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Enhance Health? New Empirical
Evidence 1900-2012

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Does Democracy or Good Governance Enhance Health? New Empirical Evidence 1900-2012*

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Abstract

It has been long debated whether regime types have impacts on human development. More specifically, compared to authoritarianism, are democracies more likely to provide public goods, including infrastructure that improve food provision and health care, and thus enhance health? Some studies support an optimistic view, and argue that with the accountability mechanisms of democratic elections, democracy is helpful in improving health. Some recent studies challenge the optimistic argument, and point out good governance, rather than regime types, as a more crucial determinant of human development. Using a newly collected dataset that covers 173 countries over the years 1900-2012 and contains more nuanced measures than commonly used, we intend to disentangle the debate. The results suggest that across models with various specifications, regime types have more consistent effects than quality of government on health outcomes throughout the entire period. Furthermore, we find that the mixed results of extant studies are due to that 1) the commonly used governance indicators are measured only for the recent decades, and the sample does not reflect the entire range of variation; 2) the positive effects of democracy are especially salient once the level of democracy has achieved certain threshold; 3) the positive effects of democracy are especially stable when both vertical and horizontal accountability mechanisms are improved.

1. Introduction

Following the cold war, democracy and human rights became dominating principles of a new global order and democracy promotion as a foreign policy goal has been increasingly accepted within the international community (Guilhot 2005). Although an extensive literature on democracy and democratization has emerged, the questions of whether and to what extent democracy can improve the lives of ordinary citizens are still up for discussion (Besley and Kudamatsu 2006).

Lately, a debate has emerged within political science research on the relationship between regime types and human welfare. On the one hand, many scholars have provided theoretical arguments and empirical evidence supporting a positive relationship between democracy and human development (Vollmer and Ziegler 2009, Deacon and Saha 2005, Antonis et al. 2009, Biser and Edwards 2012, Franco, Álvarez-Dardet and Ruiz 2004, Klomp and de Haan 2009). On the other hand, this view has been increasingly scrutinized by studies that challenge the robustness of the empirical analyses (Ross 2006) and more fundamentally the causality linking the two aspects (Gauri and Khaleghian 2002, McGuire 2004, Shandra et al. 2004, Norris 2012, Rothstein 2014). A field of research questioning the democracy argument promotes a shift of focus from regime type to good governance and the quality of government as a crucial determinant of human development and public goods provision (Diamond 2007, Sacks and Levi 2007, Holmberg and Rothstein 2009 and 2010, Rothstein 2011, Lewis 2006).

Utilizing a newly collected dataset that covers 173 countries over the years 1900-2012 and contains more nuanced measures for both democracy and good governance, we intend to disentangle the debate and compare the impacts of different aspects of democracy and governance on population health. Extant indices of good governance provide data generally for only the most recent decades which may result in biased inferences. With regard to the measures of regime type, existing studies almost exclusively rely on measures provided by Freedom House or Polity IV, which tend to treat democracy as one-dimensional phenomena. Using indicators that more concretely capture the democratic accountability mechanisms and distinguish between vertical and horizontal accountability mechanisms, we further examine the conditions under which democracy is more likely to improve health outcomes.

Our analyses suggest that regime type has more consistent impact on health outcomes than the quality of government. The mixed results identified in previous research are partly due to incomplete samples of examined cases that do not reflect a rich range of variation across countries and years. During the most recent two decades, the variations of the governance indicators across non-democracies are quite limited. In addition, we find that the positive impacts

of democracy are especially salient when both vertical and horizontal accountability mechanisms are present. Furthermore, the positive impact of democracy on health outcomes is clearer if the threshold effect of democracy is also taken into account. That is, after the transitional period of democratization, population health more significantly improves as democracy matures.

On a policy level, this paper contributes with insights on what factors might have positive effects on health in order to get closer to development goals, as defined for example in the Millennium Development Goals and in the post-2015 development agenda. It could be of value for the development assistance community to get further insights on if democracy promotion is truly motivated or if there is a reason to shift focus to other aspects of governance. If more states are to succeed in improving human well-being and population health in this case, a more precise understanding and knowledge of which aspects of governance and democracy that matters is of crucial importance.

In the following section, we discuss theories linking regime type, quality of governance, and public goods provision. Next, we describe data and measures utilized in this paper. After presenting the empirical results, we discuss the limitations and future extensions of the study.

2. Theoretical Discussion: Democracy, Good Governance, and Health Outcomes

Although the worldwide spread of democracy has instigated a substantial field of literature, some critics argue that the main purpose of this research so far has been to examine the causes and barriers of the development of representative democracy in different states, while the question of how democracies actually perform and influence the lives of their citizens to a large extent has been left unanswered (Rothstein 2011). While many studies emphasize that democracies perform better than non-democratic states in terms of producing human welfare and providing public goods for their citizens (Vollmer and Ziegler 2009, Deacon and Saha 2005, Antonis et al. 2009, Biser and Edwards 2012, Franco, Álvarez-Dardet and Ruiz 2004, Klomp and de Haan 2009), this claim is now being increasingly questioned based on the notion that many democracies fail in these aspects (Ross 2006, Holmberg and Rothstein 2010, Rothstein 2011, Diamond 2007). As emphasized by Besley and Kudamatsu (2006:313), in spite of the substantial increase of democratic states around the world, the question of how regime type affects the well-being of the world population is still open to debate.

2.1. The Effects of Regime Type

A number of scholars have identified that democracy promotes human welfare and the provision of public goods in terms of infrastructure, water, public sanitation and public schooling (Deacon and Saha 2005, Antonis et al. 2009, Biser and Edwards 2012), whereas some has looked more specifically on health outcomes. For example, Franco, Álvarez-Dardet and Ruiz (2004) find that democracy shows an independent positive impact on life expectancy, maternal mortality and infant mortality, taking a country's wealth, level of inequality and size of the public sector into account. Similarly, a study by Klomp and de Haan (2009) suggests that there is indeed a positive relationship between democracy and individual health. With a focus on sub-Saharan Africa, Kudamatsu (2012) points out that infant mortality rates fall after democratization in the post-Cold War period. Furthermore, Besley and Kundamatsu (2006) argue that health policy interventions are superior in democratic states.

Scholars have pointed out several mechanisms through which democracies are more likely to provide public goods and improve human development. The various mechanisms can be classified into three categories: representation, accountability and selection (Besley and Kudamatsu 2006:313-314, Harding and Wantchekon 2010:14-18), all of which rest on competitive elections of democracies.

The representation mechanism relates to preferences represented by those who control political office. Acemoglu and Robinson (2005) refer to democracies as dictatorships of the poor and middle class citizens and autocracies as dictatorships of the rich. According to this argument, human welfare will increase if it is of importance to the dominating groups of the democracy, compared to the groups dominating in an autocracy. Through competitive elections, the redistributive scheme in a democratic regime is more likely to reflect the preference of the median voter, belonging to the middle and lower class (Vollmer and Ziegler 2009). One can expect greater provision of public goods in a democracy than in an autocracy, since the people represented by the power holders of a democratic system have higher preferences and demands for redistribution of resources and public services. In authoritarian regimes, however, redistribution incentives are missing and fewer public goods are provided (Besley and Kudamatsu 2006:313-314, Harding and Wantchekon 2010:14-18).

The accountability argument is based on that in democracies, citizens have the ability to hold politicians accountable through elections. As a result, decision-makers feel obligated to provide a wider range of the population with public goods in order to meet the expectations of the voters and stay in power in the next elections, while power holders in autocracies are

accountable only to a narrow group of people (Besley and Kudamatsu 2006:313-314, Harding and Wantchekon 2010:14-18).

The selection argument emphasizes the process of appointing political leaders and government officials as an important difference between democratic and autocratic states. In democracies, the mechanisms to select credible and competent politicians are stronger than in autocracies. Hence, health intervention policies in democracies are supported and implemented by knowledgeable and impartial officials, which leads to improved health outcomes, unlike in autocratic states where public servants might not be selected on a merit-base (Besley and Kudamatsu 2006:313-314, Harding and Wantchekon 2010:14-18).

2.2. The Debate

While many theoretical arguments and empirical analyses suggest that democracy has positive effects on human welfare, some recent studies criticize this optimistic view. Some of the criticisms focus on the *quality of empirical analyses* conducted in previous works, while others more fundamentally question the *causal relationship* between regime types and public goods provision.

The empirical evidence supporting the optimistic view has been criticized as scarce, based on biased samples and open to scientific debate (Ross 2006). In addition, other studies find only a weak, non-existent or even negative relationship between democracy and different aspects of health (Gauri and Khaleghian 2002, McGuire 2004, Ross 2006, Shandra et al. 2004, Rothstein 2011). According to Ross (2006:860-861), past quantitative cross-national studies confirming the optimistic view have been flawed by not taking into account *global health trends* and *country-specific effects*, which complicate the possibility to trace the correct factors driving positive health developments. Another issue brought forward is the *limited and biased sample of countries* included in many of the studies: when data to a much larger extent is available for democratic states but missing for non-democracies, the results are based on a smaller skewed sample of countries. In many studies, nondemocratic states with good economic social development have been excluded from the analysis, resulting in a false impression that democracies perform better than non-democracies.

Once these flaws are corrected, the study carried out by Ross (2006:868-871) suggests that democracy has little or no effect on health indicators such as infant and child mortality. Similarly, Shandra et al. (2004) discover that the level of democracy does not have a significant effect on infant mortality rate. Gauri and Khaleghian (2002) find that immunization coverage rates are actually lower in democracies than autocracies across developing countries. Norris (2012) investigates the effect of liberal democracy on a number of aspects of human well-being,

captured by the Millennium Development Goals, and her analysis shows no positive impact on either longevity nor child mortality. Overall, based on the uneven track records of democracies' ability to ensure human welfare, many argue that representative democracy does not seem to be a safe cure against under-provision of welfare (Holmberg and Rothstein 2010, Ross 2006, Diamond 2007).

Another thread of research questions the causal relationship between democracy and public goods provision, and points out good governance, rather than regime type, as the main determinant of desirable social outcomes. An extensive literature on the importance of good governance has emerged, paying attention to its impacts on various aspects of social wellbeing (Diamond 2007, Sacks and Levi 2007, Holmberg and Rothstein 2009 and 2010, Rothstein 2011, Lewis 2006, Norris 2012).

According to Diamond (2007:119), democracy today is haunted by a ghost. That is, bad governance in the form of corruption, favoritism, patronage and abuse of power, which weakens several mechanisms through which democratic officials have more incentives to improve population health. Rothstein and Holmberg (2010) offer an overview of the relation between variables that measure the quality of government, such as rule of law, control of corruption and government effectiveness, and a number of standard measures of population health. The overall finding is that different aspects of quality of government are positively related to standard measures of population health such as life expectancy at birth and infant mortality.

