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STATE CAPACITY, DEMOCRACY AND PUBLIC GOOD PRODUCTION

The Case of Child Mortality

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ABSTRACT

The institutional literature on development has emphasized the need to check abuse of power, but overlooked whether the state has power in the first place. Bridging the state capacity and collective action literatures, we argue that since public goods critical for development, such as public health provision, constitute collective action problems (CAPs), and solving CAPs in groups the size of countries requires state high infrastructural power that makes individual behaviour observable/legible, so that it can be monitored and compliance enforced. It is only when democracy is institutionalized within such a state that it can have a positive effect on public goods provision. We test this argument using a novel measure of accumulated infrastructural power – the age, extent and quality of cadastral records – for over 1,000 years for 155 countries. Our analysis shows that this variable has an independent positive effect on infant and child mortality, and it also conditions the effect of democracy.

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Introduction

Although few would deny the importance of the state for development, it has received far less attention in the literature on the institutional determinants of development than democracy. Starting with North's pioneering work (1990), the emphasis of the literature has been on institutional constrains on power-holders. This emphasis consolidated in the 1990s and 2000s with democracy seen as the *par excellence* power-checking institution. The focus on the power-checking institutions presumes that the state has formidable power in first place. This assumption is, however, corroborated neither by empirical reality, nor by a growing literature on the independent effect of state capacity on economic development (Acemoglu et al. 2016; Hanson 2014) and public goods provision (D'Arcy and Nistotskaya 2017; Muralidharan et al. 2016).

This paper seeks to contribute to this debate by considering the joint impact of power-deploying (state capacity) and power-checking (democracy) institutions on development, which is a subject of a still small empirical literature (Asadullah and Savoia 2018; D'Arcy and Nistotskaya 2017; Hanson 2014, 2015; Knutsen 2013). We bring together the insights from the classic state capacity literature (Mann 1984; Scott 1998) and collective action (Olson 1965; Ostrom 1990) to argue that infrastructural power is a necessary condition for efficient provision of public goods and services, such public health services. In order to solve collective action problems (CAPs), which are at the heart of the public goods provision, states must effectively monitor individual behavior by making it legible to the state by *recording* and *reordering* it (Scott 1998) throughout the entire territory of the state (Herbst 2000; Mann 1984). It is only when democracy is institutionalized within a state with a certain degree of these powers that it has a positive effect on development.

We test this argument using a novel measure of accumulated infrastructural power – the age, extent and quality of state-produced cadastral records, which catalogue land holdings and interests in land. Our analysis shows that not only that this variable has an independent positive effect on lowering infant/child mortality, but that it also conditions the effect of democracy. Democracy only improves mortality rates above a certain threshold of infrastructural power that has been reached by some developing countries, such Tunisia or the Philippines, but not attained by a large number of them.

The paper makes two important contributions. First, we harness the theory of collective action to illuminate the importance of one dimension of state capacity – infrastructural power – for public goods production. Second, we measure the concept of infrastructural power with a novel indicator, thereby contributing to the literature on state capacity that has traditionally suffered from poor conceptualization and measurement (Soifer 2008).

Literature review

Nowadays institutions are seen as key determinants of development. Political institutions that are important for development are usually conceptualized as either power-deploying (state capacity) or power-checking, with the latter being the focus of much of the literature. North and Weingast (1989) convincingly argued for the importance of "credible commitment": mechanisms, such as separation of powers that constrain welfare-undermining inclinations of rulers. In addition to the developmental benefits of democracy as an effective mechanism against political moral hazard, the literature also argues that democracy fosters human development by prioritizing it through different mechanisms.[1]

A considerable body of empirical work that tested the relationship between democracy and development has produced mixed results. For example, while some argue that democracy does matter (Acemoglu et al 2014), others hold the opposite (Ross 2006). A similarly inconclusive picture arises with regard to the effects of democracy on public health outcomes (Besley and Kudamatsu 2006, Burroway 2016; Gerring et al 2012; Rosenberg 2018).

When it comes to power-deploying institutions, extant research has demonstrated their independent effect on desirable economic outcomes such as growth, entrepreneurship and revenue (Acemoglu et al 2016; Besley and Persson 2010; Bockstette et al 2002; D'Arcy and Nistotskaya 2018; Dincecco and Katz 2014; Nistotskaya and Cingolani 2016), insurgency and civil war (Braithwaite 2010; Fearon and Laitin 2003) and human wellbeing (Cingolani et al 2015; D'Arcy and Nistotskaya 2017).

Drawing on a Weberian conception of the state, the bulk of this literature has conceptualized state capacity as the quality of government bureaucracy. For example, Cingolani et al. (2015) argue that the implementation power is the most potent in politically insulated bureaucracies (2015), while Knutsen holds that "independent, rule-following bureaucratic apparatuses are vital for high state capacity" (2013, 2). However, the quality of bureaucracy has been seen not only as a power-deploying, but also as a power-checking institution. For example, meritocratically-recruited bureaucratic personnel is considered as a constraining device on predatory preferences of politicians (Miller and Whitford 2016; Nistotskaya and Cingolani 2016). Similarly, Rothstein and Teorell (2008)'s concept of impartiality in the exercise of power has more to do with preventing abuses of power than with the ability of bureaucracy to "implement logistically political decisions throughout the realm" (Mann 1984, 113). The conceptual ambiguity, as illustrated by the position of meritocratic bureaucracy on both – the power-checking and power-deploying – sides of the equation – is a considerable limitation of the literature.

[1] For example, electoral competition incentivizes politicians to produce public goods favored by the median voter (Lake and Baum 2001; Ferejohn 1986; Meltzer and Richard 1981); freedom of information provides politicians with the more complete information they need to be responsive to public's demands (North 1990; Sen 1981); and freedom of association enables interest groups, such as organized labor, to press for welfare reforms (Esping-Andersen 1985).

While bureaucratic quality may be an important ingredient of state capacity, it is only one dimension of it. Many tasks require not only the Weberian organization of bureaucracy, but also that bureaucracy that present throughout the territory of the state (Acemoglu et al 2016; Soifer 2008). To fully understand the relationship between power deploying institutions and development we need to parse its component parts, much as the literature on the varieties of democracy has done (Teorell et al 2016). In the next section we offer the first step in that direction by examining an understudied dimension of state capacity – infrastructural power. We argue that when development is looked at through the lens of the collective action problem, infrastructural power reveals itself as a necessary condition for development.

Theoretical Framework

Solving collective action problems (CAPs) has long been seen as "the core of the justification for the state" (Ostrom 1998, 1) and "the most significant reason for government" (Mansbridge 2014, 10). Many of the goods necessary for human flourishing – such as health and education, as well as physical infrastructure, and public order – are public or free-access goods. The provision of these goods by the state constitutes a series of CAPs because individuals have no incentive to contribute voluntarily to their provision, which gives rise to the free-rider problem (Olson 1965; Ostrom 1990).

