The Persistent Impact of Electoral Incentives on the Quality of Infrastructure*

Daniel Rogger and Ravi Somani†

March 2021

Abstract

What determines the quality of a nation's infrastructure? We show that electoral incentives at the time of construction have persistent effects on the functionality of contemporary African water systems. We apply a common regression discontinuity approach to the universe of water points in Nigeria, Sierra Leone, and Tanzania built over the period from 1970-2014. Across all three settings, we find that infrastructure installed in the run-up to an election is significantly more likely to be functioning today than those installed shortly after elections. Our results suggest that politicians respond to electoral incentives by adjusting the technology and provider of installed water systems. Together, the findings suggest that public officials optimally respond to responsive but myopic citizen evaluations of public performance.

Keywords: Public infrastructure; water resources; water access; elections; electoral cycles

*We gratefully acknowledge financial support from World Bank's Development Impact Evaluation i2i fund, Bureaucracy Lab and Governance Global Practice. We are grateful to Sam Asher, Aidan Coville, Paul Christian, Jonathan Phillips, Caio Piza, Ruben Poblete Cazenave and Stéphane Straub for helpful comments. We would like to thank Paula von Gablenz and Thomas Adler for excellent research assistance, Laura Chioda for providing us with relevant elevation data, and seminar participants at the World Bank for their comments. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

1 Introduction

What determines the quality of a nation's infrastructure? Recent studies highlight a range of long-run factors from geography [Duflo and Pande, 2007], through institutions [Kremer et al., 2011; McRae, 2015; Cao, 2020], to the role of ethnic identity [Burgess et al., 2015]. In this paper we provide evidence of the persistent impact of public officials' short-term electoral incentives on long-run infrastructure development. We find that local African water systems installed in the run-up to elections are significantly more likely to be functioning today than those installed shortly after elections.[1] Given the persistent nature of water infrastructure and its link to citizen welfare, we document a mechanism linking short-run electoral incentives to long-run welfare outcomes.

This question matters because of the welfare impacts of quality infrastructure and its long-term consequences for development and growth [Munnell, 1992; Kessides, 1993; Lipscomb, Mobarak and Barham, 2013; Akerman, Gaarder and Mogstad, 2015; Allcott, Collard-Wexler and O'Connell, 2016; Donaldson and Hornbeck, 2016; Jedwab and Moradi, 2016; Baum-Snow et al., 2017; Donaldson, 2018; Baqaee and Farhi, 2019; Banerjee, Duflo and Qian, 2020]. Our findings are relevant to the broad class of current public investments that determine the long-term production possibility frontier of an economy.[2] Short-term political incentives can lock an economy into an inferior long-term path of development.

Given the significance of quality infrastructure for welfare, citizens rationally respond to its perceived delivery by public officials. Existing studies find that citizens electorally reward public officials for improvements in local indicators of development.[3] In turn, core models of political economy predict that

[1] By 'water systems' we refer to surface water resources; protected and unprotected springs; protected and unprotected wells; tube wells; and boreholes; which make up the majority of available water resources for households in the contexts we study. Illustrative photographs of these systems are provided in the Appendix.

[2] Such investments might include a wide range of infrastructure-, education-, health-, and agriculture-related interventions. Undertaking actions that lower the transition rate from primary to secondary, for example, will have persistent impacts on the level of education in the country since such students rarely return to school.

[3] There is evidence that citizens reward public officials for delivering economic growth [Key et al., 1966; Fiorina, 1978]; cash transfers [Manacorda, Miguel and Vigorito, 2011; Galiani et al., 2016; Evans, Holtemeyer and Kosec, 2019]; public services [Dionne and

public officials will rationally respond to citizens' preferences and public-accountability mechanisms, such as elections, by providing public services in ways that are most likely to lead to electoral success [Besley and Coate, 1997; Besley and Burgess, 2002; Besley and Persson, 2009, 2011]. As a simple model in section 2 implies, voter myopia limits the disciplining effects of elections to a subset of years in a public official's term. The model predicts variation in the quality of public investments over the election cycle, with the incentive for quality investments highest just before elections and lowest just after.

Our results indicate that the electoral incentives for public officials do indeed vary across the political cycle [Nordhaus, 1975; Brender and Drazen, 2005; Eslava, 2011; Bonfiglioli and Gancia, 2013]. We find that water systems installed immediately after an election are 5, 6 and 9 percentage-points less likely to be functioning today relative to those installed just before an election in Nigeria, Tanzania and Sierra Leone respectively. This translates to an approximate decrease in the number of present-day functional water systems relative to the pre-election trend of 2,670, 3,000 and 1,510 in Nigeria, Tanzania, and Sierra Leone, with important consequences for water access. Our data suggests that the poorer quality infrastructure implemented immediately after an election translates into a loss of water access today for approximately 5m citizens in Nigeria; 2.3m in Tanzania; and 650,000 in Sierra Leone. We find no consistent empirical evidence across the three contexts that this decrease in quality is traded off against increases in quantity.

Our identification strategy isolates periods close to elections to identify the effects of past elections on present-day water resources, following Daniele and Dipoppa [2017] and Alesina, Piccolo and Pinotti [2019]. We control for flexible time trends to account for deterioration over time and other features of the water resource that may determine functionality, such as whether the point was constructed by a public or private contractor. We also control for characteristics of the district, such as demographic and geographic factors that may interact with the provision and maintenance of water resources in a common way across countries.[4] We do so in a common way across the three countries we study.

Horowitz, 2016; Guiteras and Mobarak, 2015; Fried and Venkataramani, 2017; Chukwuma, Bossert and Croke, 2019]; and even after they receive random shocks to their income [Bagues and Esteve-Volart, 2016; Liberini, Redoano and Proto, 2017].

[4] Our use of the term 'district' refers to the second official administrative level consistent with ISO-3166-2.

Our interpretation of these results are that public officials optimally respond to responsive but myopic citizen evaluations of public performance [Khemani, 2004]. Water systems implemented shortly before an election are simply better constructed, resulting in more durable structures more likely to be functional - in the sense of producing potable water - today. Voters weight the quality of infrastructure development closer to elections more heavily than that built early on in the election cycle. Recent evidence has shown that citizens overweight the recent past and exhibit myopic responses to public-sector performance [Gerber et al., 2011; Healy and Malhotra, 2013; Healy and Lenz, 2014; Achen and Bartels, 2017; Croke, Forthcoming].

When incentives to respond to voter myopia lead to short-term fluctuations in services, the wider welfare implications are limited to the experience of current citizens.[5] However, when it comes to investments in public infrastructure, short-term responses by public officials can have lasting effects on fundamental development indicators [Crain and Oakley, 1995; Calderón and Servén, 2010, 2004; Munnell, 1992; Calderón and Servén, 2014; Burgess et al., 2015]. Our paper provides some of the first empirical evidence of the persistent impacts of electoral incentives on the quality of infrastructure, a mechanism for long-term effects of short-term electoral concerns.

To investigate potential mechanisms, we explore features of those water systems constructed before and after elections. We find suggestive evidence that water systems constructed immediately after an election are less likely to be motorized or piped, implying that public officials respond to electoral incentives by adjusting the technology of public goods. We also find that politicians switch to public providers of water resources shortly after an election. We find no consistent or significant evidence that public officials increase the rate of installation, responding on the extensive margin, or change the location of water points, focusing on more dense or low-cost areas in response to elections. Thus, to sway voters before an election, public officials increase the technological capacity of the water points they install and outsource implementation to more capable but independent private sector actors.

An important alternative explanation for our results is that of political and

[5] Such as in the short-term distribution of bed nets [Croke, Forthcoming]; cash transfers [Manacorda, Miguel and Vigorito, 2011; Galiani et al., 2016; Evans, Holtemeyer and Kosec, 2019]; and agricultural subsidies and credit [Cole, 2009; Dionne and Horowitz, 2016].

administrative disruption shortly after an election. We remove observations that fall during the year of the election to ensure that installations are accurately assigned to before or after the election and to minimize the contribution of administrative disruption to our main results. We also interact our main specification with measures of political and administrative disruption, geographical features and conflict, to rule out disruption related to elections as plausible mechanisms.

The external validity of these findings is a core focus of our research design. We undertake the same empirical strategy in three different countries in sub-Saharan Africa. Our paper exploits common approaches to data collection on water infrastructure and coherent electoral institutions across three distinct socio-economic environments. We use data on the recent status and technology of the universe of local water systems in Nigeria, Sierra Leone, and Tanzania, covering the set of water resources that have ever been built, including those that have now failed. We combine this data with the history of elections in each country, covering 1970 to 2014.[6] We then use the same regression-discontinuity-design framework across the three contexts to identify the effect of past elections on the present-day functionality, technology, and construction of water resources. Our approach is thus similar to Easterly, Levine and Roodman [2004], Bowers et al. [2017], Ashraf et al. [2020], Corno, Hildebrandt and Voena [2020] and Bau [forthcoming] in bringing replicability across settings to the heart of our research design.

Research replicability is an increasingly active discussion among scholars in economics and across the social sciences [Hamermesh, 2007; Bohannon, 2016; Clemens, 2017; Christensen and Miguel, 2018]. Our analysis amounts to a *scientific replication* [Hamermesh, 2007] or *robustness extension* [Clemens, 2017] across the three different contexts. Our multi-country approach allows us to explore the extent to which our findings are unique to a single polity or ubiquitous across settings. Hamermesh [2007] states that for economics, "the more important type of replication is not like that of the 'hard-scientific' research, but rather in the only sensible way for a social science – by testing the fundamental idea or construct in a different social context."

