***}	-11.53^{***}
	(0.28)	(1.14)
Country FE	Yes	Yes
Year FE	Yes	Yes
N	8414	8414
R-squared	0.44	0.41

$^{***}p < .01$; $^{**}p < .05$; $^{*}p < .1$
All covariates lagged by 3 years
Standard error in paranthesis

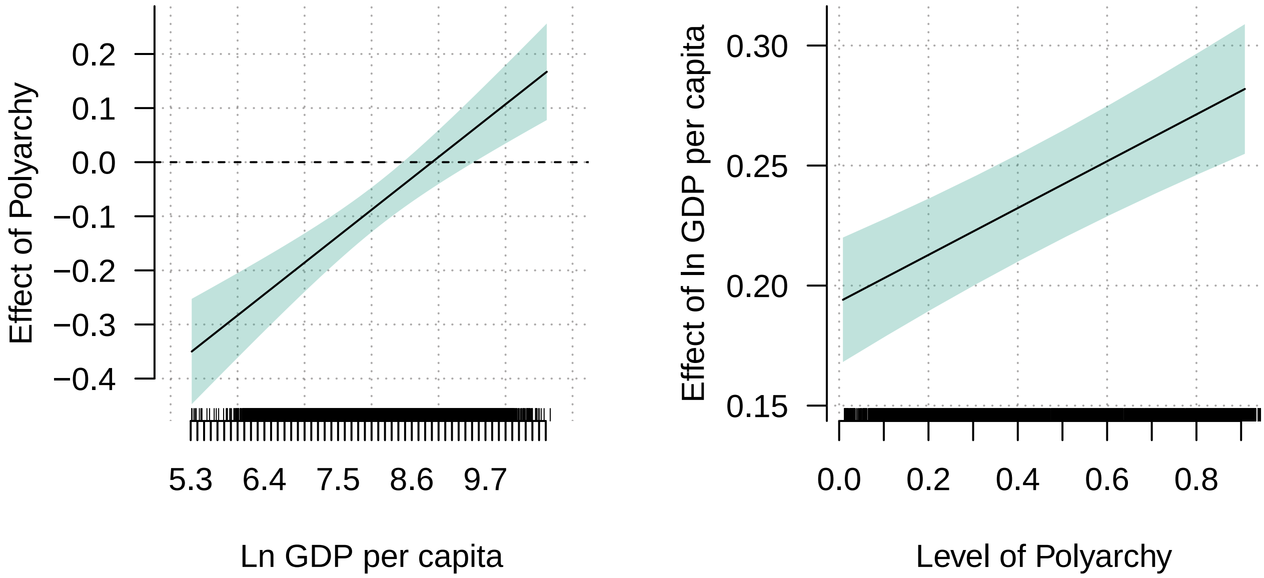

Figure A.2: Marginal effects: Interaction between Polyarchy and ln GDP per capita. Notes: Point estimates and 95 percent confidence intervals are based on Model 1 of Appendix Table A.15, with ln(skyscrapers+1) as dependent variable.

A.8 Coarsened Exact Matching (CEM) results, at the building level, on alternative proxies of skyscraper excessiveness (Height/ground-floor area and Height/number of floors)

Table A.16: CEM-matching at the building-level: Alternative proxies of the excessiveness of skyscrapers

	Height / GFA	**Height / Floors**
	Model 1	**Model 2**
Polyarchy (above or below median)	-0.0004^{**}	-0.12^{**}
	(0.0002)	(0.06)
Constant	0.002	4.65^{***}
	(0.001)	(0.42)
matched subclass FE	Yes	Yes
N	318	544
R-squared	0.23	0.46

$^{***}p < .01$; $^{**}p < .05$; $^{*}p < .1$
All covariates lagged by 3 years
Standard error in paranthesis