The institutional conditions needed to solve collective action problems are largely understood (for review see D'Arcy and Nistotskaya 2017). The "credible enforcement" condition ensures that free-riders can be identified and (threatened to be) punished, thereby incentivizing the so-called conditional co-operators. This can either take the form of formal or informal monitoring and punishment. As Ostrom (1990) showed, although informal monitoring and enforcement may work well in small groups, this is may not be the case for large groups – such as countries – where a specialist in enforcement is required. However, placing enforcement in hands of one actor brings a new challenge: some constraints are needed to ensure that the powers of the enforcer (such as state) are used only to solving CAPs, and not for the enrichment of those who control those powers. Hence, "credible commitment" is the second condition to the successful resolution of CAPs.

While a number of answers to the "credible commitment" problem have been suggested,[2] institutional solutions to "credible enforcement" have remained relatively under-theorized. With the aim to fill this gap, we argue that a particular kind of state capacity – infrastructural power – is the crucial institutional foundation of credible enforcement.

The ability to monitor individual behaviour to identify and punish free-riders, thereby creating the conditions for pro-social behaviour, is at the heart of credible enforcement. However, difficulties with the

[2] For example, constitutional design diffusing power among several actors (North and Weingast 1989), elections (Ferejohn 1986) and non-politicized public bureaucracy (Miller and Whitford 2016).

observability of individual behaviour in large groups are well-known impediments to effective monitoring (Hölmstrom 1979). In the context of such large groups as the state, the sheer size of the monitored and heterogeneity of social routines and practices of local communities (for example, a diversity of locally bounded weights and measures or tenurial arrangements) are of paramount importance.

Therefore, the requirement of effective monitoring can only be fulfilled if two conditions are met. First, the enforcer can observe behaviour of *all* members of the group. This implies that the enforcer has to be comprehensively present throughout the territory where the monitored group lives, and speaks to the state capacity literature that emphasises territorial/spatial reach of the state, or infrastructural state power (Herbst 2000; Mann 1984; Soifer 2008) as an important attribute of a capable state.

Second, the requirement of effective monitoring can only be fulfilled if individual behaviours, anchored to local social practices, are clear enough to the enforcer so it is able to interpret behaviours as "contributing" or "free riding". However, as Scott (1998) has convincingly shown, individual behaviours are not by default legible comprehensible to the state, inducing states to take purposeful actions to improve legibility (Lee and Zhang 2017). For example, in order to tax trade, states had to standardize weights and other measures. To tax capital and labour, business registers, standardized accounting and human resource management practices have to be in place. To tax land, states introduced cadasters – records of land holdings and interests in land. Making behaviour legible involves not only recording local social practices, power relations and identities, but also *reordering* them – something that the state capacity literature refers to as the "weight" of the state (Mann 1984; Scott 1998; Soifer 2008).

To sum, the synthesis of the state capacity and CAPs literatures suggests that the requirements for effective monitoring in large groups call for the state with high infrastructural power: states with comprehensive spatial reach that makes individual behaviours legible to the state by reordering and recording local social practices. Although a polity with high levels of infrastructural power can solve CAPs, the power to penetrate and reorder society could also be used for anti-developmental ends. This suggests that while infrastructural power is a necessary condition for development, it is not sufficient.

On the basis of the theoretical discussion above we put forward the following hypothesis:

H1: states with higher infrastructural power show on average higher levels of public goods provision than states with lower infrastructural power, ceteris paribus.

The CAP-based reasoning has further implications for the relationship between infrastructural power, democracy and public goods provision. The literature suggests that pro-developmental outcomes are not guaranteed in either

democracies or autocracies, but are possible under both kinds of regime.[3] In light of the argument that infrastructural power is a necessary condition for development, one would expect to observe different effects of democracy on public goods provision at different levels of infrastructural power. More specifically, it is only when democracy becomes institutionalized within a state with a certain level of infrastructural power that democracy can have a positive effect on development.[4] Therefore, our second empirical proposition is:

H2: the strength of the effect of democracy on public goods provision is moderated by the infrastructural power, ceteris paribus.

Data and Method

Measuring Infrastructural Power with Cadasters

To empirically test the hypotheses a measure of infrastructural power, reflecting both key properties – territorial reach and "weight" on the society – is required. Previously, infrastructural power has been measured via single generic or specific indicators, or through broad composite measures. For example, Fearon and Laitin (2003) use GDP per capita as the proxy for state capacity, which is too broad to accurately capture infrastructural power alone. Some measure state capacity through tax revenue (Besley and Persson 2010), which is inadequate as it makes this indicator analytically indistinguishable from outcome measures. Acemoglu et al (2016) measured it through the number of post offices at the sub-national level in 19th century USA. Although it is a neat indicator for the empirical milieu of their paper it is not a suitable indicator for state capacity across spaces and time.

To overcome these deficiencies, we developed a measure of infrastructural power, which captures the age, extent and quality of state-administered cadasters. Cadasters are defined as "parcel-based information systems underpinning functions of land registration, valuation or multiple purposes" (Haldrup and Stubkjaer 2013, 653).[5] Cadasters identify land holdings (a holding's location, its dimensions and features, including land quality) and link them to people having interests in these holdings (land's owners/users), thus facilitating legibility of a key economic asset – land.[6] Furthermore, cadasters directly relate to territorial reach and "weight" of the state. As records of land, cadasters have an explicit territorial dimension, thereby tapping into the "reach" dimension.

[3] For example, for development under autocracy in East Asia see Wade (1990), for underdevelopment under autocracy in Africa see Bates (1984); development under democracy see Acemoglu et al (2003) on Botswana and Lockwood (2015) on Japan.

[4] It is important to note that while democracy may not guarantee the best developmental outcomes, it has been argued to prevent the worst (Sen 1981). In this sense, its role may most accurately be seen in terms of "credible commitment" – a constraint on the predatory use of political power by rulers.

[5] Land registration is not synonym to individual ownership as there are many examples of cadasters, such as the Soviet land use survey, that are not predicated on this form of tenure. Communally held land can also be subject of cadasters, as, for example in Kenya, Mozambique, Namibia or South Africa.

[6] Land registration has been linked to economic development, as land titles can be used as collateral to raise capital for investment (De Soto 2000). However, our focus is not on this much-debated relationship, but rather to use land records as an indicator of infrastructural power.