This paper is among some of the first scientific replications in the field of micro-empirical political economy [Bau, forthcoming; Ashraf et al., 2020;

[6] Our data covers 1970-2014 for Nigeria; 2002-2012 for Sierra Leone; 1970-2009 for Tanzania.

Corno, Hildebrandt and Voena, 2020; Amodio, Chiovelli and Hohmann, 2019; Michalopoulos and Papaioannou, 2016]. Replicating findings within this nascent literature is especially valuable because: (i) each individual study is nearly always limited to a relatively small number of polities and public organizations; and, (ii) establishing robust findings across similar and distinct contexts helps underpin the external validity of any given study, moving the knowledge frontier closer to establishing stylized facts. While our primary objective is to assess the potential for heterogeneous effects across these different socio-economic and political contexts, we also take advantage of the additional gains to inference by combining the observations across the contexts and reporting the results of pooled regressions. The results from the pooled regressions show that water systems installed immediately after an election, across the three contexts, are 5 percentage-points less likely to be functioning today relative to those installed just before an election ($p = 0.000$).

This paper continues as follows. Section 2 outlines a simple model of myopic politics through which we interpret our results. Section 3 describes the context and data. In section 4, we present our results and investigate potential mechanisms. Section 5 concludes.

2 A Simple Model of Myopic Politics

The public official has a budget B to spend every period, which they can allocate between public goods (g_t) and private consumption ($c_t = B - g_t$).[7] Allocating more resources to private consumption induces a current-period 'accountability' cost k_{gt} that increases linearly with c_t and may contribute to a lower re-election probability (p_t which is a function of g_t). k_{gt} may vary over the electoral cycle if citizens evaluate the performance of public officials myopically, focusing on a subset of a public official's term.

The utility of the public official at time t is equal to the utility from delivering the public good ($u_g g_t$), plus the utility from private consumption ($u_c \cdot (B - g_t)$), minus the current period cost of diverting funds ($k_t \cdot (B - g_t)$), plus the utility from staying in office tomorrow if they remain in power with probability p_t. For simplicity, we assume that the contemporaneous utility from private

[7] We use private consumption for simplicity but the model applies to any alternative allocation that requires less effort by the public official and is less attractive to voters.

and public consumption enter additively, that the future value to the public official is zero if they are not elected, and that p_t is decreasing and concave in g_t: $p' < 0, p'' < 0$. Supposing the public official lives for two periods, discounts with factor β, and receives a terminal utility of T, the utility of the public official is:

$$\begin{aligned} V_t^p &= u_g g_t + u_c \cdot (B - g_t) - k_t \cdot (B - g_t) + \beta p_t V_{t+1}^p \\ &= u_g g_t + u_c \cdot (B - g_t) - k_t \cdot (B - g_t) + \beta p(g_t) T \end{aligned} \tag{1}$$

The optimal choice of g_t is found by differentiating (1) with respect to g_t:

$$p'(g_t^*) = \frac{u_c - u_g - k_t}{\beta T} \tag{2}$$

To reflect the possibility that citizens pay greater attention to the performance of public officials closer to election time, we let $k_t = \delta(\tau)$, where τ refers to the number of years before the next election, $1 < \tau < L$, where L is the term limit, and $0 < \delta(\tau) < 1$. For example, let $p(g_t)$ take the form of a standard quadratic cost function $-\frac{g_t^2}{2}$, then 2 becomes $g_t^* = \frac{k_t + u_g - u_c}{\beta T}$. The optimal level of public goods is then $g_t^* = \frac{\delta(\tau) + u_g - u_c}{\beta T}$. The level of public goods is $\frac{\delta + u_g - u_c}{\beta T}$ in the year just before the election, is $\frac{\delta^2 + u_g - u_c}{\beta T}$ 2 years before the election, and is $\frac{\delta^L + u_g - u_c}{\beta T}$ in the year just after the election. In this case, the level of public goods decreases discontinuously from $\frac{\delta + u_g - u_c}{\beta T}$ to $\frac{\delta^L + u_g - u_c}{\beta T}$ just after the election. This is illustrated in Figure A1.

Therefore, in settings in which elections are the dominant political accountability mechanism and where citizens demonstrate myopic preferences over the performance of public officials, we would expect to observe a discontinuity in the nature of public investments around election year. We now turn to investigating this possibility empirically.[8]

[8] We do not specify in the theoretical framework whether an increase in g reflects changes in technology, increases in quantity, or improved quality, but investigate these margins empirically.

3 Context and Data

3.1 Institutional Background

We study the interaction between the quality of water infrastructure and electoral incentives across three different sub-Saharan African contexts: Nigeria, Sierra Leone, and Tanzania.

These countries exhibit substantial variation in socio-economic characteristics. The countries differ in terms of: average income - GDP per capita adjusted for purchasing power parity is around USD5,300 in Nigeria, USD1,800 in Sierra Leone and USD2,770 in Tanzania; population - respectively 200 million, 7.7 million, and 56 million; and land area - respectively 910,000 square-kilometres, 72,000 square-kilometres, and 885,000 square-kilometres.[9] These populations vary in density across districts and in their ethnic and linguistic affiliations. Nigeria operates as a federal state, while Sierra Leone and Tanzania operate as unitary states. Thus, along with having distinct historical and cultural backgrounds, the social and geographic features of the three countries we study vary in meaningful ways for the operation of water-supply systems.

In terms of measures of government effectiveness, the contexts are more homogeneous. The Worldwide Governance Indicators currently ranks Nigeria at the 13th percentile for government effectiveness, Sierra Leone also at the 13th percentile, and Tanzania at the 17th percentile. The Corruptions Perception Index published by Transparency International gives a score (rank) of 26 (146) to Nigeria; 33 (119) to Sierra Leone; and 37 (96) to Tanzania. This implies a relatively comparable capacity to manage water infrastructure operations across our study settings, but also a limitation on the external validity of our findings to contexts with ratings on these margins.

3.1.1 Water Access and Supply

Importantly for this paper, Nigeria, Sierra Leone and Tanzania all exhibit low levels of water stress, measured as the percentage of total renewable supply made up by a country's total freshwater withdrawals. Compared with other regions, sub-Saharan Africa does not withdraw a large fraction of

[9] Sources for all statistics quoted in the paper and further details on our core data sources are outlined in an online technical appendix.

its available freshwater. Water stress is 7.5% in Tanzania, 5.8% in Nigeria and 0.18% in Sierra Leone, which are low by global standards. Though there exists variation across the districts we study, water is generally available for withdrawal if the appropriate infrastructure can be put in place to extract it.

Across our three settings, roughly a third of households do not have access to an improved water source (34% in Nigeria, and 39% in Sierra Leone and Tanzania). Those who do have access to improved water supplies typically source it from small-scale water systems such as those studied in this paper. For example, in Nigeria the most prevalent improved sources of water are tube wells or boreholes (37%), protected dug wells or springs (12%), and public taps/standpipes (8%). The issue of unsafe water is a core concern in all three contexts; 7.3% of all deaths in Nigeria are linked to unsafe water; 5.7% in Sierra Leone; and 7.5% in Tanzania.

Non-functional water systems impact the set of consumption and investment possibilities available in current and future periods for both citizens and governments. Individuals without ready access to water have worse health outcomes [Kremer et al., 2011; Dupas et al., 2020]; less time for activities outside water collection [Devoto et al., 2012; Meeks, 2017]; and lower incomes [Munnell, 1992; Meeks, 2017].[10] These consequences, in turn, impede individuals' capacity for productive activities.

3.1.2 Political Regimes

The countries we study currently sit right in the middle of the 2019 Democracy Index [The Economist Intelligence Unit, 2019]. The Index classifies all three countries as Hybrid Regimes, which are partially democratic and partially authoritarian. The overall score in Nigeria is 4.12 (ranking 109); in Sierra Leone 4.86 (ranking 102); and in Tanzania 5.15 (ranking 95). For some benchmarks, the highest overall score in the index is Norway (9.87);

[10] Meeks [2017] finds that new water infrastructure in Kyrgyzstan leads to a 30% decrease in the use of unprotected water sources and an average saving of 170 minutes per day, translating into a net present value of USD123 million. Kremer et al. [2011] finds that infrastructure investments in springs in Kenya lead to a substantial increase in water quality and a 25% reduction in child diarrhea, valued at around USD3 per household. Devoto et al. [2012] shows that households have a high willingness to pay for private water connections when they have access to credit and save around 82 minutes per day as a result.

the USA has a score of 7.96; and, the lowest overall score is for North Korea (1.08). The political landscape in Tanzania is dominated by a single party, whereas in Sierra Leone and Nigeria, two parties dominate elections. There are no term limits for the elections that we study (the House of Representatives in Nigeria, Parliamentary elections in Sierra Leone, and the National Assembly in Tanzania).

Using data from The Polity Project, we observe that the countries experience noticeably different trends in polity scores over the sample period [Center for Systemic Peace, 2020]. Tanzania is relatively stable reflecting its long history as a one-party state, staying at between -6 and -5 from 1970 to 1994, after which the score reaches -1 until 2010. Nigeria experiences large fluctuations in the polity score, with a score of -7 in 1970, rising to +7 until 1984, then falling to between -5 and -7 until 1998, after which there is a steady increase to 4 until 2013. These scores reflect Nigeria's transitions from democracy to and from varieties of autocracy. Sierra Leone experiences relative stability in the polity environment at between 5 and 7 from 2002 to 2012. As such, our analysis covers variation in the strength of democracy as well as geographic variation, extending the settings in which we test our core hypothesis.

