Disparities in access to clean water and sanitation: institutional causes

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Abstract

This paper uses cross-national data from 2002 and 2004 to assess the effects of key institutional variables on the improvement of access to safe water and sanitation. Two key variables of specific interest are a country’s commitment to ‘quality regulation’ and the country’s long-term development path. The evidence for the impact of those factors on expanding or contracting access to water and sanitation is mixed.

\textbf{Keywords:} Access; Disparities; Drinking water; Poverty; Regulation; Sanitation

1. Introduction

Clean water and sanitation have been central concerns of the public health movement for centuries (Beaglehole & Bonita, 1997). Access to safe drinking water and sanitation now stand among key known hazards or barriers that block communities from moving out of poverty and low levels of development; moreover, these hazards are often accentuated—not mitigated—by rapid economic development (Corvalán \textit{et al.}, 1999). The central problem for many countries, then, is to supply access to water, a resource that stands in contrast to other environmental indicators like air quality because it is a survival requirement whose costs cannot be externalized (Shafik, 1994). Hence, two of the most important linkages between the environment, development, and human health are access to clean drinking water, and the ability of communities to manage waste flows back into the environment through improved sanitation (Esrey, 1996).

However, no known papers address the impact of these political, economic, and social attributes on water scarcity, one of the most important areas for policymakers active in social development. This gap is worrisome and the purpose of this paper is to provide a preliminary framework for a discussion in this area.

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This paper investigates several possible foundations for access to clean water and improved sanitation, as measured across countries with varying geography, development patterns, social customs, and political arrangements. Three sets of attributes are investigated. First, we investigate the impact of attributes of political regimes such as the presence of parliamentary and presidential systems, representation systems like proportional representation, and the presence of federalism; we also assess the extent to which democratization increases access to water and sanitation. Second, we investigate the impact of economic development, specifically the roles of a country’s level of wealth (measured as per capita Gross Domestic Product), and its historical development path (whether the country’s legal system has English origins). The third set of mechanisms investigated represent a country’s social organization: the extent of ethnolinguistic fractionalization (ELF), the degree of income inequality, the level of technological attainment, and the geographical size of the country (which measures difficulty of extending service provision).

This paper necessarily takes an aggregate or ‘high level’ view of potential mechanisms. Our data are measurements of the extent to which the public is provided with either improved water sources or improved sanitation, which we then disaggregate into rural and urban provision. We assess both overall disparity (what percentage of a country’s population is served) and the disparities for these rural and urban populations.

The paper is organized as follows. The first section discusses the key factors which we have identified as potential causes of access to clean water and improved sanitation. Next, we briefly discuss our measurement strategies. In the third section, we review the results of the graphical and statistical approaches employed. Finally, we discuss our theory, data, test, and the implications of our results for the understanding of access to clean water.

Our data come from the 2002 and 2004 WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) estimates for a wide array of countries. Differences exist between JMP coverage estimates and country-reported coverage estimates, usually based on whether different levels of ‘improvement’ in water or sanitation facilities should be included in a given category (WHO, 2008: 12). These differences come because of the overall purpose of the JMP: to provide estimates that are globally comparable and represent a ‘best fit’ to the trend in improvement or degradation that is occurring at the country level. In contrast, the GLAAS offers measures that are perhaps more in-depth in specific countries (responding to those countries’ concerns that the JMP underestimates the extent of provision of water and sanitation services), but does so by only examining a relatively small number of countries. We may lose some fine measurement resolution at the individual country level, but our purpose is best served in this paper by enhancing our coverage of many different types of countries with varying social, economic, and political institutions.

The next section describes the key variables we examine graphically and statistically as potential mechanisms underpinning the variation observed across countries in the provision of water and sanitation services to the overall population, and to their rural and urban subpopulations.

1.1. Political institutions and behaviours

Our first key indicator is the quality of regulation in a country. This represents the degree to which regulation supports active investment by the private sector. Essentially, firms perceive high levels of regulatory quality if the regulatory burden they bear is not excessive and the returns they anticipate are sufficient to encourage investment and market entry. The World Bank has argued that a high-quality
regulatory environment is valuable if it makes it amenable for businesses to contract (The World Bank, 2009). Economists argue that perceptions of regulatory quality are fundamental to the long-term trajectory of economic growth, productivity, per capita income, and foreign direct investment (Acemoglu et al., 2005). Our approach is built on how perceptions work—on whether a government’s approach is perceived by experts as market-unfriendly or excessive (e.g. in price controls, bank supervision, foreign trade, or business), and helps account for comparison problems between developed and developing nations (e.g. Chinn & Fairlie, 2007; Bertelli & Whitford, 2009). We offer the following hypothesis: (H1) Greater provision of water and/or sanitation is positively associated with stronger perceptions that the state engages in quality regulation of the market. Our data come from the World Bank’s Governance Indicators estimate of each country’s ‘regulatory quality’ (see Appendix). This measure is fully described in the Appendix.