Another group of scholars point out the importance of the "age" of democracy and argue that the accountability mechanism works better in older democracies. Keefer and Vlaicu (2004:25-27) state that politicians in young democracies tend to fail to make credible promises to their voters, and thus are likely to engage in direct and contingent exchanges rather than provide public goods once in office. Political leaders in older democracies, on the other hand, have a greater opportunity to create credible policy reputations among a wider range of voters and are able to offer a more extensive provision of public goods. The argument is supported also by empirical evidence (Keefer 2005). Similarly, Gerring et al. (2012) argue that the relationship between democracy and human development is a time-dependent phenomenon. According to the authors, there is only slight evidence for a positive relationship between democracy and infant mortality and over the past century, it is the stock of democracy that in fact affects infant mortality.

2.3. Hypothesis

As evident from the theoretical discussion, whether and the conditions under which democracy improves population health is still under debate. In this paper, we intend to test these arguments more thoroughly, with a newly collected dataset that covers most sovereign countries from 1900 to 2012 for indicators of regime type and governance quality. As Ross (2006) points out, incomplete samples may result in biased inferences. Previous works that compare the effects of regime type and governance are limited by extant governance indices measured only for the recent decades. In the empirical analyses, we incorporate controls that capture global health trends and country-specific effects, and apply various model specifications for imputed data sets to ensure the robustness of the tests.

More importantly, when comparing the effects of democracy and quality of government, we focus on specific accountability mechanisms of democracy. The skepticism towards democracy promotion and the argument that democracy promotes various desirable social outcomes has raised an awareness of the need to discuss different dimensions of democracy. However, in large parts of the literature on the effects of democracy, as well as the critique towards it, focus is merely on a few aspects of democracy. In addition, extant studies almost exclusively rely on measures provided by Freedom House, Polity IV and Economist Intelligence Unit, which tend to treat various aspects of democracy as one-dimensional phenomena. Although these studies in theory elaborate on particular dimensions and mechanisms of democracy, such as elections, representations, or checks and balances, in practice in their empirical analysis they tend to rely on one-dimensional measures that combine different features of democracies.

We argue that vertical accountability (competitive elections) and horizontal accountability (legislative constraints on the executive) mechanisms of democracy are both important to improve population health. The distinction between them is commonly used in the literature to refer to different types of accountability mechanisms regarding the spatial direction of the accountability relationships (Schedler 1999, Lindberg 2013). Accountability in this context is defined as the main instrument through which both public institutions and individuals are subject to monitoring and control by citizens as well as other public institutions (World Bank Institute 2005).

Vertical accountability allows citizens to hold governments and politicians directly accountable through free and fair elections, along with freedoms of expression, free media, and freedom of association (O'Donnell 1998). The presence of these factors combined enables citizens to voice and demand their preferences to politicians and public institutions. Through the

mechanism of regular competitive elections citizen can freely articulate their preferences for policies. Holding regular elections does not automatically mean that these elections correspond to the will of the citizens, as more than half of the current elections in the world violate the democratic principles of basic freedom and fairness, and the respect for human rights (Diamond 2002, Hafner-Burton et al 2013:152, Lindberg 2006, 2009, Schedler 2002). Hence, factors such as suffrage, freedom of association, and the level of “cleanness” of elections in terms of absence of fraud or systematic irregularities need to be taken into account to assess the effect of electoral democracy. In addition, since elections occur only periodically, the ability of citizens to freely associate in political parties and non-governmental organizations are crucial elements in order to secure vertical accountability also in the period between elections.

Horizontal accountability is achieved when there is oversight between different state institutions in terms of checks and balances, preventing abuses of political power. When, for example, the legislature engages in executive oversight or a constitutional court reviews acts adopted by the legislature, this is a form of accountability that runs horizontally ‘among equals’ (O’Donnell,1998, Lindberg 2013). A focus on legislative control is based on the idea that legislatures are the primary national-level agency through which popular preferences are institutionally represented, laws are passed, and restraint can be imposed on the executive. As Keefer and Vlaicu (2004) point out, politicians in young democracies are less able to make credible policy commitments. We argue that legislatures can serve as a credible constraint on government’s behavior of only transferring benefits to narrow groups of voters. With the capability of questioning, investigating, and exercising oversight over the executive, legislatures are more likely to counterbalance the tendency of delivering clientelistic benefits that are contingent on the support of the governing party. That is, with the mechanism of horizontal accountability, policy commitments offered by politicians are more likely to be credible, and thus politicians have more incentives to provide large-scale benefits. Based on these arguments, we plan to test the following opposing hypotheses:

H1.1: Democratic accountability mechanism has a stronger impact on population health than quality of government.

H1.2: Quality of government has a stronger impact on population health than regime type.

Furthermore, we hypothesize that vertical and horizontal accountability mechanisms work as complements. Competitive elections or legislative constraints separately are not enough to ensure improved health outcomes. Executive and legislative politicians have incentives to represent citizens’ preferences and deliver goods only when they are faced with the uncertainty of re-election. Legislative control is required so that government officials selected through

competitive elections are more likely to make credible commitments of providing public goods. That is, the effects of these two accountability mechanisms are more salient if the other mechanism is also present. Based on these arguments, a hypothesis on the joint effect of vertical and horizontal accountability mechanisms is proposed:

H2: The impact of democracy on population health is more salient if both vertical and horizontal accountability mechanisms are strengthened.

Related to the joint effect of different dimensions of democracy, we also expect that at the early stage of democratization, increased political rights do not necessarily lead to the improvement of population health. Transitional societies, although allowing more political competition than close autocracies, still lack democratic accountability mechanisms. That is, democracies without well-functioned accountability mechanisms are less able to achieve significant improvement in population health. Only when politicians and citizens have recognized that winning competitive elections is the only way to political power, and providing public goods to a larger scale of population is helpful in attracting votes, accountability mechanisms function better. In other words, there is a threshold effect of democracy on health outcome. The positive impact of democracy on population health is especially significant after the early stage of democratic transition. Based on this expectation, a third hypothesis is proposed:

H3: There is a threshold effect of democracy on population health. The positive impact of democracy is more salient as democracy matures.

3. Data and Measures

To explore the effects of regime types and quality of government on health outcomes, we utilize mainly the new data produced by the Varieties of Democracy (V-Dem) project (dataset version 4.3)¹. The V-Dem dataset is currently the largest dataset on democracy, collecting data for 173 polities in the world for 400+ indicators from 1900 to 2012 (for 60 countries also for 2013-2014). The project distinguishes among seven main principles of democracy (electoral, liberal, deliberative, majoritarian, consensual, egalitarian, and participatory) that are disaggregated into around fifty constituent component parts, each measured by several detailed and concrete indicators. The disaggregated nature of the V-Dem data allows the selection of indicators that more accurately capture the theoretical concepts motivated in this paper.

¹ See <https://v-dem.net> for more information about the project and the codebook.

Different from existing datasets, which usually rely on a small group of experts who rate all countries or ask each expert to code one single unit, V-Dem project has invited over 2,500 local and cross-national experts to provide judgments on various indicators about democracy (Coppedge et al. 2011, 2015). Thus, the dataset is compiled by gathering factual information from existing data sources, and by expert coding for questions that require evaluation. Experts' ratings are aggregated through a Bayesian item response theory model (Pemstein et al. 2015). The model takes into account the possibilities that experts may make mistakes and have different scales in mind when providing judgments. In addition, bridging-coders, experts who coded multiple countries, are recruited to calibrate the scales of estimates cross-nationally. Finally, the project is completely transparent regarding coding procedures, the measurement model that processes the country experts' data, the aggregation decisions of the composite indicators, and thus for possible sources of measurement error.

3.1. Independent Variables: Democracy and Quality of Government

To test whether the mechanisms that require politicians to represent and be accountable to their citizens are helpful for population health, we utilize two measures that capture vertical and horizontal accountability. For the former, we rely on the *electoral accountability* index from the V-Dem dataset that fits quite accurately the conceptualization used in this paper for vertical accountability. In the V-Dem conceptual scheme the *electoral principle of democracy* is defined as selecting responsive and accountable leaders to citizens through the mechanism of competitive meaningful elections as captured by Dahl's conceptualization for "polyarchy" (1989). This is assumed to be achieved when elections are free and fair; the executive is selected (directly or indirectly) through elections; suffrage is extensive; and, finally, political and civil society organizations can operate freely. To capture this definition, the electoral accountability index combines indicators on the level of suffrage, freedom to join political and civil society organizations, whether elections are clean and without systematic irregularities, and whether the chief executive is selected through elections².

To capture the concept of horizontal accountability as defined above, we utilize the *legislative constraints on the executive index*, which focuses on the extent to which the national legislature/parliament are capable of questioning, investigating, and exercising oversight over the executive. This index is formed by taking the point estimates from a Bayesian factor analysis

² For detailed information on the aggregation formula and the exact question formulation of the indicators going into the index, see the Appendix, Table A.1 and A.2. It has to be noted that while expert survey questionnaire provides ordinal raw scores, the measurement model produces interval-level estimates of latent traits with roughly 0 as the average and 1 as the standard deviation when aggregating experts' ratings.

model of four indicators that examine whether the legislature can question executive branch officials in practice; whether the legislature and other bodies (comptroller general, general prosecutor or ombudsman) are able to investigate the executive in practice; and, finally, whether legislature opposition parties are able to exercise oversight over the governing party³.

We also include the widely used composite democracy index provided by Polity IV (Marshall 2013) as an alternative measure, which is aggregated by weighted addition of five sub-components: competitiveness and openness of executive recruitment, competitiveness and regulation of political participation, and constraints on the chief executive (a bigger weight is assigned to this sub-component). The resulting polity scale ranges from +10 (strongly democratic) to -10 (strongly autocratic) and the data is available from 1946 to 2012⁴.

Quality of government is a rather broad term, which can be both conceptualized and measured in various ways. Previous research has used measures including corruption, government effectiveness and rule of law. This paper relies on a more specific definition of QoG as “the impartiality of institutions that exercise government authority”, provided by Rothstein and Teorell (2008:165) and is measured by combining into an index five V-Dem indicators that focus on corruption in state institutions. Throughout this paper we refer to this index as the *no-corruption index*. The exact language of the corruption indicators that constitute this measure can be found in the Appendix in Table A.1. The literature has pointed out that corruption is an important indication of bad governance, and may lead to the distorted distribution of public resources (Diamond 2007, Rothstein 2011).

As McMann et al (2015) have argued there are three main advantages of the *no-corruption index* based on the V-Dem data than other widely used measures of corruption: content validity, coverage and sources used to collect the data:

First, the V-Dem corruption indicators resonate with the accepted academic usage of the term corruption as the use of public office for private gain (Gerring, 2001:117-119, McMann et al 2015). The five indicators that constitute the index look at levels of corruption within the main public officeholders: the executive, members of the legislature, members of the judiciary, and public sector employees. It is consistent with our inquiry of exploring the effects of the general quality of government, the corruption in the state institutions and public officials as an indication, on health outcome. In addition, the wording of the indicators captures different corruption forms, including bribes, undocumented extra payments, kickbacks, theft, embezzlement and misappropriation. Surveys of firms or the general public, on the other hand, provide narrower

³ For the exact question formulation of the indicators going into the index, see the Appendix, Table A.1 and A.2.