Similarly, as Scott (1998, 35-36) points out, the introduction of state-administered cadasters standardizes numerous complex local tenure arrangements (which, prior to cadaster, were clear to local inhabitants, but not to non-locals or the state functionaries), thereby making behavior in this important arena legible to the state and improving the efficiency of monitoring. In turn, this enables the state to better solve collective action problems. The potential utility of cadastral data as an indicator of state capacity was recognized in the past, but the scarcity of cross-country data on cadasters is a long-standing issue, acknowledged by the community of professional surveyors (Haldrup and Stubkjaer 2013).

Constructing the Cadaster Indicator

Cadasters have operated in a variety of economic, legal and fiscal systems and for a variety of purposes (Kain and Baigent 1992; Ting and Williamson 1999). To code consistently, we assign a score for each country every year between 1000AD and 2012,[7] based on the answers to the following three questions: Was there a state-administered cadaster? Was the cadaster narrative or cartographic? What percent of the territory of the state in its current borders was covered by the cadaster?

Narrative cadasters are records, containing *written* description of land holdings. Early cadasters, for example, the Chinese cadasters before 1143, the Ottoman *tahrir defterleri* or the Swedish *jordeböcker* were narrative cadasters. Cartographic (mapped) cadasters are records, containing *cartographic* identification of land holdings. Cartographic cadasters present the information about a land holding diagrammatically, i.e. in a drawing or sketch, accompanied by a legend. Figure 1 depicts historical examples of a narrative (Russian) and cartographic (Swedish) cadasters.

Years with no cadasters are coded as "0", years with cartographic cadasters as "1", and years with narrative cadaster as "0.75", and years with no reputable information on cadasters are score as missing data. Cartographic cadasters are given higher scores because as they are based on more systematic observations (underpinned by more sophisticated measures and instruments (Williamson 1984)), they render behaviors more legible. To quantify the difference between the two types of cadasters we draw on Libecap and Lueck (2011b) who found, in the context of a natural experiment in Ohio, that areas where land in the nineteenth century was attributed through narrative cadasters have fewer mortgages, conveyances and lower – by about 40% – land value, compared to areas with cartographic cadasters. The main reason for this is that in narrative cadastral systems "outsiders have little knowledge of local conditions and topography to determine the exact location and nature of parcels" (Libecap and Lueck 2011a: 260). In other words, legibility of narrative cadasters is lower by about 40%, compared to cartographic ones.

[7] For the period before 1000 AD historical information is poor. Collecting data for this period would require high research effort for sub-standard quality data. There are also very few examples of cadasters before 1000 (one of the few being in China).

Assigning yearly scores allows us to take into account spatial and temporal change, including, for example, the discontinuation of cadasters in the Ottoman Empire c. 1600 and Russia c. 1656. As these examples suggest, it cannot be assumed that once commenced cadastral systems would persist automatically, therefore great care was taken in documenting the presence and attributes of cadasters at every *t* of the period. [8]

To fine-tune the measure of territorial reach, for each score we apply a weight, capturing the degree of implementation of a cadastral project. We apply different approaches to the calculation of the weight, depending on the available data:

1) For the historical (pre-1900) fiscal cadasters in Europe, surveys in some colonies (e.g. Egypt, British India and Burma, Japanese Korea) and the surveys conducted in the neo-European colonies (the US, Canada, Australia and New Zealand) as well as in Russia, the weight is the percentage of the current territory of the country in question that was covered by the cadaster. Following the literature on historical fiscal and land distribution cadasters (Kain and Baigent 1992), we assume that they covered all economically active land. However, where it is established that historical cadasters were not fully implemented, the score reflects this (for example, the Ottoman Land Code of 1858 or pre-colonial Korea).

2) For recent cadasters (particularly post-World War II), we weight the basic score by the percentage of parcels that are properly surveyed and registered in the total number of parcels, as estimated by the professional community of surveyors (Cadastral Template) and/or otherwise documented in the literature. To our knowledge, this is the most accurate measure of coverage.[9]

In the coding exercise we build upon large and diverse body of sources, among which we highlight the following sources: 1) the UN-sponsored Cadastral Template Project, developed by the International Federation of Land Surveyors (Cadastral Template 2014); 2) documents from the Permanent Committee on Cadastre in the European Union (PCC undated) and the Comité Permanente sobre el Catastro en Iberoamérica (CPC Iberoamérica 2011), and 3) specialized academic literature (f.e Kain and Baigent 1992).

We opted for a test of the *accumulated* history of cadaster and democracy on current levels of public goods provision. As Gerring et al (2005) argued, when testing the effects of institutions, measures that reflect their "accumulated history" (stock) may be more appropriate that those that tap into their recent level (flow). This approach has been taken both in relation to measuring the stock of democracy (Gerring et al 2005, 2012) and the

[8] A 100-paged appendix, detailing dates and sources for each country in the sample and coding decisions, is available upon request, and will be made available online.

[9] Where we have information on properly surveyed and registered rural and urban parcels separately, we calculate implementation weight as follows: (% of parcels that are properly registered and surveyed in rural areas × % rural population) + (% of parcels that are properly registered and surveyed in rural areas × % rural population).

age of the state (Bockstette et al 2002), and is increasingly applied in the empirical literature (Asadullah and Savoia 2018; Borcan et al 2018; D'Arcy and Nistotskaya 2018).

The employed indicator (*Cadaster*) is a sum of weighted yearly scores from 1000 to 2012, capturing the "accumulated history" (stock) of infrastructural power acquired over the whole period. To illustrate: Sweden introduced narrative cadasters over its whole territory in 1530 and a full mapped cadaster in 1628 which has been well-maintained thereafter (Nistotskaya and D'Arcy 2018). Sweden's score is therefore: (.75 x 98 years) + (1 x 384) = 547.5. Ghana began land surveying and registration in 1986, however, of an estimated 6 million parcels, currently only about 30,000 (0.5%) are registered under the title registration system (Republic of Ghana 2011, 2). Ghana's score is 1 x 26 x .5 = 13.

We observe a considerable global variation in *Cadaster*. Twenty-three countries enter with a score less than 1, including eight countries with zero score. There is also considerable variation between and within global regions (Table 1, Appendix C). Western Europe and North America are the global leader, followed by Asia, Eastern Europe, North Africa and Middle Easter, Latin America and the Caribbean. Sub-Saharan African lags behind with the maximum value equal to the mean of the 18 North African and Middle Eastern countries. The raw data is skewed to the right, and log transformation makes the score to approximate normal distribution, which will be used in the analyses.