We next offer the hypothesis that a country’s level of democratization is positively associated with a country’s commitment to, and ability to attain, access to clean water and sanitation. A number of studies have asked whether democracies are more environmentally committed than non-democracies (Congleton, 1992; Midlarsky, 1998; Torras & Boyce, 1998; Barrett & Graddy, 2000; Gaston & Fredriksson, 2000; Gleditsch & Sverdrup, 2002; Neumayer, 2002; Grafton & Knowles, 2004). These studies mostly argue that the free speech and press rights associated with democracies make citizens more informed about the importance of the environment and ways to alleviate environmental and public health stresses. Armed with this knowledge, citizens of democracies place greater pressure on their government for positive environmental policy. There is strong evidence from social service provision that democratic regimes are more likely to serve under-represented populations, as seen in the cases of both literacy (Brown & Hunter, 1999) and even electric power provision (Brown & Mobarak, 2009).

However, we also recognize that the same individual liberties that lead to greater environmental commitment can also lead to greater environmental stress. The key to whether democracies are better able to commit to clean water access is the balancing of the desires of the citizens and the desires of businesses in a democracy. Some studies assess this relationship by the selection of cases from industrialized democracies only (e.g. Scruggs, 1999, 2003). Most studies of democracy find a positive effect, but many are limited to policy outputs. Others find varied support for improved environmental outcomes, usually in the case of air and water pollution levels or for land set-asides.

Much of the debate has taken place over how democracy is measured. But we are equally troubled with the lack of attention to the effect of democracy on aggregate environmental outcomes. Consideration of the adoption of particular policies is a useful route of inquiry, as is gaining knowledge of the effect of democracy on individual policy outcomes. Is democracy a prerequisite for access to clean water? Are inferences about the role of democracy policy-specific? We offer the following hypothesis: (H2) Greater provision of water and/or sanitation is positively associated with higher levels of democratization. Our data come from the Polity IV estimate of each country’s level of democratization. This measure is also fully described in the Appendix.

Our third political regime variable is the constitutional choice to have a federal system. On one hand, a number of studies have asked whether federalism is associated with lower environmental quality, which suggests that access to safe drinking water and sanitation would also be lower (Lowry, 1992; Scruggs, 1999; Eser, 2002; Helland & Whitford, 2003; Rabe, 2004, 2005). The answer appears to depend on context. Within countries, it is clear that states can make policy choices that lead to lower levels of environmental protection. The vertical delineation of tasks often makes the coordination and execution of environmental policy difficult. Environmental problems do not necessarily respect political
boundaries, so national implementation might be more effective. The core hypothesis in much of this literature is that aggregate environmental protection suffers from a ‘race to the bottom’ when more active states push through stringent environmental laws, but other states (catering to capital and business interests) loosen their environmental regulations in response to perceived flight risk.

We note, of course, that the increased power of capital may not be a by-product but, instead, an intentional outcome for federal systems that intend to be ‘market-preserving’ (Weingast, 1995). While there is evidence that states vary in terms of environmental and thus public health commitment, other analyses show limited differences (but those studies have rarely addressed federal systems in less developed areas). We assess this claim in a set of countries with varied social, economic, and political features by offering this hypothesis: \((H3)\) Greater provision of water and/or sanitation is positively associated with federalism.

Our measure of ‘strong federalism’ comes from the Database of Political Institutions, and is described in the Appendix. ‘Strong federalism’ refers to states for which regional and local political leadership are directly elected.

We next turn to three narrow hypotheses about specific representation structures in the political regimes of the countries under study. We note that a number of important studies focus on the roles of proportional representation (PR) and single-member plurality (SMP) systems in organizing how citizens individually and collectively are represented in government; for example, Persson & Tabellini (2003) argue that majoritarian systems provide direct accountability for politicians (e.g. reducing opportunities for corruption), and that relegating political competition to a small number of candidates in each district gives political outsiders few opportunities to challenge incumbents. Powell (2000) argues that proportional representation systems generally outperform plurality systems when translating votes into either majority governments or coalitions close to the median voter. This gives us a theoretical expectation that PR may be more responsive to minority interests, such as those underserved by public services like the provision of clean water and sanitation. We offer the following hypothesis: \((H4)\) Greater provision of water and/or sanitation is positively associated with proportional representation. Our data on proportional representation systems also comes from the Database on Political Institutions (see Appendix).