3.1.3 Electoral Institutions

In contrast, the electoral institutions across the three contexts that we study have important commonalities that allow for an identical empirical strategy. Given our focus on local water infrastructure systems, we focus on elections corresponding to those officials with most substantive influence over the provision of water resources during the period we study. These are the set of politicians most responsive to local infrastructure delivery needs in the water sector [World Bank, 1999; The Water and Sanitation Program, 2011*a*,*b*,*c*; Romeo and Smoke, 2015; Croke, Forthcoming].

Legislative elections in Nigeria comprise elections for the House of Representatives, which take place every 4 years. The House of Representatives consists of 360 members for single-seat constituencies. Council elections in Sierra Leone consist of 394 multi-member wards. Elections take place every 5 years. In Tanzania, members of the National Assembly are elected every 4 years. The National Assembly consists of 357 seats, 239 of which are through direct popular vote; 102 of which are reserved for women elected by their political party; 5 of which are indirectly elected through the Zanzibar House of

Representatives; 10 which may be appointed by the President; and 1 which is reserved for the Attorney General.

As is now well-established, even in one-party states and those scoring poorly on Polity Project indices, competition amongst local elites for positions in officialdom can drive substantial efforts to sway voters [Geddes, 2005; Manion, 2006; Birney, 2007; Gehlbach, Sonin and Svolik, 2016; Martinez-Bravo et al., 2017]. This is true in terms of service delivery, where elections are associated with higher public goods expenditures and provision, even in contexts with low levels of political competition [Luo et al., 2007; Martinez-Bravo et al., 2017].

Our analysis takes advantage of the regular schedule of elections that occur every 4-5 years across the settings that we study. As discussed in section 2, a discontinuous decrease in the quality of public infrastructure is expected just after elections if: (i) citizens evaluate the performance of public officials myopically [Gerber et al., 2011; Healy and Malhotra, 2013; Healy and Lenz, 2014; Achen and Bartels, 2017; Croke, Forthcoming] and (ii) citizens' core opportunity to hold officials to account are through the electoral process. In these partially democratic environments, elections represent one of the few mechanisms through which citizens can communicate preferences and grievances to local politicians and impose some cost for poor performance. These elections take place independent of the performance of any individual local public official or administration [Khemani, 2004].[11]

3.2 Data

A waterpoint is a physically persistent object, with the main body of the waterpoint made from concrete and steel. Though potentially non-functional, remains of construction typically last the 50 years or so that our study covers. This makes tracing all waterpoints built in a country over time feasible. We capitalise on recent efforts to do so in our three study countries.

We use recent census data on all water systems ever constructed in each set-

[11]The identification strategy relies on the inability of local administrations to manipulate the timing of elections in a way that is endogenous to the investment in or construction of water resources. Our analysis focuses on regularly scheduled elections, which occur during the same year across all districts in our settings, ruling out potential manipulation driving our results [Khemani, 2004].

ting available from the Water Point Data Exchange: `www.waterpointdata.org`. The censuses identified the location, installation year, technology and functionality of every waterpoint ever built in the country. The censuses are careful to attempt to reconstruct the functionality history for each and every water point in the country, including those that broke down at any point in their history irrespective of current functionality. We use administrative identifiers and geolocations of water resources to match each resource to a local administration, consistent with the second administrative level in the Database of Global Administrative Areas or ISO-3166-2 International Organization for Standardization (equivalent to counties in the USA). Details of the data sources and waterpoint mapping exercises are provided in the Appendix.

Table 1 presents summary statistics for each context. Our data time frame covers 1970-2014 for Nigeria; 2002-2012 for Sierra Leone; and 1970-2009 for Tanzania. Sierra Leone's civil war (1991–2002) makes pre-war data unreliable in many cases, such that we restrict our analysis to the post-war period.

The top panel summarizes the data that we have on water resources in each context. We see that at the time of the census, 65% of water resources are functioning in Nigeria, 85% in Sierra Leone, and 60% in Tanzania. The nature of technology used to build water systems differs across our three countries: 81% of water resources in Nigeria are installed with piped connections or motorized. The remainder consists of water resources from surface water or rainwater with non-electric pumps or no pumps and shallow wells. This percentage is lower at 29% and 21% in Sierra Leone and Tanzania. The average water resource is older in Tanzania, the average installation year being 1995, relative to 2006 and 2007 for Nigeria and Sierra Leone. Figure A2 presents histograms of water resources by their year of installation for each context. We see that public agencies are responsible for more installations in Nigeria (60%) relative to Tanzania (48%) and Sierra Leone (15%).

We present the spatial variation in waterpoints across districts in the three contexts we study in Figure 1. Since our identification strategy focuses on the comparison between water resources built shortly before and shortly after an election, we present the distribution of waterpoints built 2-years before and after the elections. The figure provides evidence of substantial spatial variation in the water resources used in our analyses, but no evidence that this varies at the macro-level shortly before and after elections.

The middle panel shows the elections that we cover in our datasets, covering all congressional elections from 1979 to 2011 for Nigeria; all council elections after the civil war in Sierra Leone (2004-2012); and all congressional elections between 1970 and 2006 for Tanzania. We see the term limits in Nigeria and Sierra Leone are 4 years and are 5 years in Tanzania.

The bottom panel presents summary statistics of the district characteristics that we capture. These controls include: primary school enrollment rate; population; population density per square kilometer; the proportion of citizens living in rural areas; literacy rate; distance from the district capital to country capital in miles; and average elevation. We see that districts are largest in Tanzania, on average, in terms of population. Sierra Leone is the most densely populated, the least literate, and least rural. Our main specifications include district fixed effects to account for these and other average differences across districts.

To construct our main dataset, we start from the water-resource-level dataset, where we have data on 54,387 water resources in Nigeria; 52,720 for Tanzania; and 17,775 for Sierra Leone. We then calculate the number of years between the construction date of the water resource and each election in our sample time frame (the elections range from 1979-2011 for Nigeria, covering 7 different elections; 1970 to 2005 for Tanzania, covering 8 different elections; and 2004-2012 for Sierra Leone, covering 3 elections). We then stack the observations so that we have one observation for each water-resource-election combination. Our main focus is within 2 years of the election (2 years before and 2 years after). When using a 2-year bandwidth, the unit of observation is then equivalent to the level of the individual water source (since the term limits across our three settings are 4 and 5 years).[12]

Our data limits us to using year as the time interval, but this approach accords with public sector budget and implementation cycles so is a natural benchmark. We would not expect public officials to be able to generate waterpoints substantially faster than within a one-year timeline given the

[12]When using a 3- or 4-year bandwidth (robustness checks only), this results in more observations than water resources, due to the overlap between election years. For example, a 4-year bandwidth around a 1999 election includes all water resources installed from 1995 to 2003, and around a 2004 election includes all water resources installed from 2000 to 2008, resulting in overlap; whereas a 2-year bandwidth around a 1999 election includes water resources installed from 1997-2001, and around a 2004 election includes water resources from 2002-2006, resulting in no overlap in observations.

rigidities of the the budgeting cycles, whether they are implemented by the public sector (52% of waterpoints in our sample) or facilitated by the public sector and implemented by the private sector.

4 Results

In Table 2, we present our estimates of the effect of the electoral cycle on water provision using the following specification:

$$
\begin{aligned}
y_{i,j,t} = &\alpha + \beta\, \mathbb{1}[t \geq Election\ Year] \\
&+ \delta_1 (t - Election\ Year) \\
&+ \delta_2 \{\mathbb{1}[t \geq Election\ Year] \times (t - Election\ Year)\} \\
&+ \lambda t + X_{i,j,t} + \phi_j + \epsilon_{i,j,t}
\end{aligned} \tag{3}
$$

Where $y_{i,j,t}$ refers to the present-day functionality of water resource i in jurisdiction j constructed in time t. $\mathbb{1}[t \geq Election\ Year]$ is an indicator equal to one if the period is after the election; $(t - Election\ Year)$ is the running variable that is the construction year relative to the election. We restrict our analysis to close periods around the election, focusing on 2 years before and after the election in our main specifications (we also present 3 year bandwidths and 4 year bandwidths for robustness).[13] λt represents a linear time trend. $X_{i,j,t}$ represent controls for the characteristics of the water resource or district and ϕ_j district fixed effects. Given that the elections and water-point construction occur throughout the year, we exclude the election year from our analysis so that we always accurately assign construction dates to before or after the election. This exclusion also ensures that short-term administrative disruption (due to an election or change in leadership) is not contributing to our estimates.

The top panel presents the results for Nigeria; the middle panel for Sierra Leone; and the bottom panel for Tanzania. Column (1) presents the results

[13]When using a 2-year bandwidth, the unit of observation is then equivalent to the level of the individual water source. The number of observations when using 2-year bandwidths is equal to the number of observations presented in Table 1 minus observations that fall within election years, which are excluded to ensure that our results are not driven by administrative disruption.

without any controls or fixed effects, just the linear time trend to account for time-driven deterioration. Column (2) includes district-level controls, column (3) includes district fixed effects, and column (4), our main specification, includes an indicator for whether the water resource was constructed by a public agency. Across all four columns for Nigeria and Sierra Leone, we find significant and negative effects of past elections on present-day functionality. In our main specification, column (4), we find significant and negative effects for all three country contexts. Since we run the same test three times, across each of the contexts, the last row in each table presents the sharpened q-values, which can be interpreted as p-values adjusted for multiple-hypothesis testing, as per Anderson [2008].[14] Our results show that water resources installed shortly after an election are significantly less likely to be functional today by between 5 and 9 percentage-points. This is after controlling for linear time trends, district fixed effects, and whether the constructor was public or private. When pooling all of the observations from the three countries and running our main specification we estimate β at -0.048 ($p = 0.000$).