To check the validity of *Cadaster* as a measure of state capacity, we examine the empirical relationship between our measure and commonly used indicators of state capacity. We expect the associations to be statistically significant, but moderate in their strength as our measure taps into dimensions which are not directly captured by any of the existing measures. Indeed, as results reported in Table 2 Appendix C suggest, all association are significant at the 99% level, signed as expected and moderate in their strength. *Cadaster* is negatively associated with *Meyer* – the measure capturing state capacity through the accuracy of censuses (Lee and Zhang 2017), as higher *Meyer* indicates larger error in the accuracy.[10] Similarly, *Cadaster* is associated negatively with the Fragile States Index as a whole and its "Risk of external intervention" component. Cadaster is also positively significantly associated with two different measures of the quality of roads – a proxy for the state's reach (Mann 1984; Herbst 2000). Similarly, *Cadaster* is associated with the bureaucracy-based measures of state capacity from the International Country Risk Guide (ICRG) and the Bertelsmann Transformation Index.

Measuring Democracy

To match the "accumulated history" approach to measuring infrastructural power, democracy is also measured as a stock variable. Following Gerring et al (2012), our main indicator for democracy is the sum of each country's

[10] *Meyer* employed in this paper is the mean of the values available for the earliest and latest year of observation, but does not include data points in between.

score on the Polity2 index (ranging from -10 (institutionalized autocracy) to +10 (institutionalized democracy)), if Polity2 score ≥ 6 for every year between 1946 and 2012. As the resulting *Democracy stock 1* is highly skewed to the right, it is ln-transformed.[11] In robustness checks two further Polity2-based measures of democratic stock is employed: the number of years under democratic rule (*Democracy stock 2* and *Democracy stock dummy*). For the interaction term analysis, we also employ *Democracy stock dummy*, which takes on value of "1" if a country has 10 or more years of democratic experience and "0" otherwise (Democracy stock, dummy). Appendix A provides full descriptions of the variables and their source, and Appendix B provides summary statistics.

Measuring Human Development

We test our argument using infant and child mortality rates, which has been increasingly treated by the public health professionals as a reflection of the quality of health services delivery rather than overall socio-economic development of a country (for review see Rosenberg 2018). In other words, the ability of the states to reduce infant and child mortality is related to solving a host of collective action problems, ranging from vaccination, access to clean water and sanitation and female education to specific health services (such as birth attendants) and taxation, needed to pay for these.

We employ the infant and under 5 mortality rates from the World Bank's World Development Indicators, averaged for 2013-2015 to minimize the influence of possible short-term spikes in the data, and transformed into logarithmic form (ln), as established in the literature (Gerring et al 2012), so that the resulting indicators reflect a percentage change in the outcome.

To test H1, we utilize the OLS estimation method of linear regression analysis to investigate the independent effect of the stock of infrastructural power (1000-2012) and democracy (1946-2012) on infant and under5 mortality rates (2013-2015), controlling for the level of economic development (GDppc in 2000 from the Maddison project in the main analysis and Gleditsch's GDPpc in 1990 from in the robustness checks), the share of population under 15, and the average level of aid (1946-2012) as per the relevant literature outlined above. In the robustness checks we also control for regional dummies. To test H2, we perform OLS analysis with an interaction term between democracy and infrastructural power.

Results

H1: Independent Effect

Figure 2 visualizes the bivariate relation between *Cadaster* and infant/under5 mortality, suggesting that on average the linear relationship fits the data well, thereby providing initial support for H1. *Democracy stock 1* fares worse in

[11] Democracy stock 1, ln = ln ($\sum \text{Polity2} \geq 6_{1946\text{-}2012} + 1$).

comparison (Figure 3): for example, for the same level of the stock of democracy Angola and Singapore (or Mali and Croatia) have infant mortality values at opposite ends of the distribution.

Table 1 reports OLS estimates of the linear relationship between the accumulated history of infrastructural power and infant mortality controlling for the stock of democracy, level of economic development, the share of population under 15 and the average sum of aid received between 1946 and 2012. In all five specifications the impact of *Cadaster* is significant at the 99% level, and signed as expected: higher values of *Cadaster* are associated with lower values of infant mortality. The stock of democracy enters significant and signed as expected. The quantitative impact of both measures is about the same: for, example in fully-specified Model 5 one percent change in the stock of *Cadaster* or democracy is associated with approximately 0.12 percent change in infant mortality. In our sample this means that moving from Haiti or Angola's level of infrastructural power to that of Cameroon or Gabon is likely to reduce child mortality by 0.12 percent (equivalent to moving from Ghana's level of infant mortality to that of India, or – at the lower end of the infant mortality rates – from the level of the Czech Republic to that of Sweden). On the other side of the spectrum: the effect of the same magnitude could be expected if moving from the level of infrastructural power of Cyprus or Spain to that of Austria or United Kingdom. The data fits the model well, with the explained variance in the outcome variable ranging from 57 percent in Model 1 to 84 percent in Model 5.

A similar pattern is observed in the analysis with under5 mortality as the outcome variable (Table 2). Both predictors of interest are significant throughout and are signed as expected. The magnitude of their impact is about the same as in the case of infant mortality. The data fits the model well, with the explained variance in under5 mortality ranging from 59 percent in the bivariate Model 1 to 86 percent in Model 5. The results of post regression investigation are within the accepted boundaries.

We note that the statistical significance of *Democracy stock 1* is sensitive to the employed indicators of GDPpc. For example, the inclusion of Madison project's GDPpc from 1990 instead of the year 2000 to the full model renders *Democracy stock 1* insignificant, despite very strong bivariate correlation between GDPpc1990 and GDPpc2000 (r=.9896***). Similarly, the inclusion of GDPpc for 2006-2008 (averaged) renders democracy insignificant. This holds true for both outcomes variables. At the same time, *Cadaster* is statistically significant (at the 99% level) and signed as expected in all the above mentioned alterations (not reported).

We re-run the analyses with two alternative measures of democracy (*Democracy stock 2* and *Democracy stock dummy*) and an alternative source for the GDPpc indicator (Table 1 Appendix D). While *Cadaster* enters significant in all specifications, democracy is significant only in Model 1 (*Democracy stock 1* on *Infant Mortality*). Further, we replicate the main analyses with the inclusion of regional dummies (Table 2 Appendix D) finding *Cadaster* to be robustly associated with improved child mortality outcomes, while democracy loses significance when the level of

GDPpc enters the specification. We also impose several restrictions on the full sample (not reported). We exclude countries without democratic experience and also the most developed regions (Western Europe and North America). Further, we replicate the analysis with data from 37 countries in Sub-Saharan Africa. In all three cases *Cadaster* is significant (at the 99% level) in all specifications and democracy is not. In addition, to control for the argument that more recently adopted cadasters may matter more than those developed in the more distant past, we re-run all regression with *Cadaster* scores discounted by 5% for each 50 years of the period under consideration, as per Bocksette et al (2002), to find the results to be substantively similar to the main analysis (not reported).