Our next two narrow hypotheses centre on the broad institutional distinction between presidential and parliamentary regimes. The centralization of power under presidential arrangements does not distribute power as widely as does the legislative authority wielded by the leadership in parliamentary systems (Mainwaring, 1995; Shugart, 1999). While in presidential systems both the party leadership and the chief executive must approve legislation, the president controls certain rents independent of a legislative check. “Rents” is a commonly used term in the social sciences. It denotes “gains”. This unconstrained authority over the creation and distribution of rents may make presidents less likely to represent under-represented constituencies (like the ones we observe in our data here) than are prime ministers (Baldez & Carey, 1999). Parties are stronger in parliamentary systems, and checks are weaker because parties in presidential systems are not required to organize to form governments. Additionally, the uncertain timing of elections may act to constrain parliamentary leaderships due to the constant threat of no-confidence votes and subsequent dissolution. We note, though, the argument that presidents are elected from a national constituency, providing a direct line of accountability between principal and agent (Lijphart, 1984; Mainwaring, 1995; Shugart, 1999; Cox & Morganstern, 2001; Persson & Tabellini, 2003). We focus on the first rationale, though, in offering two hypotheses: \((H5a)\) Greater provision of water and/or sanitation is positively associated with parliamentary systems; and \((H5b)\) Greater provision of water and/or sanitation is negatively associated with strong presidential systems.
We note that the omitted case here is weak presidential systems—those in which an assembly selects the president; in contrast, in strong presidential systems, the president is directly elected to office. Our data on presidential and parliamentary systems also comes from the Database on Political Institutions (see Appendix).

1.2. Economic attributes

We recognize that other factors may contribute to a country providing access to clean water and sanitation, including a country’s development path. The Porter hypothesis claims that environmental progress can be achieved without sacrificing competitiveness; yet, sustainability is not directly caused by increased GDP (Porter & van der Linde, 1995). Esty & Porter (2001) show that strong environmental performance is positively correlated with competitiveness and national income; they also show that there are dramatic differences in environmental performance among different countries at similar economic levels. Related to this is the debate over whether there is an inverted U-shaped relationship between national income and pollution (Grossman & Krueger, 1995), although evidence for that relationship is limited in large samples and very specific policy outcome measures (Stern, 2004). We assess a simple hypothesis: (H6) Greater provision of water and/or sanitation is positively associated with higher levels of national income. Our data come from the Penn World Tables (Heston et al., 2009), and are measured as per capita GDP (accounting for purchasing power parity). We also calculate the natural log of this measure, due to high skew. The details are presented in the Appendix.

In addition, we assess whether historical development paths affect the provision of these public services: specifically, whether common law and the support of property rights are positively or negatively correlated with access to clean water. Property rights allow for the security of contract and capital, but property rights also lead to rapid economic growth and decreased access to clean water (La Porta et al., 1999; Acemoglu et al., 2000). Our hypothesis is: (H7) English origins are associated with lower levels of access to clean water and/or sanitation. Our data on English origins comes from Acemoglu et al. (2000). We investigate only the impact of English origins (and not the impact of having origins in other countries such as France or Germany) due to the focus in the development literature on this factor.

1.3. Social attributes

Finally, we investigate the impact of three attributes of the organization of society across these countries. Scholars have identified ethnolinguistic fractionalization (ELF) as an important barrier to achieving political and economic stability (Easterly & Levine, 1997; Annet, 2001). High levels of ELF may mean minority groups are under-represented. Our hypothesis is: (H8) Greater provision of water and/or sanitation is negatively associated with higher levels of ELF. Full details on the measurement of ELF are provided in the Appendix. Essentially, higher levels of ELF mean that there is an increasing chance that two randomly drawn individuals will come from different ethnic or linguistic groups.

Clearly, countries with greater income inequality may also provide lower levels of public services like water provision or sanitation to underrepresented communities. It is true that the polarization of ethnic, political, or social groups around the distribution of material wealth may frequently constitute the central issue in national politics (Lichbach, 1989). But we also observe two ways that water access and sanitation are related to income inequality. On one hand, poor access to basic infrastructure has health
consequences that translate into income losses (Leipziger et al., 2003); infrastructure investments may themselves reduce income inequality (Calderon & Serven, 2004). At the same time, lower income inequality may lead to the types of social investment that allow people to claim for greater access to clean drinking water and sanitation services (Torras & Boyce, 1998). We offer the following hypothesis, but recognize that the direction of causality may not be clear: (H9) Greater provision of water and/or sanitation is negatively associated with higher levels of income inequality. We measure income inequality using the Gini coefficient. The “Gini Coefficient” is a commonly used term in the social sciences. It measures “income inequality” (Ray, 1998). The measurement is fully discussed in the Appendix.