⁴ The electoral accountability index is correlated to the polity score at 0.87, while the legislative constraint index is correlated to it at 0.85.

perspectives on the use of public office for private gain than judgments of specialists in the politics of the country (McMann et al 2015).

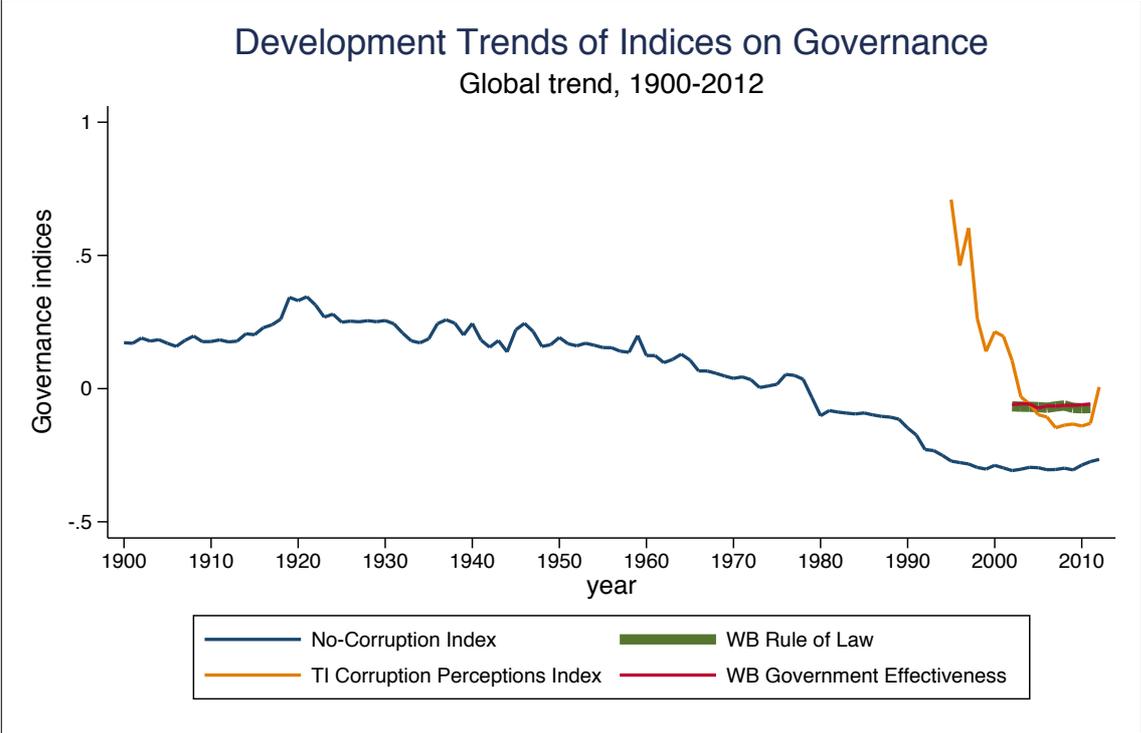
Secondly, as stressed in the previous section, one unique feature of the V-Dem data is that it allows over-time and cross-country comparisons of democracies going all the way back to 1900. This advantage allows an important contribution to the study of democracy and quality of government as existing measures are not designed for panel analysis. With a sensitive topic such as corruption, potential biases introduced by limited coverage of the dataset over time and across countries could be particularly influential. Missing data could possibly be not missing at random but selection bias could be introduced in the process of deciding which cases to include or exclude (McMann et al 2015, Treisman 2007). Thus, big variation of levels and types of corruption could be lost as a result of limited coverage of data. Table 1 compares the no-corruption index and three other commonly used measures (TI Corruption Perceptions Index, and two World Bank Worldwide Governance Indicators (Rule of Law and Government Effectiveness) (Transparency International 2013, Kaufmann et al 2010). The table shows that the time range covered by the three measures reaches 14 years for maximum 158 countries, compared to the 172 countries for 114 years of the V-Dem data. The correlation coefficients of the index used in this paper with the alternative measures are between .85 and .88. That is, country-years rated as more corrupt by extant measures of corruption also tend to be rated as more corrupt by the V-Dem index, and the other way around⁵. The pattern is also evident in Figure 1, in which the standardized average scores across countries on these indices are shown. We also include these alternative measures in the analyses to verify the findings.

Table 1. The Comparison of Governance Indices

	Correlation coefficients with V-Dem no-corruption index	Coverage
TI Corruption Perceptions Index	0.8878	1995 – 2013 N: 185 n: 2429 \bar{N} : 128 \bar{T} : 13
WB Rule of Law	0.8710	1996 – 2012 N: 195 n: 2686 \bar{N} : 158 \bar{T} : 14
WB Government Effectiveness	0.8587	1996 – 2012 N: 193 n: 2629 \bar{N} : 155 \bar{T} : 14

⁵ For a more detailed discussion of the systematic differences between the V-Dem corruption measures and some other existing indices see McMann et al. (2015).

Figure 1. Country Average Scores on Different Governance Indices



Finally, the variables used in the no-corruption index follow the same data collection method for all countries to facilitate cross-national analysis. In comparison, datasets that rely on different sources across countries are not ideal for this purpose (McMann et al 2015). Thus, the V-Dem no-corruption index also demonstrates consistency across time and countries. In addition, the inclusion of numerous possible forms of corruption makes our indicators more broadly applicable and less restrictive across contexts (Gerring, 2001:121-124), since the index takes into account the fact that some forms of corruption are more widespread in some place and time than in others.

3.2. Dependent Variable

Consistent with existing research on the effects of democracy and governance on health outcomes (Shandra et al. 2004, Ross 2006, Rothstein & Holmberg 2010, Norris 2012, Gerring et al. 2012), we utilize the data on infant and child mortality rate as an indication of population health. The main dependent variable we use is infant mortality rate calculated as the number of deaths prior to age 1 per 1000 live births in a year. The base variable is drawn from Gapminder⁶,

⁶ Gapminder. Accessed May 15, 2014. <http://www.gapminder.org/data/>

with additional data imputed from Clio-Infra⁷. The resulting measure covers all countries in the V-Dem dataset from 1900 to 2012 although the coverage is limited for certain countries in the beginning of the century⁸.

The measures on infant and child mortality rate are transformed by the natural logarithm in all following models (except for the poisson model included in the Appendix Table A.4), consistent with previous research done on the topic as the distribution of this variable is right-skewed reflecting the general downward trend in mortality in many developed countries in recent decades. In addition, the theoretical argument behind the logged transformation is that mortality rate is more resilient at higher rates as improvements in number of mortality are easier to achieve when the rate is higher.

We also use a measure for mortality rate under 5 as an alternative dependent variable. The data is provided by the Inter-agency Group for Child Mortality Estimation (IGME, 2004) that measures the probability per 1,000 that a newborn baby will die before reaching age five, if subject to current age-specific mortality rates. This time-series, however, covers only the period from 1960 to 2010.

3.3. Controls

We include several likely confounders as control variables in our models. In order to take into account the general level of development of a country, we include a measure for GDP per capita, transformed by the natural logarithm⁹ and an additional indicator for urbanization rate, measured as ratio of urban population to total population¹⁰. We also include a V-Dem measure for “stateness” - domestic autonomy that gives information whether the state is autonomous from the control of other states with respect to the conduct of domestic policy, where high values indicate full autonomy and low values refer to an authority exercised by external **power** (see the Appendix Table A.1). Since the infant mortality rate rises significantly when a country is under conflict, we also include two dummy variables that identify whether the country participated in an international armed conflict or whether it experienced an internal armed conflict¹¹ in the year. To measure the overall regime performance, we include an indicator for GDP growth rate¹². Finally, to control for oil rents, we use a variable that captures the real value of petroleum produced per

⁷ Clio-Infra. Accessed May 27, 2014. <http://www.clio-infra.eu/>. Missing data within a time-series is interpolated for each variable, increasing the number of observations as follows: (a): from 11592 to 12185; (b): from 567 to 5369. Missing data for (a) is imputed with (b), and increasing the number of observations from 12185 to 13566.

⁸ See the Appendix Table A.5 for a list of country-years included in the analyses.

⁹ Source: The Maddison-Project (2013).

¹⁰ Sources: Clio Infra (clio-infra.eu).

¹¹ Both variables are extracted from Clio Infra, drawing on Brecke (2001).

¹² Source: The Maddison-Project (2013)

capita.¹³ The descriptive statistics of variables included in the analyses can be found in the Appendix in Table A.3.

4. Results

4.1. Democracy or Quality of Government?

To test our hypothesis on the effects of democracy and governance on health outcomes, we estimate time-series cross-sectional models with fixed effects. To begin with, as explanatory variables we use indicators that have been previously used in similar studies to replicate the findings. The results are included in Table 2.

Table 2. Regression estimates of the effect of democracy and governance on infant mortality

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Infant mortality rate, logged						
Polity	-0.00326 [0.00173]	-0.000377 [0.000598]	-0.00105 [0.000750]	-0.000532 [0.000590]			
Electoral Principle					-0.00636 [0.0180]	-0.092*** [0.0221]	-0.0129 [0.0178]
WB Rule of Law	-0.0426* [0.0190]	-0.0149* [0.00653]			-0.0188** [0.00655]		
TI Corruption Perceptions Index			-0.00533 [0.00281]			-0.00468 [0.00284]	
WB Government Effectiveness				-0.0134* [0.00643]			-0.00971 [0.00643]
GDP per capita, logged	-0.590*** [0.0204]	-0.0323*** [0.00905]	-0.0683*** [0.0131]	-0.0318*** [0.00912]	-0.0322** [0.00979]	-0.069*** [0.0130]	-0.0327** [0.00999]
Urbanization rate	-3.649*** [0.192]	-0.120 [0.0841]	-0.181 [0.103]	-0.132 [0.0846]	-0.0169 [0.0842]	-0.110 [0.103]	-0.0246 [0.0848]
Lagged DV		0.955*** [0.0130]	0.930*** [0.0160]	0.953*** [0.0131]	0.956*** [0.0131]	0.934*** [0.0160]	0.957*** [0.0132]
_cons	9.999*** [0.156]	0.418*** [0.105]	0.845*** [0.145]	0.427*** [0.105]	0.361** [0.111]	0.846*** [0.145]	0.371*** [0.111]
Country FE	v	v	v	v	v	v	v
Year FE		v	v	v	v	v	v
Lagged DV		v	v	v	v	v	v
Countries	148	148	146	148	144	143	144
N	1678	1678	1605	1677	1646	1571	1645
Log likelihood	1223.6	3035.8	2779.2	3033.3	2984.8	2726.0	2979.4
adj. R-sq (within)	0.550	0.948	0.934	0.947	0.949	0.935	0.948

All independent variables are lagged for one year. Coefficients of yearly dummies are not reported. Standard error in brackets * p<0.05 ** p<0.01 *** p<0.001.