Overall, the proposition that states with higher stock of infrastructural power will on average fare better in terms of human development, compared to states with lower stocks of infrastructural power, finds strong support in the data. The results suggest that the accumulated history of infrastructural power is robustly linked to improved child mortality outcome, while the stock of democracy is not.

H2: Interaction Effect

In order to examine whether democracy's impact on human development is conditional on the stock of infrastructural power, we examine the interaction effect between the two. Table 3 reports OLS estimates of the linear relationship between the accumulated history of infrastructural power and infant/under5 mortality controlling for the stock of democracy, the interaction between infrastructural power and democracy, population under 15 and the level of economic development[12] for a sample of countries with accumulated democratic experience > 0. Models 1 and 4 are concerned with the conditional impact of the stock of democracy, measured as the sum of Polity2 levels of democracy between 1946-1992. The interaction term enters significant (at least at the 95% level), and is signed as expected. Figure 4 (left panel) visualizes the interaction effect and provides further insight. One can observe that Democracy stock 1's effect on infant/under5 mortality rates is indistinguishable from zero at lower levels of infrastructural power. It is only when *Cadaster*'s value is about 4.5 or larger, that the positive effect of democracy "kicks in". In our sample about 50% of the observations (largely countries from Sub-Saharan Africa) have not reached the level of infrastructural power necessary for the positive effects of democracy to manifest. However, our results suggest that countries such as Tunisia, Uruguay or the Philippines, which have reached the minimal threshold, may be expected to benefit from democratic institutions.

A similar pattern emerges when we examine the conditional impact of Democracy stock 2 – the number of years under democratic rule (for a sample of countries with democratic experience > 0). In Models 2 and 5 (Table 3) the interaction effect is significant (at least at the 95% level) and signed as expected. Figure 4 (right panel) visualizes the effect, suggesting the effect of democracy becomes statistically significant at about the same

[12] We dropped aid as, although significant in the main analysis, it entered positively signed, opposite to theoretical expectations, and contributed marginally to the overall fit of the model. Furthermore, the inclusion of Aid, ln into the interaction term analysis, does not change the substantive results.

level of infrastructural power as in Models 1 and 4. Furthermore, the slope of the regression line in all four visualizations (Figure 4) suggests that where democracy's effect is present, the difference in its magnitude at different levels of infrastructural power is nontrivial. A democracy dummy exhibits the same pattern: the coefficient for countries with higher stocks of democracy (more than 10 years of democratic experience) is significant and signed as expected.

We replicate the analysis for a sample of countries, which includes both democracies and non-democracies alike to find the pattern to be similar to the findings from the main analysis, (Table 3 Appendix D) although expectedly the positive effect of democracy "kicks in" at slightly lower levels of the accumulated history of infrastructural power (Figure 1 Appendix D).

Overall, the proposition that the level of infrastructural power moderates the effect of democracy on development finds support in the data. The results of our analysis suggest that there is a threshold of credible enforcement at which the credible commitment effect of democratic politics becomes welfare-enhancing. Furthermore, where the effect of democracy is present, infrastructural power amplifies it.

Conclusion

Over the past twenty-five years a very rich literature has developed examining the relationship between institutions and development. Most of this literature has focused on the institutions needed to prevent abuse of power, especially through democracy and Weberian bureaucracy. This focus on power-checking institutions has meant that the question about the role of state capacity in development has been relatively overlooked. Bridging the state capacity and CAPs literatures, we have suggested that infrastructural power – the ability of the state to penetrate society and "weigh" on local communities – is critical for development because it enables the state to monitor individual behavior more effectively, thereby solving the collective action problems that are at the heart of development.

To test the argument we have developed a novel measure of infrastructural power over the last one thousand years. As well as allowing us to empirically probe the theoretical expectations formulated in this paper, this measure has high potential to enable the exploration into other aspects of development, the effects of infrastructural power over the *longue durée*, and its interaction with other factors relevant for development.

Our findings suggest that infrastructural power is a necessary condition for development. They also suggest that democracy only improves infant and child mortality above a certain threshold of infrastructural power. Encouragingly, that threshold is not beyond the reach of many developing countries: for example, Tunisia and the Philippines have already reached it. However, it is worth re-iterating that we don't argue that infrastructural power is a necessary and *sufficient* condition. Infrastructural power is not always harnessed for

development and can be used for the opposite ends, underscoring the enduring importance of power-checking institutions. Our findings do not suggest that democratization should be delayed in countries with low infrastructural power, but that it is important to have realistic expectations of what it can deliver.

Going forward our findings would benefit from being subjected to further empirical testing. Panel data analysis in which unobserved geographical, political and cultural confounders are controlled for, is one of the possible avenues. Analysis of alternative indicators of public goods provision may be useful in showing which outcomes are more sensitive to infrastructural power. Such an analysis could enable more targeting aid programmes in states with low infrastructural power.

Our study suggests that in order for power-constraining institutions to have a meaningful effect, a certain amount of infrastructural power is required. This insight, often missing from the development discourse, is important if we are to build a complete picture of the institutional determinants of development.

TABLES AND FIGURES

TABLE 1, (INFRASTRUCTURAL POWER, DEMOCRACY AND INFANT MORTALITY: IDENPENDENT EFFECT)

	(1)	(2)	(3)	(4)	(5)
VARIABLES					
Cadaster (ln)	-0.45***	-0.37***	-0.10***	-0.09***	-0.12***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Democracy stock 1 (ln)		-0.35***	-0.20***	-0.17***	-0.12**
		(0.07)	(0.05)	(0.05)	(0.05)
Population under 15			0.07***	0.07***	0.06***
			(0.01)	(0.01)	(0.01)
GDPpc 2000 (ln)				-0.01	-0.04
				(0.03)	(0.03)
Aid (ln)					0.08***
					(0.03)
Constant	4.41***	4.03***	1.01***	1.21***	0.23
	(0.13)	(0.15)	(0.24)	(0.37)	(0.51)
Observations	155	155	153	141	138
R-squared	0.57	0.63	0.83	0.83	0.84

*Note: Models DV: Infant Mortality Rate, 2013-2015, averaged, ln-transformed; standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1*

TABLE 2, (INFRASTRUCTURAL POWER, DEMOCRACY AND UNDER5 MORTALITY: INDEPENDENT EFFECT)

	(1)	(2)	(3)	(4)	(5)
VARIABLES					
Cadaster (ln)	-0.48***	-0.40***	-0.11***	-0.11***	-0.13***
	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)
Democracy stock 1 (ln)		-0.35***	-0.19***	-0.16***	-0.11**
		(0.07)	(0.05)	(0.05)	(0.05)
Population under 15			0.07***	0.07***	0.07***
			(0.00)	(0.01)	(0.01)
GDPpc 2000 (ln)				-0.02	-0.03
				(0.03)	(0.03)
Aid (ln)					0.07**
					(0.03)
Constant	4.76***	4.38***	1.15***	1.35***	0.50
	(0.14)	(0.15)	(0.24)	(0.36)	(0.50)
Observations	155	155	153	141	138
R-squared	0.59	0.64	0.86	0.86	0.86