Our third variable in this set is the degree to which a country has attained certain technologies in four sectors: the creation of technology, the diffusion of recent innovations, the diffusion of old innovations, and human skills. The question is how well countries create and diffuse technology; it is not a measure of global technology development, but how countries participate in creating and using technology. We offer the simple hypothesis: (H10) Greater provision of water and/or sanitation is negatively associated with higher levels of technology. We discuss issues of causal path below.

Last, we offer a hypothesis about the impact of the size of the country: (H11) Greater provision of water and/or sanitation is negatively associated with land area. This is a simple reflection of the difficulty of extending services in large, spatially-dispersed countries. Our measure is the logarithm of square mileage.

2. Correlations and results

Figure 1 shows the distributions for three ways of looking at disparities in the provision of improved water sources, to: (a) the total population; (b) the rural subpopulation; and (c) the urban subpopulation.

![Graphs showing access to improved water source](https://iwaponline.com/wp/article-pdf/12/S1/155/405680/155.pdf)

Fig. 1. Access to improved water source.
The data shown here in the top two panels of Figure 1 are from 182 countries measured at two time points (2002 and 2004); the third panel includes data from 188 countries, using the United Nations data described earlier.

The countries that scored ‘100’ for the percentage of the total population served by improved water include some expected ones (e.g. Norway, Switzerland, Cyprus), and some perhaps unexpected ones (e.g. Saint Kitts and Nevis, Uruguay, Lebanon). The three lowest scores in the overall population data for this measure are Afghanistan (13%), Ethiopia (22%), and Somalia (29%). The mean percentage for the data shown in the overall population panel is 81.8%, with a standard deviation of 18.8%; Figure 1 shows a clear left skew in the distribution.

The rural population panel (in the middle panel of Figure 1) shows a much thicker left tail for the distribution. The countries that scored ‘100’ for the percentage of the rural population served by improved water again include some expected countries (e.g. Austria, Switzerland, Germany), and some perhaps unexpected countries (e.g. Belarus, Tonga, Niue). The three lowest scores in the overall population data for this measure are Afghanistan (11%), Ethiopia (11%), and Romania (16%). The mean percentage for the data shown in the rural population panel (74.4%), is lower than the overall level reported, with a larger standard deviation of 22.8%; again, Figure 1 shows a stronger left skew in the distribution.

The third panel in Figure 1, the urban subpopulation panel, shows a much thinner left tail in the distribution. The three lowest scores in the overall population data for this measure are Afghanistan (19%), Somalia (32%), and Chad (40%). The mean percentage for the data shown in the overall population panel is much higher than the overall level reported above (91.6%), with a smaller standard deviation of 12.3%. Figure 1 shows that the strong left skew in the distribution comes from the rural subpopulation—that the urban subpopulation in the vast majority of countries is well served by access to improved water. Indeed, the median for the urban subpopulation is 97% covered.

Compare the results in Figure 1 with those in Figure 2, which shows the three populations’ access to improved sanitation. In this case, the left tails of all three distributions are much thicker than those in Figure 1. The average for the overall population is 66.0%, while that for the rural subpopulation is much lower (56.9%) and for the urban one much higher (78.7%). Note, though, that all three measures are lower than that for water provision, indicating that this good is rare across the countries. The three lowest scores in the overall population data for this measure are Ethiopia (6%), Afghanistan (8%), and Chad (8%). The three lowest scores in the urban subpopulation are Congo (14%), Afghanistan (16%), and Ethiopia (19%). The three lowest scores in the rural population data are Congo (2%), Eritrea (3%), and Chad (4%).

Figure 3 shows how these six measures relate to one another. Note that for a number of the relationships we see curvature rather than straight lines (e.g. between rural access to improved water source and urban access), indicating that one is attained at a much faster speed than the other. Others show strong clustering (e.g. between urban access to improved water source and urban access to improved sanitation), suggesting that water access is attained at a much more uniform level than sanitation is. All of the panels show upward-sloping relationships, which means that there are no overt tradeoffs: one never has to expressly choose between one service and the other.

We next turn to assessing the relationships described above in the discussion of our individual hypotheses. We first discuss the evidence about the role of the regulatory environment by showing a graphical representation of the relationship and then assessing early statistical evidence. Figure 4 shows a scatterplot matrix for the case of the improved access to water sources (measured for our three
Fig. 2. Access to improved sanitation.