Across all models the independent variables are lagged by one year. In model 1, only country fixed-effects are included, while in all other models we add yearly dummies and lagged dependent variable. Yearly dummies are included to control for the general global health trends and other contemporaneous factors. One-year lagged dependent variable is added to the models

¹³ Sources: Haber and Menaldo (2011)

to test whether the *change* of infant mortality rate from one year to another is influenced by democracy and quality of government. A lagged dependent variable also serves as a proxy for omitted variables and controls for the possibility of temporal correlation.

Overall the results presented in Table 2 replicate the finding that there is a positive effect of good governance on health outcomes. The polity scores, used as a measure for level of democracy, do not come out as a statistically significant predictor of infant mortality in any of the models, while the indicators on rule of law and government effectiveness (WB) are estimated to reduce the rate of infant mortality (Models 1, 2 and 4). Although the TI measure on corruption does not cross the significance threshold (Model 3), we find that the other two proxies for governance are significant predictors of mortality, especially when adequate controls are included. In Models 5, 6 and 7 we include the V-Dem electoral principle of democracy index as one of the main explanatory variables. Across models the electoral democracy index shows statistically significant effect only in one of the specifications, while the WB rule of law indicator retains its statistical significance.

As the previous section has pointed out, the commonly used indicators of governance included in Table 2 are measured for the recent two decades, thus the total number of observations in the regression analysis above is around 1600. To test whether the omitted countries and years in the first set of models are introducing bias, we include the no-corruption index as a proxy for governance in the models presented in Table 3. Table A.5 in the Appendix compares countries and years covered in the first model of Table 2 and 3.

The most important findings from this round of analysis are that *the electoral component index* and *the legislative control index* have consistent positive effects on health outcomes, even when the lagged dependent variable and other relevant controls are included in the model (GDP growth, oil rents, domestic autonomy and occurrence of conflicts). The effects of democracy, either measured as the quality of competitive elections or the capacity of legislative constraints, are largely reduced but still significant if the lagged dependent variable is controlled. Table A.4 in the Appendix shows the results of additional robustness checks, including those based on imputed data, and the same patterns prevail.

Based on model 2 and 5, a one standard deviation increase on the electoral principle or the legislative constraint index is associated with a decrease in infant mortality rate of more than 1 per 1000. However, the effects of the no-corruption index are less clear as the indicator does not show statistically significant results in the presence of other important factors to health. In one of the alternative specifications where mortality rate under 5 years is used as the dependent variable

(sample covers 1960-2012), the indicator even has a positive effect on mortality rates, opposite to the negative relationship as we expected.

Table 3. Regression estimates of the effect of democracy and governance on health, 1900-2012

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Infant Mortality Rate, logged						Mortality Rate Under 5, logged	
Electoral Principle	-0.485*** [0.0285]	-0.0393*** [0.00736]	-0.0520*** [0.00853]				-0.0308*** [0.00515]	
Legislative Constraints				-0.259*** [0.0217]	-0.0208*** [0.00555]	-0.0238*** [0.00632]		-0.0378*** [0.00351]
No-Corruption	-0.0283 [0.0326]	-0.0292*** [0.00838]	-0.00768 [0.0102]	-0.0427 [0.0323]	-0.0321*** [0.00821]	-0.0180 [0.00988]	0.0565*** [0.00586]	0.0627*** [0.00566]
GDP per capita, logged	-0.786*** [0.0117]	-0.0173*** [0.00372]	-0.0176*** [0.00448]	-0.819*** [0.0115]	-0.0181*** [0.00367]	-0.0195*** [0.00445]	0.00732** [0.00234]	0.00612** [0.00230]
Urbanization Rate	-2.406*** [0.0546]	0.00696 [0.0175]	-0.00650 [0.0193]	-2.605*** [0.0520]	0.00292 [0.0173]	-0.0108 [0.0191]	0.0142 [0.0133]	0.0136 [0.0130]
Lagged DV		0.943*** [0.00340]	0.936*** [0.00397]		0.944*** [0.00333]	0.938*** [0.00390]	0.986*** [0.00276]	0.987*** [0.00270]
GDP Growth Rate			-0.0009*** [0.00018]			-0.0009*** [0.00018]		
Petroleum Produced per capita			0.0000002 [0.000001]			0.0000003 [0.000001]		
Domestic Autonomy			0.00381 [0.00274]			0.00207 [0.00272]		
Armed Conflict, International			0.00556 [0.00410]			0.00734 [0.00402]		
Armed Conflict, Internal			-0.00522 [0.00362]			-0.00488 [0.00357]		
_cons	11.47*** [0.0761]	0.360*** [0.0463]	0.409*** [0.0530]	11.74*** [0.0752]	0.373*** [0.0436]	0.409*** [0.0510]	-0.0652* [0.0274]	-0.0600* [0.0269]
Country FE	v	v	v	v	v	v	v	v
Year FE		v	v	v		v	v	v
Lagged DV		v	v	v		v	v	v
Countries	146	146	106	146	146	106	145	145
N	8055	7942	5739	8217	8088	5851	5222	5281
Log likelihood	-2642.8	9027.0	7044.5	-2797.4	9220.4	7184.7	9955.2	10130.3
adj. R-sq	0.810	0.990	0.992	0.810	0.990	0.992	0.995	0.995

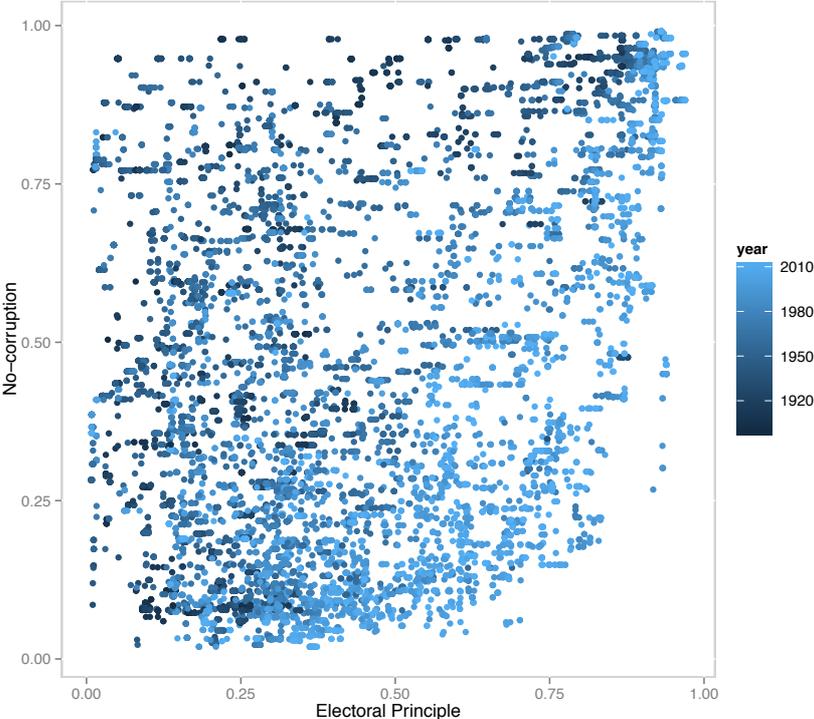
All independent variables are lagged for one year. Coefficients of yearly dummies are not reported. Standard error in brackets * p<0.05 ** p<0.01 *** p<0.001.

4.2. The Incomplete Sample

To explore why the results from the two tables presented above differ so extensively we first analyze the difference in the samples. The number of cases in Table 3 compared to Table 2 increases approximately 3.5 times in the models when all control variables are included and 5 times in the baseline models. The list of the countries and the year-range included in the regression analysis, documented in Table A.5 in the Appendix, reveals that the difference in the number of observations comes from the much richer data of country-years prior to 1996.

To examine how the difference in data coverage affects the variations of the main explanatory variables, we first depict the relationship between the levels of democracy measured as the quality of elections and the no-corruption index of all observations (country-years) from 1900 to 2012. Figure 2 shows the scatterplot. The figure suggests that across the entire time period, we can observe all different kinds of combinations between these two indicators. In addition to data points in the first and the third quadrants, there are some country-years rated high on the no-corruption but low on the electoral index, while others have free and fair elections but lag behind in terms of the quality of government.

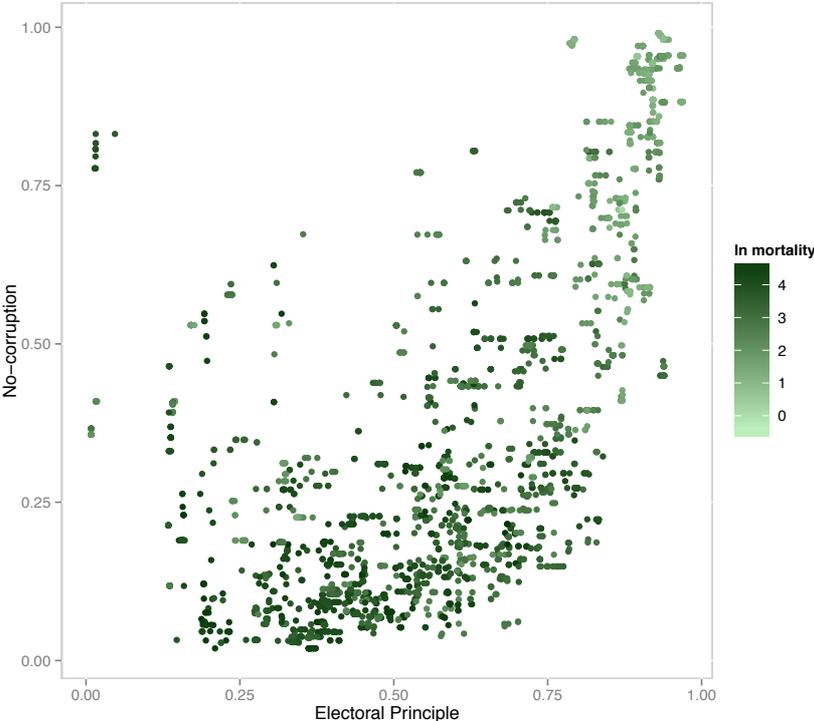
Figure 2: The relationship between electoral principle and no-corruption indices (1900-2012)



In the figure, colors represent different years, and suggest that the observed combinations of the values of electoral and no-corruption indices seem to vary over time. Back in time, there were more countries that had a high quality of government but did not hold competitive elections; while recently, the combination of low values on the no-corruption index and high-values on the electoral index is more common.