Our results represent a 7.5%, 9.5%, and 10% decrease in Nigeria, Tanzania, and Sierra Leone respectively, relative to the mean level of functionality in each country. Relative to a constant electoral incentive for public officials to invest in public infrastructure, this translates to an approximate increase in the number of dysfunctional water resources by 2,670, 3,000, 1,510 in Nigeria, Tanzania, and Sierra Leone, with important consequences for water access. Our data suggests that 1,880 citizens are served by each individual water resource in Nigeria; 777 in Tanzania, and 433 in Sierra Leone. Hence, our estimates of the effects of short-term political incentives translate into negative consequences for water access for approximately 5m citizens in Nigeria; 2.3m in Tanzania; and 650,000 in Sierra Leone.

Figure 2 presents this evidence graphically, without any of the controls or fixed effects (nor the linear time trend), for 2-year bandwidths and 3-year bandwidths. The graphs show clear evidence across countries and specifications of a sudden decrease in functionality today based on the timing of installation relative to the election.

Columns (5) to (9) present alternative specifications to show that our results are robust to different analytical and modelling assumptions. Column (5) in-

[14] Note that sharpened q-values can be lower than unadjusted p-values when a large number of hypotheses are true rejections [Anderson, 2008].

cludes quadratic time trends, column (6) expands the bandwidth around the election to 4 years, column (7) reduces the bandwidth to 3 years, column (8) conditions on the technology of the water resource, and column (9) presents the results from a local polynomial regression-discontinuity estimation with robust bias-corrected standard errors as per Calonico, Cattaneo and Titiunik [2014], Calonico, Cattaneo and Farrell [2018], and Calonico et al. [2019]. Across all specifications, we see a significant and negative coefficient for β.

In our main specifications, we present robust standard errors, which are consistent in the case of no model misspecification [Lee and Card, 2008]. To allow for misspecification errors, we also estimate the 'honest' confidence intervals following [Kolesár and Rothe, 2018] and find that both the upper and lower bounds of our estimated confidence intervals are negative for each of the contexts.[15]

In addition to our robustness checks within the regression-discontinuity-design framework, we use an alternative 'event study' estimation strategy to explore the effect of elections on water resources in Table A1. We run the following regression:

$$
\begin{aligned}
y_{i,j,t} = \alpha &+ \beta\, \mathbb{1}[t = Year\ Before\ Election] \\
&+ \lambda t + X_{i,j,t} + \phi_j + \epsilon_{i,j,t}
\end{aligned} \tag{4}
$$

Where $\mathbb{1}[t = Year\ Before\ Election]$ is an indicator equal to one if the water resource was constructed in the year just before the nearest election. The results are entirely consistent with those presented above: water resources constructed during the year *before* an election are significantly *more* likely to remain functional until the present day.

Importantly, our research strategy provides an additional degree of assurance typically unavailable in other micro-level studies. That our findings are consistent across three different contexts, each of which are buffeted by dif-

[15] The confidence intervals with these parameters are: (-0.086, -0.013) for Nigeria; (-0.14, -0.051) for Sierra Leone; and (-0.15, -0.069) for Tanzania. Based on their sample code, we use a uniform kernel function, a Hölder smoothness class and a smoothing constant of 0.01; and use a significance level of 0.1 and apply a bandwidth of 2, as per our main specification in column (4) of Table 2.

ferential trends in politics, economics, and technology adoption, lends further credibility to the results.

Together, our results imply that waterpoints built just before an election in all three settings are more likely to have survived to today than those built just after. We now turn to potential explanations of this finding and provide further evidence that is consistent with a political economy interpretation of the results.

4.1 Mechanisms

Descriptive evidence from the technical teams undertaking the waterpoint censuses shows that the majority of waterpoint failure (68%) occurs within the first year, and that these failures are fundamentally determined by design and implementation features [Andres et al., 2018]. Similar technical assessments from South America emphasize the role of technology in determining long-run functionality [Cronk and Bartram, 2017; Janke, Ng and Bellisario, 2017].

A World Bank review of rural water systems emphasized the positive impact private sector participation has on the implementation of small-scale rural water schemes [World Bank, 2017*a*]. Similarly, qualitative case studies on waterpoint functionality emphasize the importance of the choice of implementer in water system longevity [Fisher et al., 2015; Cronk and Bartram, 2017]. Related to this, many case studies point to the nature of the implementer's engagement with communities, and the governance regimes they are embedded in, as important for determining functionality [Jiménez and Pérez-Foguet, 2011; Alexander et al., 2015; Walters and Javernick-Will, 2015; Andres et al., 2018].

Building on these studies, we structure our empirical analysis of mechanisms around the waterpoints core design features. Our data allow us to assess the technological design of the waterpoints implemented before and after elections; the extent to which public officials adjust the choice of implementer; the location of construction; and, the number of water points or installation rate. We also incorporate additional data on changes in local political parties and the incidence of conflicts to empirically explore the role of political and administrative disruption for our results.

Waterpoint Design and Provider Sector

In Table 3 column (1), we run our main specification consistent with equation 3 and column (4) of Table 2 but use an indicator for whether the water resource was motorized or had a piped connection as the dependent variable. We find suggestive evidence that piped or motorized water resources are less likely to be installed shortly after an election in the three settings. The coefficients are negative for each context and significant at the 1% level for Sierra Leone. When pooling all of the observations from the three countries and running the same specification we estimate β at -0.039 (p = 0.000). This response by public officials is rational when citizens have preferences for superior technology and demonstrate responsive but myopic evaluations of public officials [Gerber et al., 2011; Healy and Malhotra, 2013; Healy and Lenz, 2014; Achen and Bartels, 2017; Croke, Forthcoming]. The relationship between technology and durability may be mediated by a number of channels: technology may be providing an observable proxy of the overall quality of the initial investment, it may increase the salience of the water system and its value to citizens who then maintain it, or it has an innate durability. We are constrained in our ability to separate between these explanations with our data.[16]

In Table 3 column (2), we use an indicator for whether the water resource was provided by a public provider.[17] We find evidence that politicians respond to electoral incentives by adjusting the choice of provider. Water points are significantly more likely to be installed by a public provider just after the election in Nigeria (β = 0.037, p = 0.000) and Tanzania (β = 0.031, p = 0.021), and we find a positive but insignificant effect in Sierra Leone (β = 0.018, p = 0.292). In a pooled regression combining the observations from all three countries, the estimates for β is 0.030 (p = 0.000). This suggests that politicians are more likely to use private providers shortly before

[16]We also rule out discontinuities in the availability of relevant technology as an alternative explanation for our main results, since: (i) the global frontier of waterpoint technology is not affected by elections in these three countries; and (ii) advances in technology persist so that once new technologies, such as water reticulation, are installed within a local government, they remain, rather than being responsive to elections. Other potential determinants of the present-day status of water resources are the environmental conditions within districts, such as elevation, which are fixed over time and, hence, unresponsive to elections.

[17]We, therefore, exclude this as a control variable for this set of regressions.

an election and that these water resources are significantly more likely to remain functional over time. This finding is consistent with existing literature that documents the higher quality of privately provided services in developing countries [Banerjee, Deaton and Duflo, 2004; Kremer et al., 2005; Muralidharan, 2006; Das et al., 2016; Kingdon, 2020].[18]

These results are consistent with the model presented in section 2 that politicians shift the nature of public investments in the run-up to elections so as to increase their quality. In the aftermath of elections, the quality of public investments falls in response to its lower impact on subsequent election outcomes. In turn, these dynamics have long-term impacts on the durability of the infrastructure created soon after elections.

Location and Quantity of Waterpoints

We also explore whether politicians respond to electoral incentives by adjusting the location of water resources. We rerun our main specification with variables indicating the characteristics of the location of the water point as dependent variables. The analysis is conducted at the district-year level, without district fixed-effects, with state or region fixed effects and district controls for distance to capital and literacy rate as explanatory variables (as well as our other main controls: the running variable, the interacted running variable, and the linear trend). We use logged population density; logged elevation; and the rurality (percentage of rural inhabitants) of the location of the water resource as dependent variables. We find no significant evidence that politicians respond to electoral incentives by adjusting the location of the water resources: none of the coefficients on *After Election* are significantly different from zero, across the three settings and the three dependent variables.

We also run our main specification in columns (3) to (5) of Table 3 but interacting our main variable of interest ($\mathbb{1}[t \geq Election\ Year]$) with a proxy for installation costs and feasible production technology: the elevation (in logs) of the district in which the water resource was installed. Such a regression assesses the extent to which politicians move public investments to those districts in which waterpoint installation is least complex. We find no evidence of such endogenous investments.

[18] However, there is currently insufficient empirical evidence to conclude that one sector provides higher quality services than the other overall [Coarasa et al., 2017].

In Table A2, we present district-year level estimates of the effect of the election on the number of water resources constructed within the district-year. We regress the log of the number of water resources constructed per year on $\mathbb{1}[t \geq Election\ Year]$, $(t - Election\ Year)$, $\mathbb{1}[t \geq Election\ Year] \times (t - Election\ Year)$, and district fixed effects using the same bandwidth of 2 years before and after an election. We find inconsistent and imprecise evidence across the three settings, with differing signs and magnitudes of effect. Only in the case of Sierra Leone do we find a significant coefficient on $\mathbb{1}[t \geq Election\ Year]$. In a pooled regression combining observations from all three settings we estimate the coefficient on $\mathbb{1}[t \geq Election\ Year]$ of 0.011 ($p = 0.850$). Together, we take these results as joint evidence that there is not a consistent quantity-quality trade off in waterpoint design across the settings we investigate.