Fig. 3. Relationships between disparities.
different populations); Table 1 shows the correlations. The scatterplot matrix suggests a positive relationship, and the estimated correlations are 0.549 (rural water) and 0.505 (urban water) (overall water is omitted since the measure is itself a blend of the two subpopulations). Figure 5 shows a graph for sanitation, and Table 1 shows the estimated correlations to be roughly the same as that for water. On the face of it, this appears to provide evidence that water and sanitation outcomes are positively related to perceptions of the quality of the regulatory regime across a wide array of countries.

In contrast, Figures 4 and 5 show slightly upward-sloping but noticeably more diffuse relationships between democratization and our six dependent variables. Table 1 shows correlations in the 0.30–0.40 range, suggesting a weaker relationship between these outcomes and democratization. In some ways, it is useful to note any relationship here, but the contrast with regulatory quality remains important.

We next review the relationships between our measures of access to water and sanitation and our remaining political institutional variables. Figures 6 and 7 show side-by-side boxplots of the distributions for each of our six dependent variables; each variable (rural, urban, and overall, all for water and sanitation) is shown for two conditions: with and without strong federalism. The simple inference is that the median percentage for overall population access to improved water is higher in federal systems; it is also higher in the case of the rural subpopulation, but does not seem higher for the urban subpopulation. Table 2 shows difference-in-means tests for these six variables given the
treatment condition of federalism; all tests account for unequal variances by calculating Satterthwaite’s degrees of freedom for the test (Satterthwaite, 1946). Table 2 shows a higher expected mean in the case of the rural subpopulation in the strong federalism condition (by 13.1 percentage points); the urban population mean percentage is expected to be 4.7 points higher. The impact of federalism appears

Table 1. Correlations.

<table>
<thead>
<tr>
<th></th>
<th>Rural improved sanitation</th>
<th>Rural improved water supply</th>
<th>Urban improved sanitation</th>
<th>Urban improved water supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulatory quality</td>
<td>0.555*</td>
<td>0.549*</td>
<td>0.531*</td>
<td>0.505*</td>
</tr>
<tr>
<td>Democracy</td>
<td>0.343*</td>
<td>0.374*</td>
<td>0.291*</td>
<td>0.325*</td>
</tr>
<tr>
<td>ELF</td>
<td>-0.280*</td>
<td>-0.280*</td>
<td>-0.376*</td>
<td>-0.252*</td>
</tr>
<tr>
<td>GINI</td>
<td>-0.399*</td>
<td>-0.436*</td>
<td>-0.387*</td>
<td>-0.242*</td>
</tr>
<tr>
<td>Land area</td>
<td>-0.190*</td>
<td>-0.236*</td>
<td>-0.166*</td>
<td>-0.090†</td>
</tr>
<tr>
<td>Technological ach.</td>
<td>0.744*</td>
<td>0.645*</td>
<td>0.713*</td>
<td>0.642*</td>
</tr>
<tr>
<td>Ln GDP per capita</td>
<td>0.754*</td>
<td>0.706*</td>
<td>0.743*</td>
<td>0.570*</td>
</tr>
</tbody>
</table>

* Indicates significance at better than 0.001.
† Indicates significance at better than 0.05.

Fig. 5. Relationships between disparities in access to improved sanitation and potential causes.
higher in the case of removing rural disparities than urban ones. Figure 7 shows the estimated differences in the case of sanitation, with rural differences even greater in the case of strong federalism; urban means are also expected to be higher, but that difference is not estimated to be statistically significant.

Figures 8 and 9 show the results for PR’s effects; Table 2 shows the difference-in-means tests. The Figures show higher medians in the treatment condition, although the tests show significant differences.
differences only for water supply and rural improved sanitation. There appears to be some evidence that PR’s representation system spreads some benefits to underserved populations.

Figures 10 and 11 show the results for having a parliamentary system; Figures 12 and 13 show the results of having a strong presidential system. Table 2 shows the difference-in-means tests. The Figures show higher medians in the treatment condition for parliaments, and roughly the same reduction in medians for having a strong presidential system. The tests show significant differences for all subpopulations and for both water supply and improved sanitation. This provides a measure of evidence that parliamentary systems provide greater access to water and sanitation when compared to presidential systems. Note that the real gains are in the cases of rural subpopulations.

Table 2. Difference of means tests.