To further verify this pattern, Figure 3 shows the scatterplot between the no-corruption and the electoral indices but only for observations after 1996 when the WB and TI governance indicators start to be measured. The figure shows that there is a roughly positive relationship between the two indicators. In addition, there are many countries that hold competitive elections but have corrupt governments. Contrary to the previous figure that covers the entire period between 1900 and 2012, it is rare to observe the combination of low values on the electoral index but high values on the governance index. The same pattern prevails in Figure 4 and 5, when the polity scores are used as the measure of regime types and TI corruption perception index as the measure of governance.

Figure 3: The relationship between electoral principle and no-corruption indices (1996-2012)



These plots show that a sample after 1996 does not reflect all possible variations of combinations between the two main explanatory variables. However, the existing governance

indicators used in previous research are only measured for the most recent two decades. To verify whether it is the limited coverage that results in the conflicting results shown in Table 2 and 3, we estimate the same models as those in Table 3 but limit the analysis only to observations after 1996. The results are presented in models 1 to 6 in Table 4.

The model coefficients are consistent with some previous studies, and show that for this time period, the no-corruption index has more consistent and significant positive effects on health than regime types, either measured as competitive elections, legislative constraints, or the polity scores.

Figure 4: The relationship between polity and no-corruption indices (1996-2012)

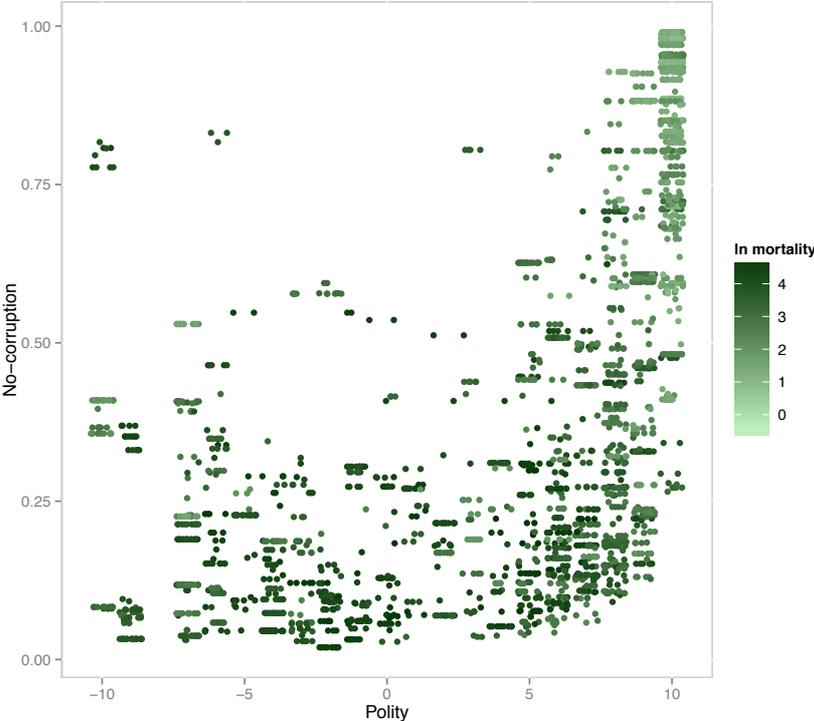


Figure 5: The relationship between electoral principle and TI corruption perception indices (1996-2012)

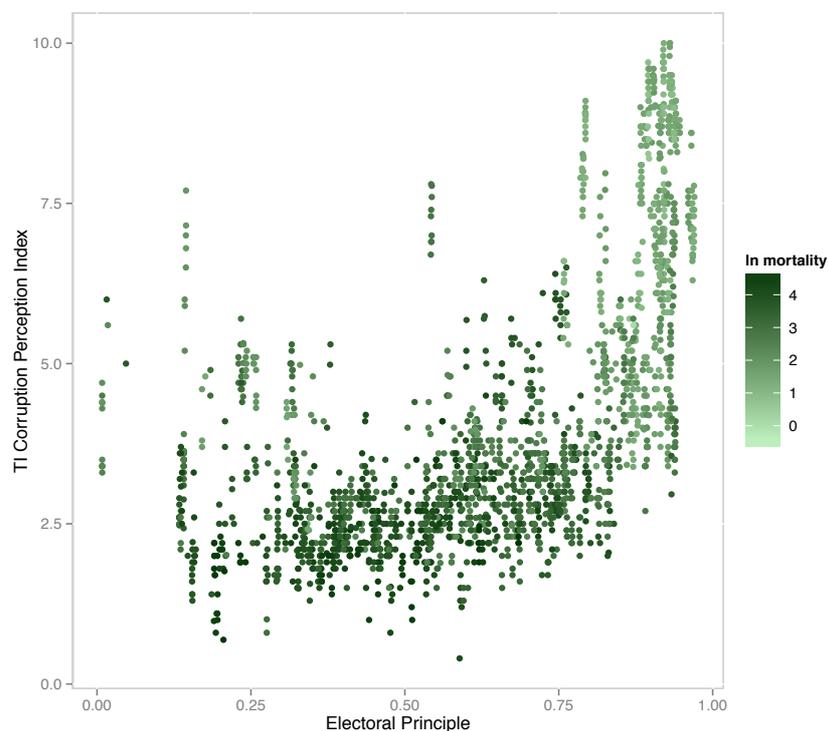


Table 4. Regression estimates of the effect of democracy and governance on health

	(1) 1996-	(2) 1996-	(3) 1996-	(4) 1996-	(5) 1996-	(6) 1996-	(7) 1946-
	Infant Mortality Rate, logged						
Electoral Principle	-0.00288 [0.0504]	0.0661 [0.0339]					
Legislative Constraints			-0.106** [0.0404]	0.0545* [0.0272]			
Polity					-0.0052*** [0.00156]	-0.00043 [0.00105]	-0.00018*** [0.00238]
No-Corruption Index	-0.132* [0.0610]	-0.106** [0.0409]	-0.0703 [0.0630]	-0.114** [0.0421]	-0.116 [0.0602]	-0.114** [0.0402]	-0.0105 [0.0087]
GDP per capita,logged	-0.689*** [0.0187]	-0.184*** [0.0166]	-0.687*** [0.0187]	-0.183*** [0.0165]	-0.685*** [0.0189]	-0.184*** [0.0167]	-0.00125*** [0.0037]
Urbanization Rate	-3.481*** [0.163]	0.0769 [0.142]	-3.485*** [0.161]	0.0932 [0.141]	-3.499*** [0.166]	0.0617 [0.144]	0.0366* [0.018]
Lagged DV		0.421*** [0.0201]		0.424*** [0.0199]		0.418*** [0.0202]	0.935*** [0.0038]
_cons	10.75*** [0.141]	3.319*** [0.182]	10.78*** [0.139]	3.298*** [0.181]	10.75*** [0.142]	3.387*** [0.182]	0.269*** [0.0414]
Country FE	v	v	v	v	v	v	v
Year FE		v		v		v	v
Lagged DV		v		v		v	v
N	2012	2012	2030	2030	1971	1971	6327
Countries	143	143	144	144	140	140	143
Log likelihood	1504.3	2328.6	1521.6	2358.0	1473.4	2289.5	8084.4
adj. R-sq	0.602	0.823	0.603	0.824	0.606	0.826	0.987

All independent variables are lagged for one year. Coefficients of yearly dummies are not reported. Standard error in brackets * p<0.05 ** p<0.01 *** p<0.001.

In model 7, we conduct the same analysis with polity scores as the measure of regime type and for the entire time period since the polity data is available (1946). Similar with results shown in Table 3, democracy significantly reduces infant mortality rates, while the effects of corrupt governance are less clear. These analyses suggest that the conflicting results identified in the literature and also in the previous section are to a larger extent due to the limited coverage of samples than different measures of democracy. The result that quality of government rather than democracy is the crucial determinant of health holds only for a sample of most recent decades, which does not reflect the entire range of variations.

We also estimate the model for samples of other time periods. For example, the indicator of mortality rates under 5, provided by the United Nations IGME, is measured for years after 1960. As model 7 and 8 in Table 3 and Table A.6 in the Appendix show, for a subsample of years after 1960, both infant and child mortality rates increase with higher levels of quality of government and decrease with higher levels of democracy. Table A.6 in the Appendix also includes the analyses for other time periods, and the results suggest that the effects of the no-corruption index vary substantially across subsamples of different time periods. Democracy more consistently leads to the improvement of health, except for the subsample of the most recent two decades when the variations in levels of corruption across non-democratic countries are largely reduced. Further research is required to examine whether the different effects of corruption across subsamples are due to that the impacts of governance are contingent on other factors or simply the results of biased slices of countries.

4.3. Vertical and Horizontal Accountability

To test the hypothesis that the combination of both vertical and horizontal accountability mechanisms especially urges politicians to provide public goods (hypothesis 2), we include the interaction term between the electoral principle and legislative constraint indices in the analyses. The results are shown in Table 5.

Table 5. Regression estimates of the joint effect of vertical and horizontal accountability mechanisms

	(1)	(2)	(3)	(4)	(5)
	1900-	1900-	1900-	1996-	1960-
Infant Mortality Rate, logged					
Electoral Principle	1.178***	0.0731***	0.0249	0.0994*	0.0416*
	[0.0708]	[0.0182]	[0.0214]	[0.0388]	[0.0167]
Legislative Constraints	0.906***	0.0695***	0.0477***	0.173***	0.0367**
	[0.0437]	[0.0120]	[0.0128]	[0.0362]	[0.0128]
Electoral Principle x Legislative Constraints	-2.603***	-0.186***	-0.126***	-0.244***	-0.129***
	[0.0936]	[0.0248]	[0.0282]	[0.0590]	[0.0242]
No-Corruption Index	0.151***	-0.0195*	-0.00176	-0.00902	0.0281***
	[0.0318]	[0.00850]	[0.0104]	[0.0220]	[0.00776]
GDP per capita,logged	-0.686***	-0.0156***	-0.0173***	-0.0372***	-0.00199
	[0.0118]	[0.00371]	[0.00447]	[0.00884]	[0.00327]
Urbanization Rate	-2.432***	-0.00876	-0.0210	-0.0479	0.0392*
	[0.0521]	[0.0176]	[0.0196]	[0.0729]	[0.0174]
Lagged DV		0.937***	0.932***	0.945***	0.959***
		[0.00350]	[0.00407]	[0.0116]	[0.00367]
GDP Growth Rate			-0.00092***		
			[0.000184]		
Petroleum Produced per capita			0.000000		
			[0.000001]		
Domestic Autonomy			0.00430		
			[0.00276]		
Armed Conflict, International			0.00528		
			[0.00411]		
Armed Conflict, Internal			-0.00532		
			[0.00362]		
_cons	10.15***	0.335***	0.397***	0.394***	0.142***
	[0.0875]	[0.0463]	[0.0530]	[0.103]	[0.0360]
Country FE	v	v	v	v	v
Year FE		v	v	v	v
Lagged DV		v	v	v	v
N	8053	7940	5737	2012	5854
Countries	146	146	106	143	146
Log likelihood	-2266.7	9053.0	7052.0	3667.0	8503.8
adj. R-sq	0.827	0.990	0.992	0.953	0.987

All independent variables are lagged for one year. Coefficients of yearly dummies are not reported. Standard error in brackets * p<0.05 ** p<0.01 *** p<0.001.