Political and Administrative Disruption

Identification relies on the absence of other discontinuities around elections that might determine the present-day status of water resources. Political and administrative disruption, as a result of elections, are potential mechanisms behind our results. Elections can be disruptive to the provision of public infrastructure, as resources and attention are drawn towards electoral processes. These effects may be exacerbated if elections lead to changes in political leadership, which may generate changes in policy direction, management, and senior personnel. Such changes may lead to a poor implementation environment in the months following the election. We have already noted that we remove observations that fall during the year of the election to minimize the contribution of administrative disruption to our estimates. In this section we further explore evidence on the role of disruption in explaining our results.

In Table 3 columns (6) to (11), we present the results of our main specification but now interacting our main variable of interest ($\mathbb{1}[t \geq Election\ Year]$) with other potential mediating factors.[19] In columns (6) to (8) we directly explore the role of *administrative* disruption, driven by changes in the local party.[20] In columns (9) to (11), we explore the role of the most extreme form of political disruption: conflict. We construct a variable ('Conflict') that

[19]We always include each variable of the interaction individually in the specifications, but show only the interaction for presentation purposes, given space limitations.

[20]We extract data on state and district-level political-party transitions from the African Elections Database and Adam Carr's Election Archive. For Nigeria we have state-level

is equal to the total number of conflicts recorded in the district per year, covering 1997 to 2020 from the Armed Conflict Location and Event Data Project (ACLED). We find no consistent evidence that any of these margins contribute to the election-driven provision of water resources.

4.2 Conclusion

We provide empirical evidence from three distinct settings in sub-Saharan Africa that public officials increase the quality of implementation of water systems in the run-up to elections with long-term consequences for water access. We find that water systems installed immediately after an election are 5, 6 and 9 percentage-points less likely to be functioning today relative to those installed just before an election in Nigeria, Tanzania and Sierra Leone respectively. This translates to an approximate decrease in the number of present-day functional water systems relative to the pre-election trend of 2,670, 3,000 and 1,510 in Nigeria, Tanzania, and Sierra Leone, with important consequences for water access. We find no consistent empirical evidence across the three contexts that this decrease in quality is traded off against increases in quantity, or is due to administrative or political disruption.

We present a model of myopic citizen evaluations of past public-sector performance as an explanation for our findings. In line with our model, we present evidence that public officials adjust the design (technology of water systems) and choice of provider (public versus private) in response to electoral incentives. Such responses are rational when faced with responsive but myopic voters, as public officials increase the quality of public investments shortly before elections to attract voters but switch back to 'personal' consumption shortly after elections with limited electoral costs. In turn, these dynamics have long-term impacts on the durability of the infrastructure created soon after elections.

These findings highlight the interaction between short-term responses by public actors to political incentives and long-term development outcomes. Our results are relevant to a broad range of public investments that determine an economy's long-run production possibility frontier, such as many in the agriculture, education, health, and infrastructure sectors. Short-term

transitions due to availability; for Sierra Leone we have district-level transitions; for Tanzania, there are no changes in the political party, nationally and locally, in the sample timeframe.

political incentives can lock an economy into an inferior long-term path of development.

The robustness of our findings across three distinct settings provides further support to the results from any particular country. This approach is relatively rare in micro-economic studies, particularly in the field of political economy. The benefits of early replication are that it allows researchers to better evaluate the significance of any particular study finding and more rapidly move towards a stylized understanding of how politics impacts development.

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Table 1: Summary Statistics

	Nigeria				Sierra Leone				Tanzania			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Mean	Std Dev	Min	Max	Mean	Std Dev	Min	Max	Mean	Std Dev	Min	Max
Water Points												
Dummy variable for whether a water point is functioning [1 == yes]	0.65	0.48	0.00	1.00	0.85	0.36	0.00	1.00	0.60	0.49	0.00	1.00
Technology Dummy [=1 if motorized or piped connection]	0.81	0.40	0.00	1.00	0.29	0.45	0.00	1.00	0.22	0.42	0.00	1.00
Motorization Dummy	0.28	0.45	0.00	1.00	0.03	0.17	0.00	1.00	0.10	0.31	0.00	1.00
Year of Installation	2006	8.41	1970	2014	2007	2.91	2002	2012	1995	11	1970	2009
Dummy for Public Installer	0.61	0.49	0.00	1.00	0.15	0.36	0.00	1.00	0.47	0.50	0.00	1.00
Observations	54,387				17,775				52,720			
Electoral Cycle												
Election Years [List of Years]	1979				2004				1970			
	1983				2008				1975			
	1992				2012				1980			
	1999								1985			
	2003								1990			
	2007								1995			
	2011								2000			
									2005			
District Characteristics												
Primary school enrollment	0.74	0.26	0.26	1.75	1.01	0.12	0.65	1.18	0.71	0.11	0.27	1.05
Population	175,552	104,359	11,781	1,280,000	200,498	82,374	70,246	458,117	283,958	152,843	51,902	1,780,000
Population density per square kilometer	528	2,457	10.39	111,013	3,044	12,863	21.90	58,807	135	333	2.66	3,428
Proportion of people living in rural areas	0.79	0.29	0.00	1.00	0.68	0.20	0.00	0.91	0.77	0.07	0.67	1.00
Literacy rate	0.60	0.25	0.01	1.00	0.32	0.11	0.21	0.68	0.78	0.07	0.59	0.96
Distance of the district capital to the country capital in miles	237	67	8.57	435	98	52	0.00	182	250	99	5.16	453
Average elevation	356	199	0.95	1,291	177	125	16.18	455	1,063	496	32.32	2,466

Notes: Figures rounded to 2 decimal places except for statistics for Year of Installation, Population and Population Density, which are rounded to the nearest integer. Electoral Cycle references House elections for Nigeria. For data on water resources, we use the National Water Supply and Sanitation Survey 2015 for Nigeria; the Sierra Leone Waterpoint Atlas of 2012; and the Water Point Data Exchange for Tanzania. For demographic and geographical data, for Nigeria we use the 2006 National Core Welfare Indicators Survey and the Nigeria Data Portal; for Sierra Leone we use the 2004 Population and Housing Census; the 2004 Education Statistics of Sierra Leone; and the 2004 Integrated Household Survey; and for Tanzania we use the Basic Statistics Portal. Dummy variable for whether a water point is functioning [1 == yes] is a binary indicator for whether the water resource was recorded as functional in the waterpoint census or mapping exercise. Technology Dummy [=1 if motorized or piped connection] is a binary indicator for whether the water resource was categorized as motorized or had a piped connection. Motorization Dummy is a

Table 2: Regression Discontinuity Design Estimates: Functionality and the Electoral Cycle

RDD Estimates
Dependent Variable: Functionality of Water Points [Functioning=1]
Robust Standard Errors in Parentheses in Columns (1) to (8); Heteroskedasticity-robust Nearest Neighbor Variance Estimator with 3 neighbors in Column (9)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	2 Year Bandwidth	Controls	District FE	Public	Flexible Time Trend	4 Year Bandwidth	3 Year Bandwidth	Conditional on Complexity	Non-Parametric Local Polynomial Estimator 3 Year Bandwidth and District Fixed Effects
Nigeria									
After Election [=1 if the year after the election]	-0.044***	-0.044***	-0.053***	-0.049***	-0.029**	-0.023***	-0.047***	-0.050***	-0.048***
	(0.013)	(0.013)	(0.013)	(0.012)	(0.013)	(0.007)	(0.009)	(0.012)	[0.012]
Number of Years Installed After Nearest Election [Negative if Before]	0.026***	0.027***	0.025***	0.024***	0.017***	0.010***	0.012***	0.024***	
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.002)	(0.003)	(0.006)	
After Election x Number of Years Installed After Nearest Election	-0.027***	-0.030***	-0.023***	-0.021***	-0.018**	-0.010***	0.001	-0.021***	
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.003)	(0.004)	(0.008)	
Dummy for Public Installer				-0.097***	-0.091***	-0.100***	-0.098***	-0.087***	
				(0.005)	(0.005)	(0.004)	(0.004)	(0.005)	
Technology Dummy [=1 if motorized or piped connection]								-0.091***	
								(0.006)	
Linear Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District controls	No	Yes	No	No	No	No	No	No	No
District fixed effects	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	54485	54485	54485	54485	54485	101927	81283	54485	81283
Adjusted R-squared	0.00079	0.039	0.12	0.13	0.13	0.13	0.13	0.13	
p-value on *After Election*				0.000					
Sharpened q-value on *After Election*				0.001					
Sierra Leone									
After Election [=1 if the year after the election]	-0.083***	-0.085***	-0.087***	-0.085***	-0.058***	-0.046***	-0.073***	-0.092***	-0.042***
	(0.018)	(0.017)	(0.017)	(0.017)	(0.019)	(0.010)	(0.012)	(0.017)	[0.008]
Number of Years Installed After Nearest Election [Negative if Before]	0.019***	0.022***	0.021***	0.020***	0.013*	0.017***	0.021***	0.020***	
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.003)	(0.004)	(0.007)	
After Election x Number of Years Installed After Nearest Election	0.004	-0.000	0.002	0.003	0.006	-0.016***	-0.007	0.006	
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.004)	(0.006)	(0.011)	
Dummy for Public Installer				-0.088***	-0.088***	-0.089***	-0.089***	-0.078***	
				(0.008)	(0.008)	(0.006)	(0.007)	(0.008)	
Technology Dummy [=1 if motorized or piped connection]								-0.056***	
								(0.006)	
Linear Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District controls	No	Yes	No	No	No	No	No	No	No
District fixed effects	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18527	18527	18527	18527	18527	31219	26080	18527	26080
Adjusted R-squared	0.014	0.019	0.030	0.038	0.039	0.040	0.039	0.042	
p-value on *After Election*				0.000					
Sharpened q-value on *After Election*				0.001					
Tanzania									
After Election [=1 if the year after the election]	-0.087***	-0.058***	-0.058***	-0.057***	-0.058***	-0.032***	-0.019*	-0.057***	-0.032***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.009)	(0.011)	(0.016)	[0.007]
Number of Years Installed After Nearest Election [Negative if Before]	0.039***	0.032***	0.018***	0.017***	0.017***	0.006***	0.004	0.018***	
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.002)	(0.003)	(0.006)	
After Election x Number of Years Installed After Nearest Election	-0.027***	-0.028***	-0.003	-0.001	-0.001	0.000	-0.002	-0.003	
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.003)	(0.005)	(0.010)	
Dummy for Public Installer				-0.040***	-0.040***	-0.041***	-0.036***	-0.040***	
				(0.006)	(0.006)	(0.004)	(0.005)	(0.006)	
Technology Dummy [=1 if motorized or piped connection]								-0.039***	
								(0.007)	
Linear Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District controls	No	Yes	No	No	No	No	No	No	No
District fixed effects	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	39901	39901	39901	39901	39901	79802	61499	39901	61499
Adjusted R-squared	0.062	0.087	0.16	0.16	0.16	0.16	0.16	0.16	
p-value on *After Election*				0.071					
Sharpened q-value on *After Election*				0.001					