<table>
<thead>
<tr>
<th></th>
<th>Rural improved sanitation</th>
<th>Rural improved water supply</th>
<th>Urban improved sanitation</th>
<th>Urban improved water supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>English origins</td>
<td>5.596</td>
<td>4.229</td>
<td>2.425</td>
<td>0.646</td>
</tr>
<tr>
<td>PR</td>
<td>4.390</td>
<td>4.960*</td>
<td>5.471†</td>
<td>3.401†</td>
</tr>
<tr>
<td>Parliamentary</td>
<td>21.461‡</td>
<td>14.731‡</td>
<td>13.020‡</td>
<td>6.230‡</td>
</tr>
<tr>
<td>Presidential</td>
<td>□ 20.747‡</td>
<td>□ 18.067‡</td>
<td>□ 12.480‡</td>
<td>□ 4.977‡</td>
</tr>
<tr>
<td>Federalism</td>
<td>□ 13.095‡</td>
<td>8.148*</td>
<td>10.275</td>
<td>4.732‡</td>
</tr>
</tbody>
</table>

* Indicates significance at better than 0.05 (two-tailed test).
† Indicates significance at better than 0.01 (two-tailed test).
‡ Indicates significance at better than 0.001 (two-tailed test).

Does this mean that political institutions and outputs are the most important drivers of access to clean water and improved sanitation? In contrast, Figures 4 and 5 show a fairly strong upward-sloping relationship between GDP and access to water and sanitation. The estimated correlations reported in Table 1 range between 0.57 and 0.76, indicating strong associations. The effects of our second

![Fig. 8. Disparities in access to water, by PR.](https://iwaponline.com/wp/article-pdf/12/S1/155/405680/155.pdf)
‘development path’ variable, English origins, are shown in Figures 14 and 15. The graphs indicate no significant differences, although the difference-in-means tests in Table 2 show slight positive (but not statistically significant) impact. In general, though, GDP seems to be a strong and important predictor of the degree to which countries mitigate urban and rural disparities in clean water and sanitation provision.

There are no clear relationships shown for ELF, Gini, or land area in Figures 4 and 5, though Table 1 provides useful evidence through estimated correlations. Land area has small negative impact, but both ELF and Gini have moderate negative effects (as predicted). Again, though, the magnitude of the

Fig. 9. Disparities in sanitation, by PR.

Fig. 10. Disparities in access to water, by parliamentary system.
correlations is small. In contrast, the effect of technological attainment is shown fairly clearly, in Figures 4 and 5, as virtually a straight line. The estimated impacts are well within the range of the correlations estimated for GDP.

Are these results robust to multivariate analyses? Those analyses, which are not presented here due to space limitations, provide useful guides for interpreting the results shown above. The key findings are as follows.

Fig. 11. Disparities in sanitation, by parliamentary system.

Fig. 12. Disparities in access to water, by strong presidential system.
First, it is not possible to disentangle the impact of technology and GDP; estimating the two simultaneously causes collinearity, which suggests that we have to choose between these two explanations on theoretical grounds rather than on estimates drawn from these global data. The best guess is that technology is an antecedent to economic growth, and so should be omitted from the causal mechanism; its absence is a better way of deciding its impact on access to water and sanitation.

Second, in a multivariate model, GDP is a strong, positive predictor of access to water and sanitation. For example, increasing GDP from the minimum value to the maximum value increases the percentage of the overall population with access to improved water sources by 56%; it increases the percentage of...
the rural population with access by 60%. It increases the percentage of the rural population with access to improved sanitation by 88%. Improved economic development improves access to clean water and sanitation.

Perceptions of regulatory quality are not a robust predictor of access, probably because its effects are entangled with that of economic development (although its direct effects can be independently estimated). In the case of water quality, English origins provide an 8 percentage point boost in access to water (but only for rural populations). No other mechanisms have robust associations in the case of clean water access.

In the case of access to improved sanitation, the only additional robust association is the impact of democratization. Democracies are more likely to provide improved sanitation services, especially so for rural populations, but for urban ones too. Moving from the lowest level of democratization to the highest levels still does not have the impact of economic development: it only produces a 17 point increase in the percentage of the rural population with access to improved sanitation, and half that in the case of the urban subpopulation. Along with economic development, though, democratization represents one of the few mechanisms explored in this paper with demonstrable effects on these disparities.

3. Discussion

The purpose of this paper is to explore several possible foundations for access to clean water and improved sanitation. We offer an investigation of these foundations using data on access to improved water and sanitation, as measured across countries with varying geography, development patterns, social customs, and political arrangements. We test hypotheses and investigate the impact of attributes of political regimes, such as the presence of parliamentary and presidential systems, representation systems like proportional representation, and the presence of federalism; we also assess the extent to which democratization increases access to water and sanitation.
We provide some evidence (as other recent studies also do) that democratization causes nation-states to shift patterns of providing and preserving social benefits. Specifically, democracy is correlated with improved sanitation in rural areas and in urban areas, and also with improved water supplies in rural and urban areas; all correlations are significant at the 0.001 level. Our final measure of the shape of the political regime is the extent to which the country is perceived as having a high-quality regulatory regime; we do not find robust evidence that regulatory quality improves access. While in the raw correlations the degree of regulatory quality is correlated with improvements in both sanitation and water supplies in both rural and urban areas, and those correlations are significant at the 0.001 level, we have less faith in these findings since they are not robust to inclusion in a multivariate regression model.