Models 1 to 3 cover all the time period 1900 - 2012, while model 4 and 5 are for subsamples of different time periods. Consistent with the expectation, the positive effects of electoral competition on population health are contingent on whether the legislature is capable to control the executive branch. If the power of legislatures is limited, the establishment of free and fair elections does not necessarily lead to the improvement of health. The effects of electoral accountability mechanisms are especially salient when legislatures are powerful. Based on model 1, the effects of an increase of the electoral index on mortality rate turn to negative once the legislative constraint index reaches the level of 0.45.

Similarly, the development of legislative power itself is not helpful for health. Both vertical and horizontal accountability mechanisms lead to the decline of mortality rates only when

the other accountability mechanism is also present. The results also show that the contingent effects of both accountability mechanisms prevail in subsamples of different time periods and across different model specifications. Furthermore, the effects of the quality of government indicator become insignificant or positive on mortality rate.

4.4. The Threshold Effects of Democracy

Table 6. Regression estimates of the threshold effect of democracy on health

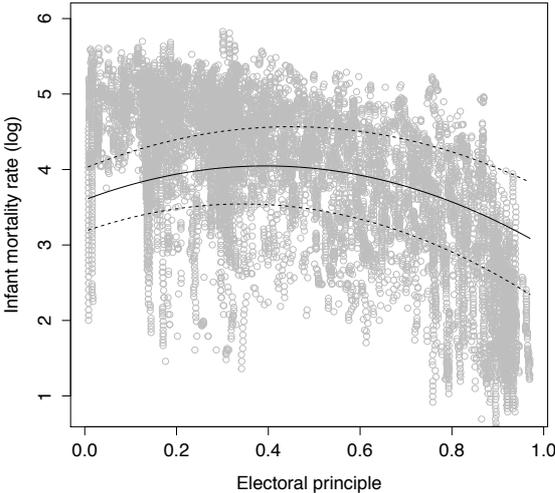
	(1) 1900-	(2) 1900-	(3) 1900-	(4) 1996-	(5) 1960-	(6) 1960-
	Infant Mortality Rate, logged					Mortality Rate Under 5
Electoral Principle	2.278*** [0.0872]	0.123*** [0.0237]	0.0405 [0.0269]	0.460* [0.189]	1.260*** [0.125]	0.855*** [0.132]
Electoral Principle^2	-2.891*** [0.0869]	-0.172*** [0.0239]	-0.0959*** [0.0265]	-0.471* [0.185]	-1.974*** [0.123]	-1.570*** [0.129]
No-Corruption	0.279*** [0.0319]	-0.0138 [0.00862]	-0.000558 [0.0104]	-0.0909 [0.0630]	0.323*** [0.0366]	0.235*** [0.0397]
GDP per capita,logged	-0.685*** [0.0113]	-0.0170*** [0.00371]	-0.0185*** [0.00448]	-0.691*** [0.0187]	-0.558*** [0.0137]	-0.577*** [0.0138]
Urbanization Rate	-2.407*** [0.0511]	-0.00812 [0.0175]	-0.0195 [0.0196]	-3.455*** [0.163]	-2.628*** [0.0644]	-3.282*** [0.0670]
Lagged DV		0.935*** [0.00355]	0.931*** [0.00414]			
GDP Growth Rate			-0.0009*** [0.00018]			
Petroleum Produced per capita			0.0000003 [0.000001]			
Domestic Autonomy			0.00421 [0.00274]			
Armed Conflict, International			0.00564 [0.00410]			
Armed Conflict, Internal			-0.00532 [0.00362]			
_cons	10.06*** [0.0830]	0.357*** [0.0462]	0.415*** [0.0529]	10.65*** [0.145]	9.235*** [0.107]	10.12*** [0.111]
Country FE	v	v	v	v	v	v
Year FE		v	v			
Lagged DV		v	v			
N	8055	7942	5739	2012	5870	5488
Countries	146	146	106	143	146	146
Log likelihood	-2114.5	9053.7	7051.3	1507.7	-981.4	-591.2
adj. R-sq	0.833	0.990	0.992	0.603	0.676	0.719

All independent variables are lagged for one year. Coefficients of yearly dummies are not reported. Standard error in brackets * p<0.05 ** p<0.01 *** p<0.001.

To test the hypothesis that in transitional democracies, political competition does not necessarily lead to the provision of public goods (hypothesis 3), we include the squared term of the electoral principle index in the analysis. The results are shown in Table 6. Models 1 to 3 include observations from 1900 to 2012, and the other models are for subsamples of different time periods.

Consistent with the hypothesis, the results suggest that there is a curvilinear relationship between democracy and health outcome. As the level of democracy increases, infant and child mortality rates first slightly increase and then decrease. The lines in Figure 6 represent the relationship between the electoral index and mortality rate estimated by model 1, and the gray dots are the observed values of the two indicators. In quite close autocracies, a small increase in suffrage or political competition does not lead to the improvement of population health. Only when the level of democracy reaches certain threshold, mortality rate declines as democracy matures. Based on these models, the threshold is at a lower-middle level of the electoral index, which roughly represents a regime in which a small number of civil and political groups are independent of the ruling regime, freedom of discussion is somewhat respected, and elections allow for some competition. Once crossing the threshold, improved political participation and competition are leading to improved health.

Figure 6: The estimated relationship between democracy and mortality rate



It has to be noted that this pattern holds even for the subsample of the most recent two decades. In addition, when the squared term of electoral principle is included in the model, the effects of the no corruption index disappear or remain negative on population health. Since there may be also a threshold effect of democracy on corruption, the relationship between democracy and governance and thus their potential joint impacts on public goods provision require further studies¹.

¹ Norris (2012) has argued that high levels of electoral democracy and QoG converge, and that could be one reason why the effects of corruption on mortality rates seem to vary substantially across subsamples. Another interesting perspective worth investigating is the conditions under which corruption or clientelism can serve as substitute for social policies and can be used as a way to gain access to public services thus enhancing health outcomes.

5. Conclusions

In this paper we conduct thorough analyses examining the effects of regime type and governance quality on the improvement of health outcomes in a country. By utilizing a dataset that covers more than 160 countries over the years 1900-2012 and contains nuanced and disaggregated measures of democracy and governance, we show that democracy has significant and positive effects on population health. Our analyses suggest that the mixed results pointed out in previous research are partly due to incomplete samples that do not reflect the entire variation range of combinations in terms of democratic development, governance performance and health outcomes. The previously widely used indicators of governance quality are only measured for the recent two decades, when the variations of the governance indicators across non-democracies are quite limited. Furthermore, we find that the positive force of democracy on health outcomes is clearer if the threshold effect of democracy is also taken into account. That is, after the transitional period of democratic reforms, mortality rate declines as democracy matures. Finally, the positive impacts of democracy are especially salient when both vertical and horizontal accountability mechanisms are present. The effects of the squared term of democracy indicators and the interaction between vertical and horizontal accountability indicators are significant and robust across models with different specifications and different time periods.

The findings have a number of implications. First, the results demonstrate the impact of incomplete samples, especially for topics affected by global temporal trends. Limited coverage of samples over time and across countries can be influential. For the topic of this paper, the important contribution of the V-Dem project is not in providing drastically different measures of regime types and governance quality, but in collecting a dataset that covers a long time period of most countries for various detailed indicators.

Second, the results show that the effects of corruption on mortality rates seem to vary substantially across samples of different time periods and models with different specifications. Further studies are required to examine whether the effects of governance quality are conditional on some factors sensitive to temporal patterns, whether the impacts of corrupt governance vary across democracies of different ages or different waves, and if other indicators on governance, such as state capacity or effectiveness, show the same pattern.

Finally, our findings highlight the importance of exploring the role of different dimensions of democracy. Scholars have pointed out the limitation of electoral competition. How different types of horizontal accountability mechanisms improve the provision of public goods or limit the distortion of resource allocation are worth further studies.

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Appendix

Table A.1. Independent Variables for the V-Dem Project

Indicator	Question	Response categories / Aggregation
Electoral component index	To what extent is the electoral principle of democracy achieved? Clarification: The electoral principle of democracy seeks to achieve responsiveness and accountability between leaders and citizens through the mechanism of competitive elections. This is presumed to be achieved when suffrage is extensive; political and civil society organizations can operate freely; elections are clean and not marred by fraud or systematic irregularities; and the chief executive of a country is selected (directly or indirectly) through elections.	The electoral component index is operationalized as a chain defined by its weakest link of freedom of association (v2x_frassoc_thick), suffrage (v2x_suffr), clean elections (v2xel_frefair), and elected executive (v2x_accex). The index is thus aggregated using this formula: .125*v2x_frassoc_thick+.125*v2x_suffr+.125*v2xel_frefair+.125*v2x_accex+.5*v2x_frassoc_thick*v2x_suffr*v2xel_frefair*v2x_accex.
Legislative constraints on the executive index	To what extent is the legislature and government agencies (e.g., comptroller general, general prosecutor, or ombudsman) capable of questioning, investigating, and exercising oversight over the executive?	The index is formed by taking the point estimates from a Bayesian factor analysis model of the indicators for legislature questions officials in practice (v2lgqstexp), executive oversight (v2lgotovst), legislature investigates in practice (v2lginvstp), and legislature opposition parties (v2lgoppart).
Executive bribery and corrupt exchanges	How routinely do members of the executive (the head of state, the head of government, and cabinet ministers), or their agents, grant favors in exchange for bribes, kickbacks, or other material inducements?	0: It is routine and expected. 1: It happens more often than not in dealings with the executive. 2: It happens but is unpredictable: those dealing with the executive find it hard to predict when an inducement will be necessary. 3: It happens occasionally but is not expected. 4: It never, or hardly ever, happens.
Executive embezzlement and theft	How often do members of the executive (the head of state, the head of government, and cabinet ministers), or their agents, steal, embezzle, or misappropriate public funds or other state resources for personal or family use?	0: Constantly. Members of the executive act as though all public resources were their personal or family property. 1: Often. Members of the executive are responsible stewards of selected public resources but treat the rest like personal property. 2: About half the time. Members of the executive are about as likely to be responsible stewards of selected public resources as they are to treat them like personal property. 3: Occasionally. Members of the executive are responsible stewards of most public resources but treat selected others like personal property. 4: Never, or hardly ever. Members of the executive are almost always responsible stewards of public resources and keep them separate from personal or family property.