*Note: Models DV: Infant Mortality Rate, 2013-2015, averaged, ln-transformed; standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1*

TABLE 3, (INFRASTRUCTURAL POWER, DEMOCRACY AND INFANT/UNDER5 MORTALITY: INTERACTION EFFECT (COUNTRIES WITH DEMOCRACY STOCK >0))

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
Cadaster (ln)	0.29*	0.03	-0.06*	0.20	-0.02	-0.08**
	(0.17)	(0.09)	(0.04)	(0.16)	(0.08)	(0.04)
Democracy stock 1(ln)	0.33**			0.26		
	(0.16)			(0.16)		
Democracy stock 1 # Cadaster	-0.10***			-0.08**		
	(0.03)			(0.03)		
Democracy stock 2 (ln)		0.22*			0.18	
		(0.13)			(0.12)	
Democracy stock 2 # Cadaster		-0.08***			-0.07**	
		(0.03)			(0.03)	
Democracy stock, dummy			0.37*			0.35*
			(0.19)			(0.19)
0.Democracy dummy # Cadaster			0.00			0.00
			(0.00)			(0.00)
1.Democracy dummy # Cadaster			-0.13***			-0.12**
			(0.05)			(0.05)
Population under 15	0.06***	0.06***	0.07***	0.07***	0.07***	0.07***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
GDPpc 2000 (ln)	0.00	-0.00	-0.02	0.00	-0.00	-0.03
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Constant	0.03	1.00*	1.38***	0.52	1.28**	1.51***
	(0.85)	(0.54)	(0.37)	(0.82)	(0.52)	(0.36)
Observations	99	102	141	99	102	141
R-squared	0.85	0.84	0.83	0.87	0.87	0.85

Note: Models 1-3 DV: Infant Mortality Rate, 2013-2015, averaged, ln-transformed; Models 4-6 DV: Under5 Mortality Rate, 2013-2015, averaged, ln-transformed; standard errors in parentheses;
**** p<0.01, ** p<0.05, * p<0.1*

FIGURE 1, (EXAMPLES OF NARRATIVE AND CARTOGRAPHIC CADASTERS)

Note: The left panel is the Novgorod narrative cadaster of 1571-1572 (historical polity – the Grand Dutch of Moscow, contemporary polity – Russia). Year: 1571-1572. Image: Wikimedia https://commons.wikimedia.org/w/index.php?curid=41555598. The right panel is a cartographic cadaster of a settlement in Danmarks parish, Uppsala county, Sweden. Year: 1635. Source: the Swedish National Land Survey (Lantmateriet).

FIGURE 2, (CADASTER AND INFANT/UNDER5 MORTALITY)

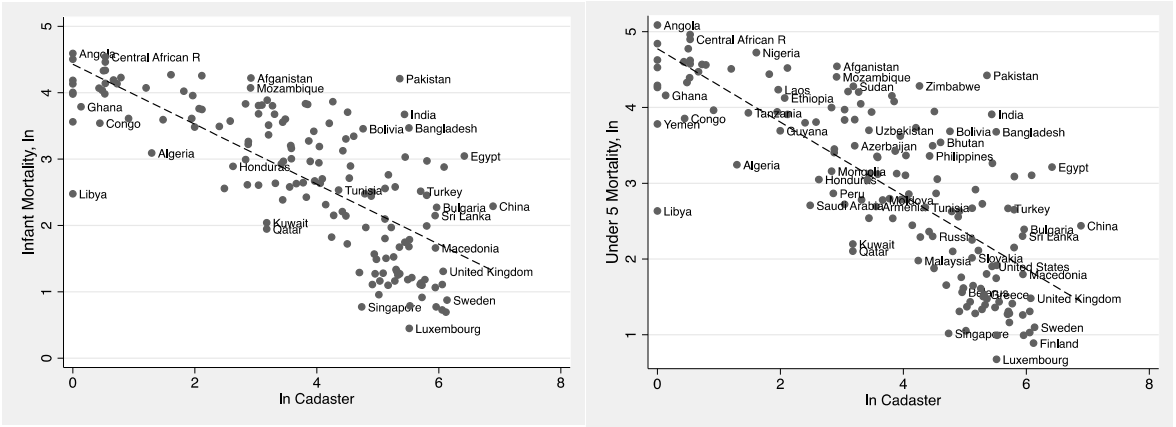


FIGURE 3, (DEMOCRACY AND STOCK 1 (IN) AND INFANT/UNDER5 MORTALITY)