Our primary finding is that economic development, specifically the roles of a country’s level of wealth (measured as per capita Gross Domestic Product), builds the foundation on which countries can expand service provision. The correlations between GDP with improved water supplies and sanitation in rural and urban areas are significant at the 0.001 level; they are also sizeable, ranging from 0.570 to 0.754. There is some evidence that the historical development path (whether the country’s legal system has English origins), plays a direct role here, but it is likely that the role is really indirect: that English origins support broader economic development, which then filters down to subpopulations through expanded access. Though none of these findings are significant in the case of the t-tests, the multivariate model gives us some hope that English origins provides a better platform for improving access to water supplies and sanitation, though that effect is probably very small. The broadest and most important effect in terms of impact remains GDP.

4. Conclusion

This paper is a preliminary venture, and its findings are therefore tentative. More in-depth investigations need to take place before a basic multivariate model can be found. Nonetheless, we believe that the gap in the literature on safe water access and sanitation—that no known papers address the impact of these political, economic, and social attributes on water scarcity—puts policymakers in a tough position when deciding about mechanisms to pursue this sort of social development. Access to safe drinking water and sanitation now stand among key known hazards or barriers that block communities from moving out of poverty and low levels of development. Our paper shows that the reverse may be true: that the key lever to be pulled is economic development for countries who want to supply access to water. This finding has important practical implications. Our battery of univariate tests reveals a strong correlation between GDP and access to improved water or sanitation in either rural or urban areas. The size of the correlations suggests that there is only small room for movement: 75% of the variance in sanitation (in either urban or rural areas) is associated with GDP; 70% of the variance in rural improved water supply is associated with GDP. However, we find that much less is associated with GDP in the case of improved urban water supply. This finding is very useful, because it gives credence to other studies, some of which are offered in this volume, that show the importance of mechanism design for providing these kinds of public goods. It is in this subset of situations—urban areas, in the case of water supplies—that there is a lot of room to expand service provision. The findings offered here suggest much more limited opportunities in the other areas of service provision.
References


A. Appendix

This appendix describes variables collected for the countries included in this study. Much of our data was generated by projects at the World Bank: The Database on Political Institutions (DPI) and the Governance Matters database. The former offers cross-country data chronicling the political institutions of 177 states whereas the latter measures perceptions of governance in 213 states. The data stem from work performed by Beck et al. (2001) and Kaufman et al. (2003). The variables we employ are catalogued below. The DPI was updated in 2008. The data are available at: http://econ.worldbank.org/WEBSITE/EXTERNAL/EXTDEC/EXTRERESearch/0,,contentMDK:20649465~pagePK:64214825~piPK:64214943~theSitePK:469382,00.html

A.1. Proportional representation (PR)

This variable describes whether a state uses proportional representation to elect all or a portion of its legislators. A political system is coded ‘1’ if either chamber of the legislature is elected based on the percentage of votes received by their party and/or if Beck et al. (2001)’s sources specifically refer to the system in question as ‘proportional.’ The state is coded ‘0’ if these conditions do not apply. N/A is recorded if the Legislative Index of Electoral Competitiveness for the country is 4 or lower, meaning that there is competition for seats, albeit in a one-party system (Source: Beck et al., 2001).

A.2. Parliamentary or presidential systems

This variable designates political systems as either presidential, assembly-elected presidential or parliamentary. The system is coded presidential (0) if a single executive is elected by popular vote. Additionally, a system is coded presidential if the chief executive is elected by an assembly and can only be recalled by a two-thirds vote or dissolution of the assembly. The system is coded ‘1’ if the assembly elects, but cannot recall, the chief executive. Finally, in cases where both a president and prime minister exist, a system is deemed presidential only after passing a three-part test. First, the president must be able to veto legislation while the parliament may only override if it possesses a supermajority. Second, the president must be allowed to appoint and dismiss cabinet ministers (including the PM) and to dissolve parliament. Third, Beck et al. (2001) classify a system as presidential (0) if the available data does not clarify the executive’s abilities on the first two counts, yet Beck et al. (2001)’s sources still refer to the president as the key decision-maker. The system is coded as parliamentary (2) if the preceding conditions do not hold. We distinguish between systems with fully independent presidents (1) and others, including parliamentary systems and those where the assembly names the president (Source: Beck et al., 2001).