Public sector corrupt exchanges	How routinely do public sector employees grant favors in exchange for bribes, kickbacks, or other material inducements?	<p>0: Extremely common. Most public sector employees are systematically involved in petty but corrupt exchanges almost all the time.</p> <p>1: Common. Such petty but corrupt exchanges occur regularly involving a majority of public employees.</p> <p>2: Sometimes. About half or less than half of public sector employees engage in such exchanges for petty gains at times.</p> <p>3: Scattered. A small minority of public sector employees engage in petty corruption from time to time.</p> <p>4: No. Never, or hardly ever.</p>
Legislature corrupt activities	Do members of the legislature abuse their position for financial gain?	<p>0: Commonly. Most legislators probably engage in these activities.</p> <p>1: Often. Many legislators probably engage in these activities.</p> <p>2: Sometimes. Some legislators probably engage in these activities.</p> <p>3: Very occasionally. There may be a few legislators who engage in these activities but the vast majority do not.</p> <p>4: Never, or hardly ever.</p>
Judicial corruption decision	How often do individuals or businesses make undocumented extra payments or bribes in order to speed up or delay the process or to obtain a favorable judicial decision?	<p>0: Always.</p> <p>1: Usually.</p> <p>2: About half of the time.</p> <p>3: Not usually.</p> <p>4: Never.</p>
Domestic autonomy	Is the state autonomous from the control of other states with respect to the conduct of domestic policy?	<p>0: Non-autonomous. National level authority is exercised by an external power, either by law or in practice.</p> <p>1: Semi-autonomous. An external political actor directly constrains the ability of domestic actors to rule, decides who can or cannot rule through formal rules or informal understandings, or precludes certain policies through explicit treaty provisions or well-understood rules of the game from which the subject state cannot withdraw.</p> <p>2: Autonomous. Domestic political actors exercise political authority free of the direct control of external political actors.</p>

Table A.2. Structure of aggregation for the main independent variables

Mid-Level Democracy and Governance Indices	Lower-Level Indices	Names Indicators	v2_tag Indices and Indicators
Electoral Component Index			v2x_EDcomp_thick
	Freedom of association index (thick)		v2x_frassoc_thick
		Party Ban	v2psparban
		Barriers to parties	v2psbars
		Opposition parties autonomy	v2psoppaut
		Elections multiparty	v2elmulpar
		CSO entry and exit	v2cseeorgs
		CSO repression	v2csreprss
	Share of population with suffrage		v2x_suffr
		Percent of population with suffrage	v2elsuffrage
	Clean elections index		v2xel_frefair
		EMB autonomy	v2lembaut
		EMB capacity	v2lembcap
		Election voter registry	v2elrgstry
		Election vote buying	v2elvotbuy
		Election other voting irregularities	v2elirreg
		Election government intimidation	v2elintim
		Election other electoral violence	v2elpeace
		Election free and fair	v2elfrfair
	Elected executive index (de jure)		v2x_accex
		Lower chamber elected	v2lgello
		Upper chamber elected	v2lgelecup
		Legislature dominant chamber	v2lgdomchm
		HOS selection by legislature in practice	v2exaphos
		HOS appointment in practice	v2expathhs
		HOG selection by legislature in practice	v2exaphogp
		HOG appointment in practice	v2expathhg
		HOS appoints cabinet in practice	v2exdfcbhs
		HOG appoints cabinet in practice	v2exdjcbhg
		HOS dismisses ministers in practice	v2exdfdms
		HOG dismisses ministers in practice	v2exdfdshg
		HOS appoints cabinet in practice	v2exdfcbhs

Legislative constraints on the executive index		v2xlg_legcon
	Legislature questions officials in practice	v2lgqstexp
	Executive oversight	v2lgotovst
	Legislature investigates in practice	v2lginvstp
	Legislature opposition parties	v2lgoppart

No-corruption index		
	Executive bribery and corrupt exchanges	v2exbribe
	Executive embezzlement and theft	v2exembez
	Public sector corrupt exchanges	v2excrptps
	Legislature corrupt activities	v2lgcrprt
	Judicial corruption decision	v2jucorrdc

Table A.3. Descriptive statistics of all variables used in the analysis

Indicators	Mean	SD	Min	Max
Infant Mortality Rate (log)	3.85	1.04	0.00	5.83
Mortality Rate Under 5 (log)	3.88	1.19	1.06	6.09
Electoral Principle of Democracy	0.50	0.27	0.01	0.97
Legislative Constraints	0.53	0.32	0.03	0.99
Polity	1.63	7.45	-10.00	10.00
No-Corruption	0.50	0.32	0.02	0.99
TI Corruption Perceptions Index	4.33	2.26	0.40	10.00
WB Rule of Law	-0.15	1.00	-2.67	2.00
WB Government Effectiveness	-0.06	1.00	-2.45	2.34
GDP per capita (log)	7.99	1.03	5.35	10.67
Urbanization Rate	0.46	0.23	0.01	0.97
GDP Growth Rate	1.94	5.90	-61.49	65.90
Petroleum Produced per capita	319.80	2359.69	0.00	78588.80
Domestic Autonomy	0.81	0.72	-1.90	1.94
Armed Conflict, International	0.08	0.27	0.00	1.00
Armed Conflict, Internal	0.12	0.32	0.00	1.00

Table A.4. Robustness Tests

DV	(1)	(2)	(3)	(4)	(5)	(6)
			Infant Mortality Rate (log)			
			Random			
Model	OLS	OLS	Effect	Fixed Effect	Fixed Effect	Poisson
Sample	Full	Full	Full	Full	Imputed	Imputed
Electoral Principle	-54.11*** [1.972]	-21.74*** [1.925]	-0.0348*** [0.00636]		-0.146*** [0.0187]	-0.360*** [0.00577]
No-Corruption	34.81*** [1.525]	-8.530*** [1.684]	-0.0208** [0.00643]		-0.113*** [0.0203]	-0.0679*** [0.00525]
Electoral Principle (10 yr lagged)				-0.522*** [0.0290]		
No-Corruption (10 yr lagged)				0.0191 [0.0345]		
GDP per capita (log)	-24.15*** [0.707]	-13.38*** [0.683]	-0.0222*** [0.00284]	-0.782*** [0.0124]	-0.214*** [0.00787]	-0.196*** [0.00189]
Urbanization Rate	-59.88*** [2.900]	-44.60*** [2.695]	-0.0329** [0.0104]	-2.511*** [0.0556]	-0.938*** [0.0417]	-2.317*** [0.0121]
_cons	301.4*** [4.355]	308.1*** [11.68]	0.256*** [0.0407]	11.46*** [0.0809]	4.479*** [0.0800]	
Year FE		v	v	v	v	v
Country FE				v	v	v
Region FE		v				
Lagged DV			v		v	v
N	8014	8014	7942	7291	19213	19213
adj. R-sq	0.592	0.727	0.989	0.809	0.846	
Countries			146	146	202	202
Log Likelihood	-39855.4	-38189.9		-2155.6	-6757.5	-291022.5

Table A.5. Country-years included in Table 2, Table 3, and the Imputed Data

	Country_name	Year range Table 2	Year range Table 3	Imputed Data
1	Afghanistan	1996 - 2000	1959 - 2008	1900 - 2012
2	Albania	1996 - 2010	1958 - 2010	1912 - 2012
3	Algeria	1996 - 2010	1953 - 2010	1900 - 2012
4	Angola	1996 - 2010	1973 - 2010	1900 - 2012
5	Argentina	1996 - 2010	1946 - 2010	1900 - 2012
6	Armenia	1996 - 2010	1990 - 2010	1990 - 2012
7	Australia	1996 - 2010	1902 - 2010	1901 - 2012
8	Austria	1996 - 2010	1919 - 2010	1918 - 2012
9	Azerbaijan	1996 - 2010	1990 - 2010	1990 - 2012
10	Bahrain	1996 - 2010	-	-
11	Bangladesh	1996 - 2010	1973 - 2010	1971 - 2012
12	Barbados	-	-	1900 - 2012
13	Belarus	1996 - 2010	1990 - 2010	1990 - 2012
14	Belgium	1996 - 2010	1900 - 2010	1900 - 2012
15	Benin	1996 - 2008	1959 - 2008	1900 - 2012
16	Bhutan	-	-	1900 - 2012
17	Bolivia	1996 - 2010	1945 - 2010	1900 - 2012
18	Bosnia and Herzegovina	-	1997 - 2010	1992 - 2012
19	Botswana	1996 - 2008	1961 - 2008	1900 - 2012
20	Brazil	1996 - 2010	1929 - 2010	1900 - 2012
21	Bulgaria	1996 - 2010	1905 - 2010	1900 - 2012
22	Burkina Faso	1996 - 2010	1959 - 2010	1919 - 2012
23	Burma/Myanmar	1996 - 2010	1931 - 1987	1900 - 2012
24	Burundi	1996 - 2008	1961 - 2008	1916 - 2012
25	Cambodia	1996 - 2010	1974 - 2010	1900 - 2012
26	Cameroon	1996 - 2010	1964 - 2010	1961 - 2012
27	Canada	1996 - 2010	1900 - 2010	1900 - 2012
28	Cape Verde	1996 - 2008	1973 - 2008	1900 - 2012
29	Central African Republic	1996 - 2008	1950 - 2008	1920 - 2012
30	Chad	1996 - 2008	1959 - 2008	1920 - 2012
31	Chile	1996 - 2010	1900 - 2010	1900 - 2012
32	China	1996 - 2010	1950 - 2010	1900 - 2012
33	Colombia	1996 - 2010	1923 - 2010	1900 - 2012
34	Comoros	1996 - 2008	1972 - 2008	1900 - 2012
	Congo, Democratic			
35	Republic of	1996 - 2010	1960 - 2010	1900 - 2012
36	Congo, Republic of the	1996 - 2008	1960 - 2008	1903 - 2012
37	Costa Rica	1996 - 2010	1954 - 2010	1900 - 2012
38	Croatia	1996 - 2010	1991 - 2010	1941 - 2012
39	Cuba	1996 - 2008	1931 - 2008	1902 - 2012
40	Cyprus	-	-	1900 - 2012
41	Czech Republic	1996 - 2010	1929 - 2010	1918 - 2012
42	Denmark	1996 - 2010	1901 - 2010	1900 - 2012
43	Djibouti	1996 - 2008	1975 - 2008	1900 - 2012
44	Dominican Republic	1996 - 2010	1950 - 2010	1900 - 2012
45	East Timor	-	-	1900 - 2012
46	Ecuador	1996 - 2010	1900 - 2010	1900 - 2012
47	Egypt	1996 - 2010	1913 - 2010	1900 - 2012
48	El Salvador	1996 - 2008	1939 - 2008	1900 - 2012
49	Equatorial Guinea	1996 - 2008	-	-
50	Eritrea	-	1993 - 1993	1900 - 2012
51	Estonia	1996 - 2010	1990 - 2010	1918 - 2012
52	Ethiopia	-	-	1900 - 2012
53	Fiji	-	-	1900 - 2012
54	Finland	1996 - 2010	1907 - 2010	1900 - 2012
55	France	1996 - 2010	1902 - 2010	1900 - 2012
56	Gabon	1996 - 2008	1959 - 2008	1910 - 2012
57	Gambia	1996 - 2008	1955 - 2008	1900 - 2012
58	Georgia	1996 - 2010	1990 - 2010	1990 - 2012