Notes: * p< 0.1; ** p<0.05; *** p<0.01. The specification used for Flexible Time Trend also includes a quadratic of the installation year. Robust Standard Errors in Parentheses in Columns (1) to (8); Heteroskedasticity-robust Nearest Neighbor Variance Estimator with 3 neighbors in Column (9). The dependent variable is a binary indicator for whether the water resource was recorded as functional in the waterpoint census or mapping exercise. Technology Dummy [=1 if motorized or piped connection] is a binary indicator for whether the water resource was categorized as motorized or had a piped connection. District controls include the primary school enrollment rate; population; population density per square kilometer; the proportion of citizens living in rural areas; literacy rate; distance from the district capital to country capital in miles; and the average elevation. Sharpened q-values refer to p-values adjusted for multiple hypothesis testing based on Anderson (2008). For data on water resources, we use the National Water Supply and Sanitation Survey 2015 for Nigeria; the Sierra Leone Waterpoint Atlas of 2012; and the Water Point Data Exchange for Tanzania. For demographic and geographical data, for Nigeria we use the 2006 National Core Welfare Indicators Survey and the Nigeria Data Portal; for Sierra Leone we use the 2004 Population and Housing Census; the 2004 Education Statistics of Sierra Leone; and the 2004 Integrated Household Survey; and for Tanzania we use the Basic Statistics Portal. For data on elections we

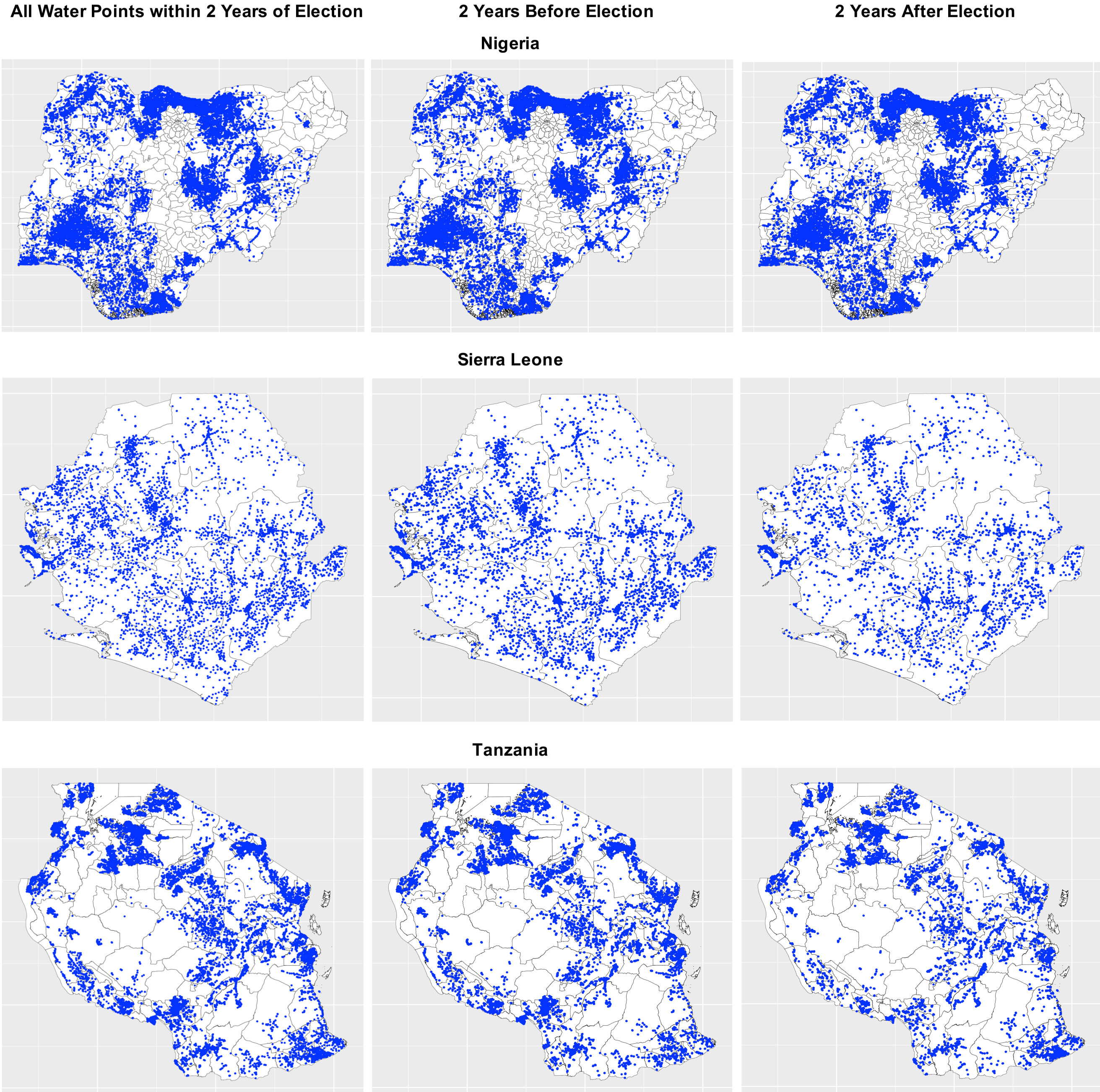
Table 3: Mechanisms: Technology, Choice of Provider, Politics, and Conflict

RDD Estimates
Dependent Variable: Technology of Water Points [=1 if motorized or piped connection] in columns (1), (4), (7), and (10); Choice of Provider [=1 if public provider] in column (2); Functionality [Functioning=1] in columns (3), (6), and (9); Log of Number of Water Points Installed in Year in columns (5), (8), and (11)
Robust Standard Errors in Parentheses

	Technology	Provider	Elevation			Local Party Change			Conflict (Disruption)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Technology and the Electoral Cycle	Public Provider and the Electoral Cycle	Functionality & Elevation	Technology & Elevation	Production & Elevation	Functionality & Local Party Change	Technology & Local Party Change	Production & Local Party Change	Functionality & Conflict	Technology & Conflict	Production & Conflict
Nigeria											
After Election [=1 if the year after the election]	-0.008	0.037***	-0.066**	-0.003	0.017	-0.053***	-0.012	0.077	-0.046***	-0.008	0.117*
	(0.009)	(0.010)	(0.031)	(0.020)	(0.111)	(0.013)	(0.010)	(0.066)	(0.013)	(0.009)	(0.062)
After Election [=1 if the year after the election] x Log Elevation			0.003	-0.001	0.014						
			(0.005)	(0.003)	(0.018)						
After Election [=1 if the year after the election] x Local Party Change						0.003	0.009	0.030			
						(0.008)	(0.006)	(0.039)			
After Election [=1 if the year after the election] x Conflict									-0.002	0.000	-0.013
									(0.001)	(0.001)	(0.012)
Linear Trend	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	54485	54485	54485	54485	8882	54485	54485	8882	54485	54485	8882
Adjusted R-squared	0.28	0.51	0.13	0.28	0.22	0.13	0.28	0.23	0.13	0.28	0.23
Sierra Leone											
After Election [=1 if the year after the election]	-0.128***	0.018	-0.036	-0.015	-1.076**	-0.083***	-0.107***	-1.092***	-0.086***	-0.120***	-1.156***
	(0.020)	(0.017)	(0.034)	(0.037)	(0.465)	(0.018)	(0.021)	(0.276)	(0.018)	(0.020)	(0.250)
After Election [=1 if the year after the election] x Log Elevation			-0.010*	-0.023***	-0.007						
			(0.006)	(0.007)	(0.078)						
After Election [=1 if the year after the election] x Local Party Change						-0.005	-0.044***	0.077			
						(0.011)	(0.013)	(0.178)			
After Election [=1 if the year after the election] x Conflict									-0.004	-0.001	0.004
									(0.003)	(0.004)	(0.064)
Linear Trend	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18533	18533	18527	18533	140	18527	18533	140	18527	18533	140
Adjusted R-squared	0.16	0.047	0.038	0.16	0.37	0.038	0.16	0.39	0.038	0.16	0.38
Tanzania											
After Election [=1 if the year after the election]	-0.011	0.031**	-0.029	0.032	-0.286	-0.057***	-0.011	-0.228	-0.056***	-0.011	-0.231
	(0.012)	(0.013)	(0.049)	(0.041)	(0.453)	(0.016)	(0.012)	(0.162)	(0.016)	(0.012)	(0.162)
After Election [=1 if the year after the election] x Log Elevation			-0.004	-0.006	0.009						
			(0.007)	(0.006)	(0.064)						
After Election [=1 if the year after the election] x Local Party Change						**No local party changes observed in sample timeframe**					
After Election [=1 if the year after the election] x Conflict									-0.029*	-0.008	-0.312*
									(0.015)	(0.015)	(0.173)
Linear Trend	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	40115	40115	39901	40115	2359	39901	40115	2359	39901	40115	2359
Adjusted R-squared	0.37	0.44	0.16	0.37	0.12	0.16	0.37	0.12	0.16	0.37	0.12