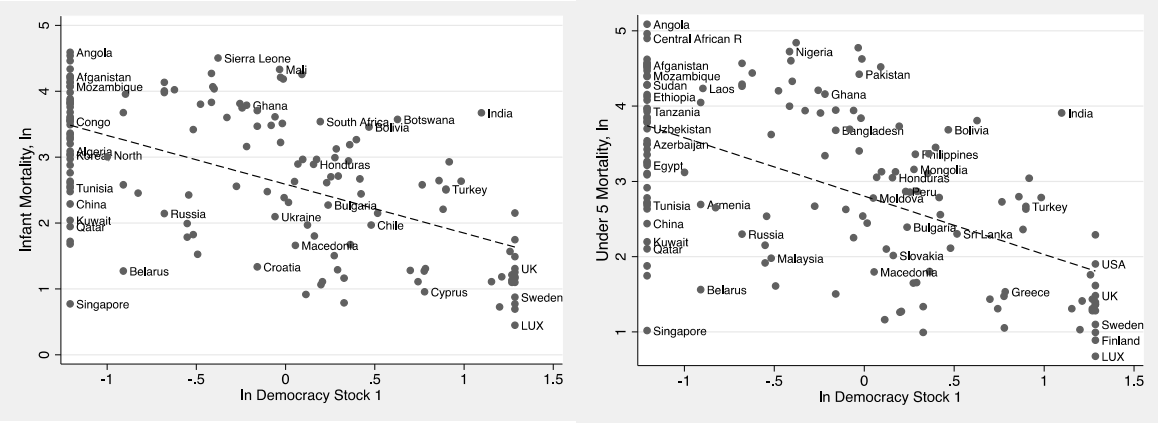
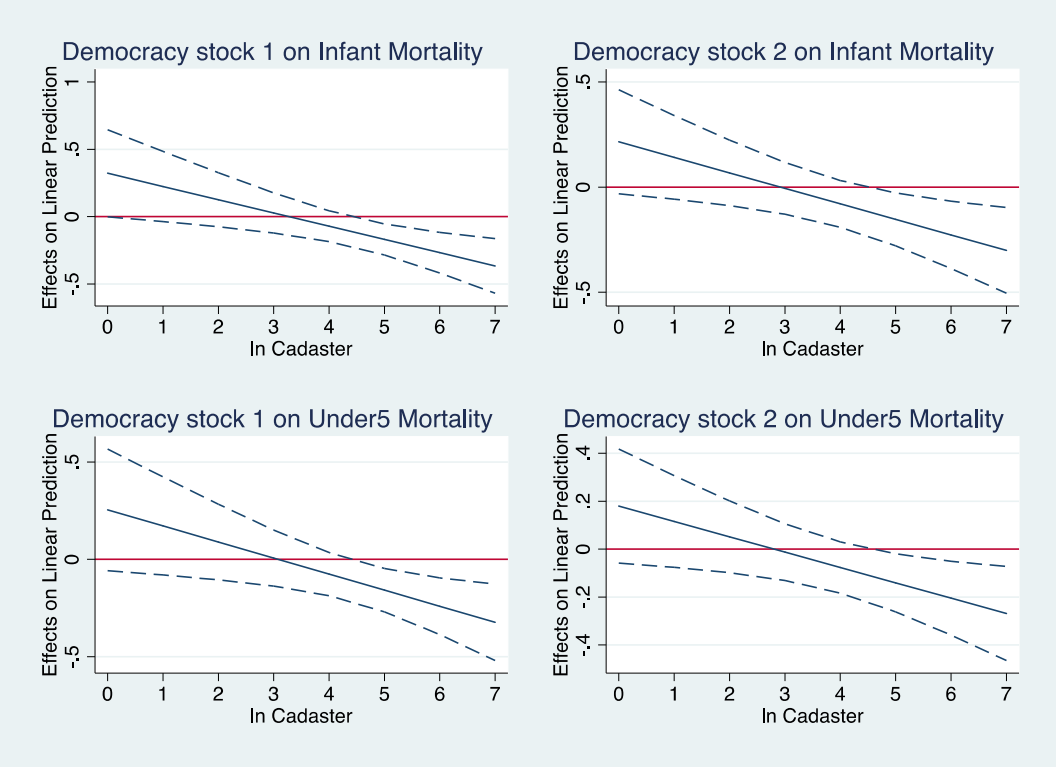


FIGURE 4, (AVERAGE MARGINAL EFFECTS OF DEMOCRACY STOCK 1 AND 2 ON INFANT MORTALITY (UPPER PANEL) AND ON UNDER5 MORTALITY (BOTTOM PANEL) WITH 95% CI'S (COUNTRIES WITH DEMOCRACY STOCK >0))



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APPENDIX

Appendix A: Variables: description and sources

Main Explanatory Variable

Cadaster: extend and quality of state-administered cadastral records, 1000-2012, ln-transformed. Source: Constructed by the authors.

DV

Infant Mortality: the number of infants dying before reaching one year of age, per 1,000 live births in a given year, 2013-2015, averaged, ln-transformed. Source: World Bank, The QoG standard dataset, version Jan 2017 (wdi_mortinf).

Under5 Mortality: the probability per 1,000 that a newborn baby will die before reaching age five, if subject to age-specific mortality rates of the specified year, 2013-2015, averaged, ln-transformed. Source: World Bank, The QoG standard dataset, version Jan 2017 (wdi_mortu5).

Control Variables

Democracy stock 1: sum of Polity2 scores, 1946-2012, ln-transformed. Ln ($\sum$ Polity2 ≥ 6 $_{1946\text{-}2012}$ + 1). Source: Authors' constructed, based on the QoG standard dataset, version Jan 2017 (p_polity2).

Democracy stock 2: sum of years a country's score on Polity2 ≥ 6, 1946-2012, ln-transformed. Ln ($\sum$ (if Polity2 $\geq 6 = 1$) $_{1946\text{-}2012}$ + 1). Source: Authors' constructed, based on the QoG standard dataset, version Jan 2017 (p_polity2).

Democracy dummy: "1" if Democracy stock 2 > 10, otherwise "0". Source: Authors' constructed, based on the QoG standard dataset, version Jan 2017 (p_polity2).

GDPpc (main analysis): gross domestic product in 1990 int GK $ per capita, 2000, ln-transformed. Source: the Maddison Project (Bolt and van Zanden 2014), The QoG standard dataset, version Jan 2017 (mad_gdppc).

GDPpc (robustness): estimate of GDP pc in US dollars at current year international prices, 1990, ln-transformed. Source: Gleddich (2002), The QoG standard dataset, version Jan 2017 (gle_rgdpc).

Population under 15: the share of population aged 0-14, 2008-2010, averaged. Source: World Bank, The QoG standard dataset, version Jan 2017 (wdi_pop014).

Aid: sum of commitments provided, not including international organizations, 1946-2012, averaged. World Bank, The QoG standard dataset, version Jan 2017 (aid_cpsc).

Appendix B: Summary statistics

Variable	N	mean	sd	min	max
Main explanatory variable					
Cadaster	155	121	147.3	0	977.3
Cadaster ln	155	3.74	1.84	0	6.89
Response variables: contemporary tax outcomes					
Infant Mortality Rate	155	25.39	23.13	1.57	98.73
Infant Mortality Rate, ln	155	2.73	1.1	.45	4.59
Under5 Mortality Rate	155	34.13	34.54	1.97	162.07
Under5 Mortality Rate, ln	155	2.95	1.16	.68	5.09
Control variables					
Democracy stock 1	155	182.13	215.68	0	670
Democracy stock 1, ln	155	-.19	.87	-1.21	1.29
Democracy stock 2	155	22.34	22.95	0	70
Democracy stock 2, ln	155	2.29	1.6	0	4.26
Democracy stock, dummy	155			0	1
GDPpc 2000 ln	141	10.63	1.82	6.77	15.9
GDPpc 1990 ln	128	8.25	1.23	5.78	10.68
Population under 15	153	29.04	10.97	13.39	49.85
Aid, ln	152	19.18	1.5	10.3	21.88

Appendix C: Validation

TABLE 1, (*CADASTER,* BY WORLD REGIONS*)*

World Region	N	mean	sd	min	max
Western Europe and North America	21	257.9	109.6	132.9	458.5
Asia	22	185.2	224.2	5.53	977.3
Eastern Europe and post-Soviet	28	150.2	116.7	20	386.3
North Africa and Middle East	18	142.5	169.3	0	610.6
Latin America and Caribbean	23	79.4	76.21	0	329
The Pacific	3	42.7	12	30.4	54
Sab-Saharan Africa	40	13.7	25.61	0	133