	German Democratic			
59	Republic	-	-	1946 - 1990
60	Germany	1996 - 2010	1903 - 2010	1900 - 2012
61	Ghana	1996 - 2010	1951 - 2010	1902 - 2012
62	Greece	1996 - 2010	1920 - 2010	1900 - 2012
63	Guatemala	1996 - 2010	1956 - 2010	1900 - 2012
64	Guinea	1996 - 2008	1950 - 2008	1900 - 2012
65	Guinea-Bissau	1996 - 2008	1975 - 2007	1900 - 2012
66	Guyana	-	-	1900 - 2012
67	Haiti	1996 - 2008	1955 - 2008	1900 - 2012
68	Honduras	1996 - 2008	1920 - 2008	1900 - 2012
69	Hong Kong	-	-	1900 - 2010
70	Hungary	1996 - 2010	1920 - 2010	1918 - 2012
71	Iceland	-	-	1900 - 2012
72	India	1996 - 2010	1910 - 2010	1900 - 2012
73	Indonesia	1996 - 2010	1949 - 2010	1900 - 2012
74	Iran	1996 - 2010	1950 - 2010	1900 - 2012
75	Iraq	1996 - 2010	1950 - 2010	1920 - 2012
76	Ireland	1996 - 2010	1921 - 2010	1919 - 2012
77	Israel	1996 - 2010	1950 - 2010	1948 - 2012
78	Italy	1996 - 2010	1900 - 2010	1900 - 2012
79	Ivory Coast	1996 - 2010	1955 - 2010	1900 - 2012
80	Jamaica	1996 - 2010	1913 - 2010	1900 - 2012
81	Japan	1996 - 2010	1946 - 2010	1900 - 2012
82	Jordan	1996 - 2010	1950 - 2010	1922 - 2012
83	Kazakhstan	1996 - 2010	1991 - 2010	1990 - 2012
84	Kenya	1996 - 2010	1950 - 2010	1900 - 2012
85	Korea, North	1996 - 2008	1959 - 2008	1900 - 2012
86	Korea, South	1996 - 2010	1950 - 2010	1900 - 2012
87	Kosovo	-	-	1999 - 2012
88	Kuwait	1996 - 2010	-	1900 - 2012
89	Kyrgyzstan	1996 - 2010	1990 - 2010	1990 - 2012
90	Laos	1996 - 2008	1950 - 2008	1900 - 2012
91	Latvia	1996 - 2010	1990 - 2010	1920 - 2012
92	Lebanon	2005 - 2008	1955 - 2008	1918 - 2012
93	Lesotho	1996 - 2008	1950 - 2008	1900 - 2012
94	Liberia	1996 - 2008	1950 - 2008	1900 - 2012
95	Libya	1996 - 2008	1957 - 2008	1934 - 2012
96	Lithuania	1996 - 2010	1990 - 2010	1918 - 2012
97	Macedonia	1996 - 2010	1991 - 2010	1991 - 2012
98	Madagascar	1996 - 2010	1959 - 2009	1900 - 2012
99	Malawi	1996 - 2010	1954 - 2010	1900 - 2012
100	Malaysia	1996 - 2010	1955 - 2010	1900 - 2012
101	Maldives	-	-	1900 - 2012
102	Mali	1996 - 2010	1959 - 2010	1900 - 2012
103	Malta	-	-	1900 - 2012
104	Mauritania	1996 - 2008	1950 - 2008	1904 - 2012
105	Mauritius	-	-	1900 - 2012
106	Mexico	1996 - 2010	1949 - 2010	1900 - 2012
107	Moldova	1996 - 2010	1990 - 2010	1990 - 2012
108	Mongolia	1996 - 2008	1950 - 2008	1911 - 2012
109	Montenegro	-	-	1900 - 2012
110	Morocco	1996 - 2010	1962 - 2010	1912 - 2012
111	Mozambique	1996 - 2010	1973 - 2010	1900 - 2012
112	Namibia	1996 - 2008	1959 - 2008	1900 - 2012
113	Nepal	1996 - 2008	1959 - 2008	1900 - 2012
114	Netherlands	1996 - 2010	1901 - 2010	1900 - 2012
115	New Zealand	1996 - 2010	1902 - 2010	1900 - 2012
116	Nicaragua	1996 - 2008	1920 - 2008	1900 - 2012
117	Niger	1996 - 2010	1956 - 2010	1922 - 2012
118	Nigeria	1996 - 2010	1950 - 2010	1914 - 2012
119	Norway	1996 - 2010	1900 - 2010	1900 - 2012

120	Oman	1996 - 2010	-	-
121	Pakistan	1996 - 2010	1950 - 2010	1947 - 2012
122	Palestine/British Mandate	-	-	1918 - 1947
123	Palestine/Gaza	-	-	1948 - 2012
124	Palestine/West Bank	-	-	1948 - 2012
125	Panama	1996 - 2008	1949 - 2008	1903 - 2012
126	Papua New Guinea	-	-	1900 - 2012
127	Paraguay	1996 - 2008	1950 - 2008	1900 - 2012
128	Peru	1996 - 2010	1929 - 2010	1900 - 2012
129	Philippines	1996 - 2010	1907 - 2010	1900 - 2012
130	Poland	1996 - 2010	1929 - 2010	1918 - 2012
131	Portugal	1996 - 2010	1909 - 2010	1900 - 2012
132	Qatar	1996 - 2010	1971 - 2010	1900 - 2012
133	Romania	1996 - 2010	1910 - 2010	1900 - 2012
134	Russia	1996 - 2010	1906 - 2010	1900 - 2012
135	Rwanda	1996 - 2008	1961 - 2008	1916 - 2012
136	Sao Tome and Principe	-	1975 - 2008	1900 - 2012
137	Saudi Arabia	1996 - 2010	1950 - 2010	1932 - 2012
138	Senegal	1996 - 2010	1957 - 2010	1904 - 2012
139	Serbia	-	-	1900 - 2012
140	Seychelles	-	1967 - 2008	1903 - 2012
141	Sierra Leone	1996 - 2008	1954 - 2008	1900 - 2012
142	Singapore	1996 - 2010	-	1900 - 2012
143	Slovakia	1996 - 2010	1993 - 2010	1939 - 2012
144	Slovenia	1996 - 2010	1989 - 2010	1989 - 2012
145	Solomon Islands	-	-	1900 - 2012
146	Somalia	1996 - 2008	1980 - 2008	1900 - 2012
147	Somaliland	-	-	1900 - 2012
148	South Africa	1996 - 2010	1910 - 2010	1900 - 2012
149	South Sudan	-	-	2011 - 2012
150	South Yemen	-	-	1900 - 1990
151	Spain	1996 - 2010	1901 - 2010	1900 - 2012
152	Sri Lanka	1996 - 2010	1948 - 2010	1900 - 2012
153	Sudan	-	-	1900 - 2012
154	Suriname	-	-	1900 - 2012
155	Swaziland	1996 - 2008	1964 - 2008	1900 - 2012
156	Sweden	1996 - 2010	1902 - 2010	1900 - 2012
157	Switzerland	1996 - 2010	1902 - 2010	1900 - 2012
158	Syria	1996 - 2010	1950 - 1964	1918 - 2012
159	Taiwan	1996 - 2008	1950 - 2008	1900 - 2012
160	Tajikistan	1996 - 2010	1990 - 2010	1990 - 2012
161	Tanzania	1996 - 2010	1950 - 2010	1914 - 2012
162	Thailand	1996 - 2010	1950 - 2010	1900 - 2012
163	Togo	1996 - 2008	1950 - 2008	1916 - 2012
164	Trinidad and Tobago	1996 - 2008	1950 - 2008	1900 - 2012
165	Tunisia	1996 - 2010	1958 - 2010	1900 - 2012
166	Turkey	1996 - 2010	1949 - 2010	1900 - 2012
167	Turkmenistan	1996 - 2010	1991 - 2010	1990 - 2012
168	Uganda	1996 - 2010	1953 - 2010	1900 - 2012
169	Ukraine	1996 - 2010	1990 - 2010	1990 - 2012
170	United Arab Emirates	1996 - 2010	-	-
171	United Kingdom	1996 - 2010	1900 - 2010	1900 - 2012
172	United States	1996 - 2010	1932 - 2010	1900 - 2012
173	Uruguay	1996 - 2010	1920 - 2010	1900 - 2012
174	Uzbekistan	1996 - 2010	1990 - 2010	1990 - 2012
175	Vanuatu	-	-	1906 - 2012
176	Venezuela	1996 - 2010	1929 - 2010	1900 - 2012
177	Vietnam, Democratic Republic of	-	-	1945 - 2012
178	Vietnam, Republic of	-	-	1902 - 1975
179	Yemen	1996 - 2010	1990 - 2010	1918 - 2012
180	Zambia	1996 - 2010	1950 - 2010	1911 - 2012

Table A.6. The Effects of Democracy and Governance in Different Subsamples

	(1) 1960-	(2) 1946-	(3) 1974-	(4) 1960-	(5) 1960-
DV	Infant Mortality Rate (log)				
Electoral Principle	-0.0485*** [0.00714]	-0.0394*** [0.00772]	-0.0652*** [0.00866]		
Legislative Constraints				-0.0339*** [0.00505]	
Polity					-0.00172*** [0.000216]
No-Corruption Index	0.0204** [0.00767]	-0.0284*** [0.00816]	0.0493*** [0.00950]	0.0175* [0.00747]	0.0248** [0.00785]
GDP per capita, logged	-0.00378 [0.00325]	-0.0120*** [0.00363]	-0.00707 [0.00414]	-0.00430 [0.00321]	-0.00806* [0.00333]
Urbanization Rate	0.0478** [0.0174]	0.0177 [0.0179]	0.116*** [0.0262]	0.0419* [0.0172]	0.0560** [0.0177]
_cons	0.173*** [0.0356]	0.289*** [0.0405]	0.207*** [0.0450]	0.172*** [0.0352]	0.184*** [0.0367]
Year FE	v	v	v	v	v
Country FE	v	v	v	v	v
Lagged DV	v	v	v	v	v
N	5855	6782	4485	5916	5605
adj. R-sq	0.987	0.986	0.977	0.987	0.988
Countries	146	146	145	146	143
Log Likelihood	8487.4	8413.2	6576.3	8604.4	8196.3