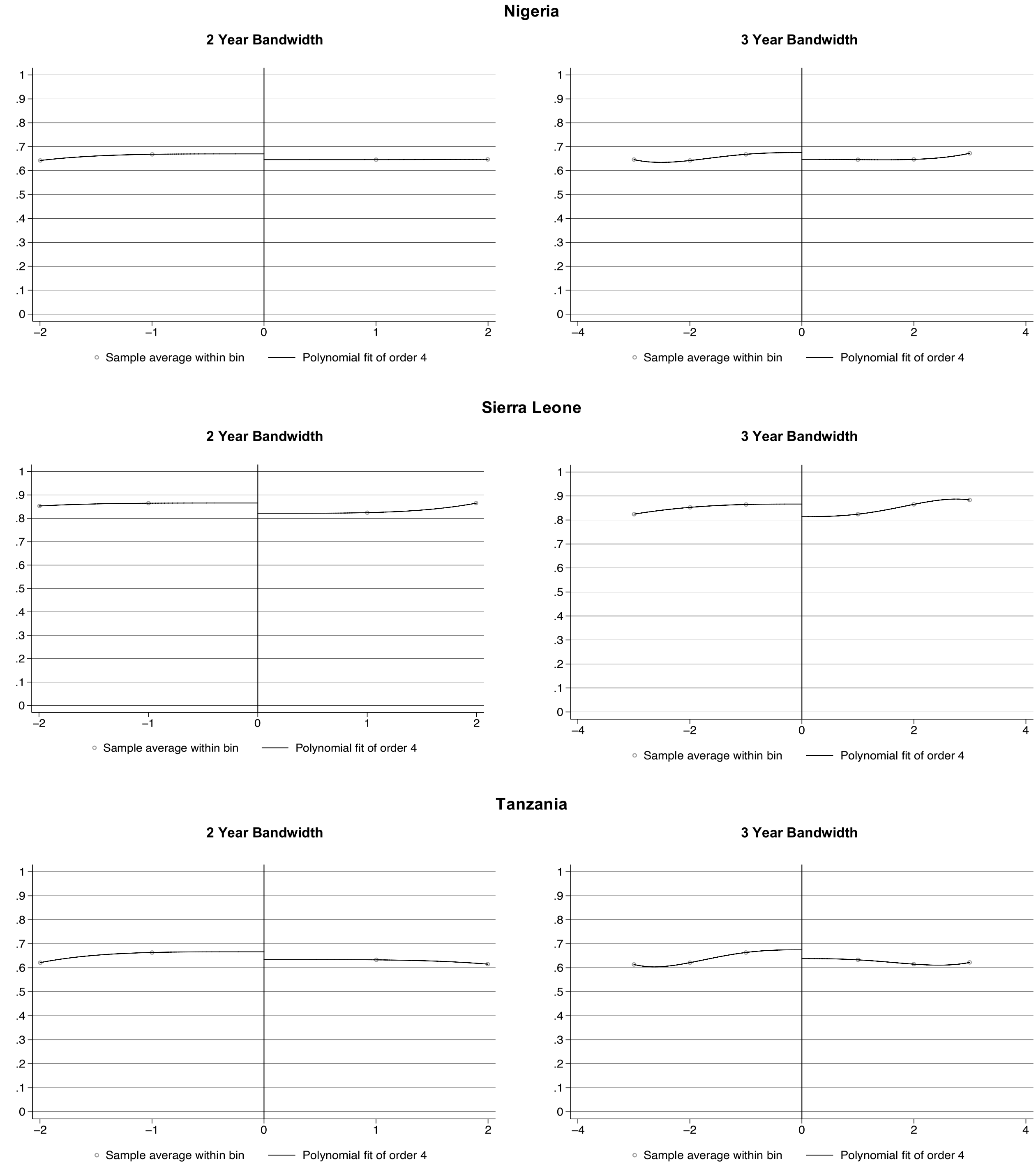
Notes: * p< 0.1; ** p<0.05; *** p<0.01. Robust Standard Errors in Parentheses. Local party refers to state-level election results for Nigeria due to availability of sub-national election data; for Sierra Leone local party refers to district-level election results; for Tanzania, there are no local party changes in the sample timeframe. No local party changes are observed in sample timeframe in the case of Tanzania. Local Party Change is equal to one if the election led to a change in the local party. Technology Dummy [=1 if motorized or piped connection] is a binary indicator for whether the water resource was categorized as motorized or had a piped connection. Elevation is in metres. Conflict refers to the total number of conflicts recorded in the district per year, covering 1997 to 2020 from the Armed Conflict Location and Event Data Project (ACLED). For data on water resources, we use the National Water Supply and Sanitation Survey 2015 for Nigeria; the Sierra Leone Waterpoint Atlas of 2012; and the Water Point Data Exchange for Tanzania. For demographic and geographical data, for Nigeria we use the 2006 National Core Welfare Indicators Survey and the Nigeria Data Portal; for Sierra Leone we use the 2004 Population and Housing Census; the 2004 Education Statistics of Sierra Leone; and the 2004 Integrated Household Survey; and for Tanzania we use the Basic Statistics Portal. For data on elections we use the African Elections Database and Adam Carr's Election Archive.

Figure 1: Spatial Variation in Water Points, Before and After Elections



Notes: The figures show the spatial distribution of water resources (blue dots) in Nigeria (top), Sierra Leone (middle), and Tanzania (bottom). The left panel shows all water resources constructed within 2 years of an election, excluding those constructed within an election year. The middle panel shows all water resources constructed 2 years before an election, excluding the election year. The right panel shows all water resources constructed 2 years after an election, excluding the election year. Maps are sourced from the Database of Global Administrative Areas.

Figure 2: Functionality and Proximity to Elections



Notes: The figure shows the sample average level of functionality (y-axis) for each year relative to the next election (x-axis) and a polynomial fit of order 4, fitted separaetly on each side of the threshold of 0 on the x-axis, representing the year of the election. The results are presented for Nigeria in the top panel, Sierra Leone in the middle panel, and Tanzania in the bottom panel. The figures on the left use a bandwidth of 3 years either side of the election and the figures on the right 2 years. For data on water resources, we use the National Water Supply and Sanitation Survey 2015 for Nigeria; the Sierra Leone Waterpoint Atlas of 2012; and the Water Point Data Exchange for Tanzania. For data on elections we use the African Elections Database and Adam Carr's Election Archive.