A.3. Polity

The Polity variable consists of a score assigned to each country based on the level of democracy vs autocracy within its political system. These distinctions are based on the general ‘openness’ or
‘closedness’ of political institutions, as determined by Polity IV scholars through examination of numerous indicators such as the constraints on the chief executive, the regulation and competitiveness of participation, the openness of executive recruitment, etc. Scores are generated by subtracting aggregate ‘autocracy’ from ‘democracy’ to create a range of $-10$ to $10$ with $10$ being the most democratic and $-10$ the most autocratic (Polity IV data set developed by Gurr et al., 2005).

A.4. Ln (Natural Logarithm) GDP per capita

This variable records the natural log of each state’s per capita Gross Domestic Product for each year in the database. GDP per capita is in 2000 US dollars and is adjusted for purchasing power parity (Source: Penn World Tables (Heston et al., 2009)).

A.5. Federalism

This variable describes whether the state or provincial governments are locally elected. The measure records a zero if neither the local executive nor the local legislature is directly elected by the population they govern. The data point is coded as a ‘1’, however, if either is directly elected and the other is indirectly elected. Finally, a score of ‘2’ for this variable signifies that both local executive and legislature are directly elected. Finally, in cases where multiple tiers of sub-national government exist, Beck et al. (2001) consider the highest level to be the state/provincial level. We only code those with a score of ‘2’ as being a strongly federal system (Source: Beck et al., 2001).

A.6. Ethnolinguistic fractionalization (ELF)

Our ELF data are an average of three indices created by Philip Roeder (2001). One index calculates scores with subgroup data, where available (e.g. Ute, Blackfoot, Crow vs the catch-all ‘indigenous’), another excludes racial distinctions among groups that do not dramatically alter linguistic/cultural patterns (e.g. black and white Americans). A third classifies racially distinct sub-groups as independent of one another regardless of their linguistic similarity. The scores generated are a fraction and represent the chance that two random draws will produce individuals from different ethnolinguistic groups (Source: ELF Indices, 1961 and 1985 (Roeder, 2001)).

A.7. English origins

An English origin dummy variable is generated to reflect legal attributes such as judicial vs legislative precedent, rights to private property, and the general rights of the individual relative to the state. As the literature identifies the impact these aspects of a legal system have on institutional performance, we feel it appropriate to include them in our model regarding the control of corruption. In general, English legal systems are coded as ‘1’ for former colonies and all others are coded as zero, in keeping with La Porta et al. (1997)’s data on the subject (Source: La Porta et al., 1997).
A.8. Income inequality

The Gini index measures the level of income inequality within society and is recorded as a number between ‘0’ and ‘1’, where ‘0’ describes perfect equality (everyone has identical income) and ‘1’ refers to perfect inequality (one person earns all income while all others earn nothing). If the area between the line of perfect equality and the Lorenz curve is \( A \), and the area underneath the Lorenz curve is \( B \), the Gini coefficient is \( \frac{A}{A + B} \). “Lorenz curve” is a commonly used term in the social sciences. It measures “wealth concentration” (Lorenz, 1905). This is expressed in our data as the numerical equivalent of this percentage, which is always between 0 and 100 (Source: World Income Inequality Database V 2.0a: United Nations University – World Institute for Development Economics Research (WIDER), 2005).

A.9. Regulatory quality

Our variable is from the World Bank’s Governance Matters data collection, which includes multiple year measures for six primary areas of governance in almost 200 countries. These ‘benchmarks’ are meant to illuminate the core themes that contribute to economic growth across disparate countries and across time. The six indicators are: Voice and Accountability, Political Stability and Lack of Violence, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. Since 1996, multinational organizations have used these measures to study the key themes in governance and the ways citizens react to the state and its behaviour.

Variables are constructed by estimating a measurement model that summarizes data provided by 17 different organizations. We employ data collected in 2002 and 2004. Our focus is the regulatory quality dimension that ‘includes measures of the incidence of market-unfriendly policies such as price controls or inadequate bank supervision, as well as perceptions of the burdens imposed by excessive regulation in areas such as foreign trade and business development’ (Kaufman et al., 2003).

A.10. Technological achievement

We use the Technology Achievement Index for the United Nations Human Development Report (UNDP, 2001), which uses multiple indicators for the level of technology in four sectors: the creation of technology, the diffusion of recent innovations, the diffusion of old innovations, and human skills. High scores for the index indicate high levels of technology in the nation. Generally, the index tries to capture how well countries create and diffuse technology; it is not a measure of global technology development, but how countries participate in creating and using technology. The hallmarks of this index are that it condenses a broad range of technological achievements into a single comparable metric, and that it is heavily weighted towards the role of information. As noted above, the incidence of voluntary commitments is thought to hinge in part on the role of information and access to information.