TABLE 2, (VALIDITY CHECKS FOR *CADASTER)*

	N	Cadaster	Cadaster ln
		Pairwise Correlations	
Meyer	114	-.427	-.563
ffp_fsi	157	-.438	-.499
ffp_ext	157	-.431	-.484
wdi_roadpaved	157	.432	.572
wef_road	157	.295	.377
icrg_qog	157	.481	.526
bti_ba	157	.366	.521
wbgi_gee	157	.493	.574
wbgi_rle	157	.478	.564

Note: all correlation coefficients are significant at the 99% level and signed as expected. Meyer = accuracy of census (mean of the earliest and the latest available data per observation, Lee and Zhang 2017); icrg_qoq = ICRG Indicator of Quality of Government; ffp_fsi = Failed States Index; ffp_ext = External Intervention; bti_ba = Basic Administration; wbgi_gee = Government Effectiveness; wdi_roadpaved = Roads, paved (% of total roads); wef_road = Quality of road infrastructure

Appendix D: Robustness Checks

TABLE 1, (INFRASTUCTIRAL POWER, DEMOCRACY AND INFANT/UNDER5 MORTALITY: INDEPENDENT EFFECT (WITH ALTERNATIVE INDICATORS FOR THE STOCK OF DEMOCRACY AND GDPpc*)*

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
Cadaster (ln)	-0.09***	-0.09***	-0.10***	-0.10***	-0.11***	-0.12***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Democracy stock 1 (ln)	-0.09*			-0.08		
	(0.05)			(0.05)		
Democracy stock 2 (ln)		-0.03			-0.03	
		(0.03)			(0.03)	
Democracy stock, dummy			0.01			0.01
			(0.08)			(0.08)
Population under 15	0.05***	0.05***	0.05***	0.05***	0.05***	0.06***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
GDPpc 1990 (ln)	-0.29***	-0.30***	-0.30***	-0.28***	-0.29***	-0.29***
	(0.06)	(0.06)	(0.06)	(0.05)	(0.05)	(0.05)
Aid (ln)	0.01	0.01	0.02	0.01	0.01	0.02
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Constant	3.79***	3.93***	3.78***	3.89***	4.02***	3.88***
	(0.92)	(0.93)	(0.93)	(0.91)	(0.91)	(0.92)
Observations	125	125	125	125	125	125
R-squared	0.87	0.87	0.86	0.88	0.88	0.88

*Note: Models 1-3 DV: Infant Mortality Rate, 2013-2015, averaged, ln-transformed; Models 4-6 DV: Under5 Mortality Rate, 2013-2015, averaged, ln-transformed; standard errors in parentheses; *** p<0.01, ** p<0.05,*

** p<0.1*

TABLE 2, (INFRASTUCTIRAL POWER, DEMOCRACY AND INFANT MORTALITY: INDEPENDENT EFFECTS (WITH REGIONAL DUMMIES)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES										
Cadaster (ln)	-0.26***	-0.21***	-0.11***	-0.11***	-0.12***	-0.27***	-0.22***	-0.11***	-0.12***	-0.13***
	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)
Democracy stock 1 (ln)		-0.31***	-0.14**	-0.10	-0.08		-0.31***	-0.13**	-0.09	-0.07
		(0.08)	(0.06)	(0.07)	(0.07)		(0.08)	(0.06)	(0.07)	(0.07)
Population under 15			0.07***	0.07***	0.07***			0.07***	0.07***	0.07***
			(0.01)	(0.01)	(0.01)			(0.01)	(0.01)	(0.01)
GDPpc 2000 (ln)				0.01	0.01				0.01	0.01
				(0.03)	(0.03)				(0.03)	(0.03)
Aid (ln)					0.03					0.03
					(0.03)					(0.03)
Regional dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	2.57***	2.63***	0.77***	0.58	0.14	2.82***	2.88***	0.94***	0.75	0.36
	(0.23)	(0.22)	(0.25)	(0.41)	(0.52)	(0.23)	(0.22)	(0.24)	(0.39)	(0.50)
Observations	155	155	153	141	138	155	155	153	141	138
R-squared	0.75	0.78	0.87	0.87	0.87	0.78	0.80	0.89	0.89	0.89

*Note: Models 1-5 DV: Infant Mortality Rate, 2013-2015, averaged, ln-transformed; Models 6-10 DV: Under5 Mortality Rate, 2013-2015, averaged, ln-transformed; regional dummies, reference category – Western Europe and North America, standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1*

TABLE 2, (INFRASTUCTIRAL POWER, DEMOCRACY AND INFANT/UNDER5 MORTALITY: INTERACTION EFFECTS (DEMOCRACY AND NON-DEMOCRACIES INCLUDED)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
Cadaster (ln)	-0.18***	-0.02	-0.06	-0.19***	-0.04	-0.08**
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Democracy stock 1 (ln)	0.37***			0.33**		
	(0.14)			(0.14)		
Democracy stock 1# *Cadaster*	-0.12***			-0.11***		
	(0.03)			(0.03)		
Democracy stock 2 (ln)		0.14**			0.13**	
		(0.06)			(0.06)	
Democracy stock 2# *Cadaster*		-0.05***			-0.05***	
		(0.01)			(0.01)	
Democracy stock, dummy			0.36*			0.34*
			(0.19)			(0.19)
0. Democracy dummy # *Cadaster*			0.00			0.00
			(0.00)			(0.00)
1. Democracy dummy # *Cadaster*			-0.13***			-0.12**
			(0.05)			(0.05)
Population under 15	0.07***	0.07***	0.07***	0.07***	0.07***	0.07***
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
GDPpc 2000 (ln)	0.00	-0.01	-0.02	-0.00	-0.01	-0.03
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Constant	1.55***	1.16***	1.37***	1.67***	1.30***	1.50***
	(0.36)	(0.36)	(0.37)	(0.35)	(0.36)	(0.36)
Observations	141	141	141	141	141	141
R-squared	0.85	0.84	0.83	0.87	0.86	0.85

*Note: Models 1-3 DV: Infant Mortality Rate, 2013-2015, averaged, ln-transformed; Models 4-6 DV: Under5 Mortality Rate, 2013-2015, averaged, ln-transformed; standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1*

FIGURE 4, (AVERAGE MARGINAL EFFECTS OF DEMOCRACY STOCK 1 AND 2 ON INFANT MORTALITY (UPPER PANELS) AND ON UNDER5 MORTALITY (BOTTOM PANEL) WITH 95% CI'S (DEMOCRACIES AND NON-DEMOCRACIES INCLUDED COUNTRIES))