Figure A1: Optimal Provision of Public Goods in Response to Myopic Citizens

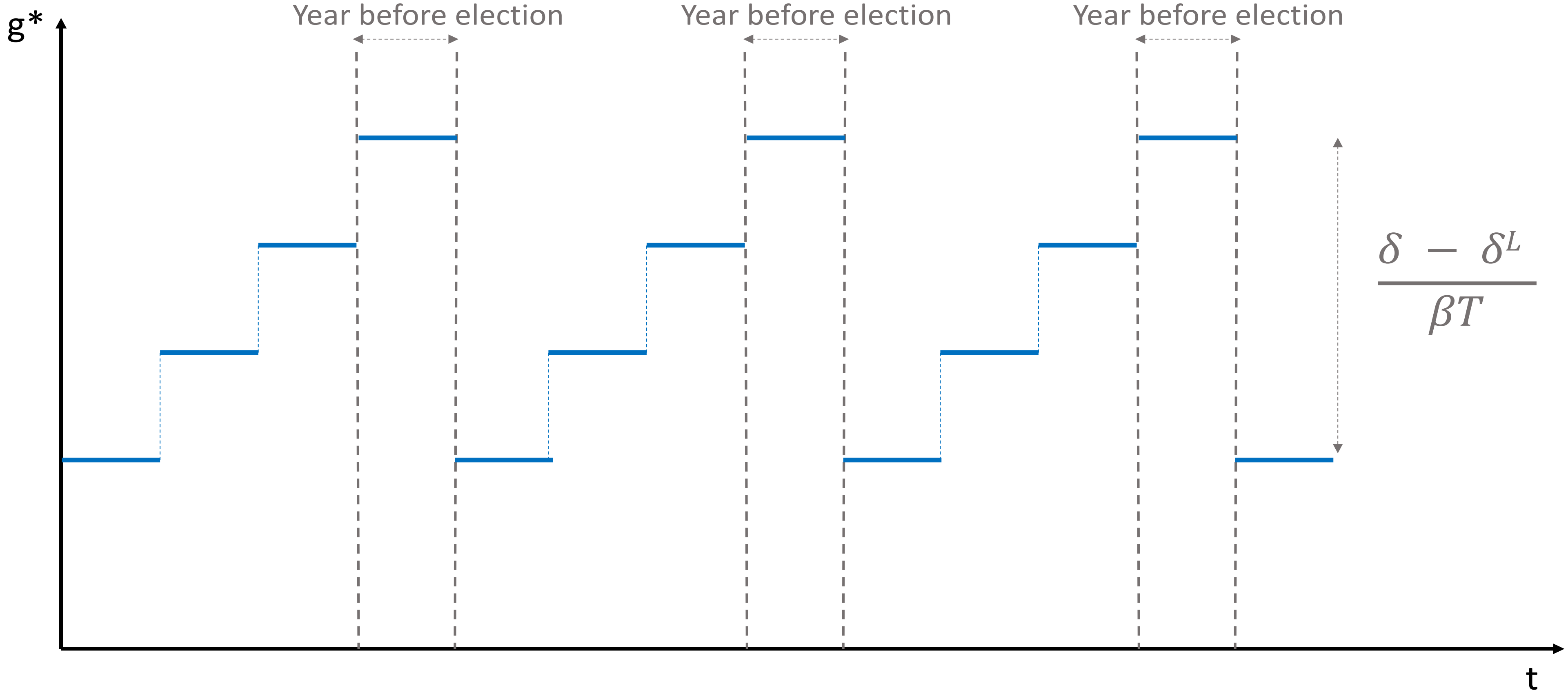
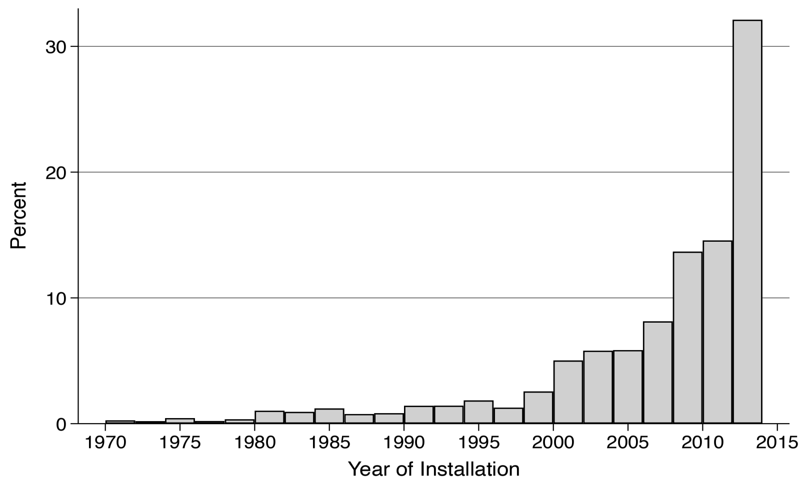
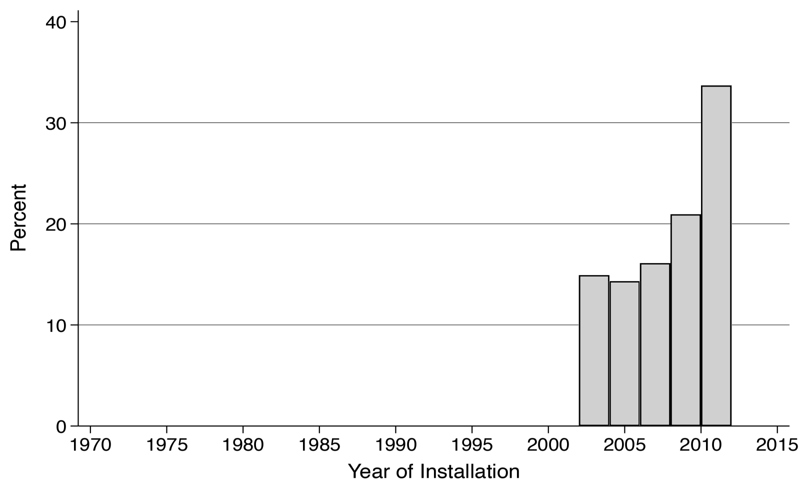


Figure A2: Distribution of Years Installed

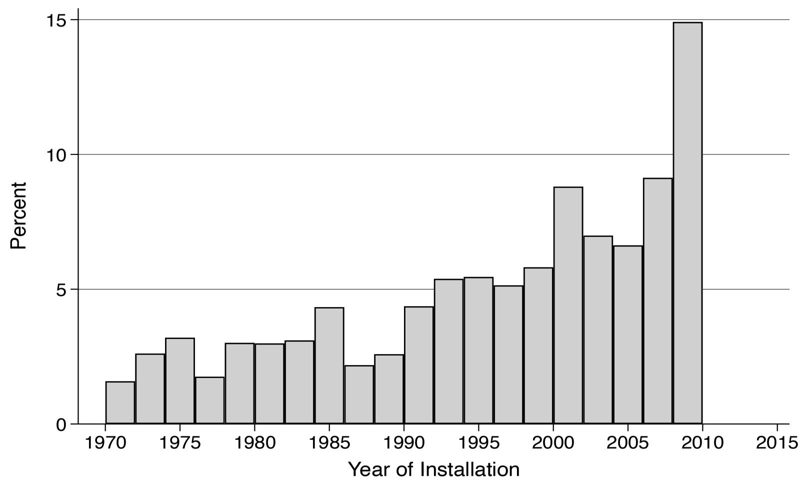
Nigeria



Sierra Leone



Tanzania



Notes: The figures show the histograms of installation years of water sources in the sample dataset for Nigeria (top); Sierra Leone (middle); and Tanzania (bottom). The bin width is two years. For data on water resources, we use the National Water Supply and Sanitation Survey 2015 for Nigeria; the Sierra Leone Waterpoint Atlas of 2012; and the Water Point Data Exchange for Tanzania.

Table A1: Robustness: Year Before Election Dummy

OLS Estimates
Dependent Variable: Functionality of Water Points [Functioning=1]
Robust Standard Errors in Parentheses

	(1) Nigeria	(2) Sierra Leone	(3) Tanzania
Year before election	0.025***	0.032***	0.012**
	(0.005)	(0.005)	(0.005)
Dummy for Public Installer	-0.103***	-0.091***	-0.027***
	(0.005)	(0.009)	(0.005)
Linear Trend	Yes	Yes	Yes
District fixed effects	Yes	Yes	Yes
Observations	54387	17765	52428
Adjusted R-squared	0.13	0.040	0.16

Notes: * p< 0.1; ** p<0.05; *** p<0.01. Robust Standard Errors in Parentheses. Year before election is an indicator equal to one if the water point is constructed in the year before the nearest election. For data on water resources, we use the National Water Supply and Sanitation Survey 2015 for Nigeria; the Sierra Leone Waterpoint Atlas of 2012; and the Water Point Data Exchange for Tanzania. For demographic and geographical data, for Nigeria we use the 2006 National Core Welfare Indicators Survey and the Nigeria Data Portal; for Sierra Leone we use the 2004 Population and Housing Census; the 2004 Education Statistics of Sierra Leone; and the 2004 Integrated Household Survey; and for Tanzania we use the Basic Statistics Portal. For data on elections we use the African Elections Database and Adam Carr's Election Archive.

Table A2: Production and the Electoral Cycle

RDD Estimates
Dependent Variable: Log Number of Water Points Installed Per Year
Robust Standard Errors in Parentheses

	(1)	(2)	(3)
	Nigeria	**Sierra Leone**	**Tanzania**
After Election [=1 if the year after the election]	0.093	-1.109***	-0.228
	(0.062)	(0.248)	(0.162)
Number of Years Installed After Nearest Election [Negative if Before]	-0.078***	0.601***	-0.025
	(0.027)	(0.159)	(0.074)
After Election x Number of Years Installed After Nearest Election	0.132***	-0.396**	0.077
	(0.040)	(0.192)	(0.104)
District fixed effects	Yes	Yes	Yes
Observations	8882	140	2359
Adjusted R-squared	0.22	0.37	0.12

Notes: * p< 0.1; ** p<0.05; *** p<0.01. Robust Standard Errors in Parentheses. For data on water resources, we use the National Water Supply and Sanitation Survey 2015 for Nigeria; the Sierra Leone Waterpoint Atlas of 2012; and the Water Point Data Exchange for Tanzania. For demographic and geographical data, for Nigeria we use the 2006 National Core Welfare Indicators Survey and the Nigeria Data Portal; for Sierra Leone we use the 2004 Population and Housing Census; the 2004 Education Statistics of Sierra Leone; and the 2004 Integrated Household Survey; and for Tanzania we use the Basic Statistics Portal. For data on elections we use the African Elections Database and Adam Carr's Election Archive.

Technical Appendix

Our data on water systems is sourced from the Water Point Data Exchange and is based on the National Water Supply and Sanitation Survey 2015 for Nigeria, a census of all water resources and schemes in Nigeria; the Sierra Leone Waterpoint Atlas of 2012, the result of a comprehensive mapping exercise led by the Ministry of Energy and Water Resources; and the 2017 Water Point Mapping of Tanzania, led by the Ministry of Water [Water Point Data Exchange, 2015].

Such censuses and mapping exercises consist of visits to all lower-tier administrative units (e.g., villages and districts), even if a functional water point is not registered there, in order to develop a comprehensive picture of the set of water resources that have ever been built [Jiménez and Pérez-Foguet, 2011; Welle, 2010; Verplanke and Georgiadou, 2017; Ministry of Water Resources, 2017; World Bank, 2017*b*]. That is, the waterpoint census initiatives claim to contain all waterpoints built in our study period, irrespective of their functionality status. The credibility of the claim that the data contains all constructed waterpoints is primarily due to the fact that the water infrastructure we study are relatively large and permanent constructions that are well known to communities. The methodology of the exercise - to visit all geographies irrespective of existing registers of waterpoints - ensures comprehensive coverage.

Though there are many countries with observations on the data exchange, the vast majority are either incomplete or suffer from data quality issues. The countries we analyze are all those available that have a complete and coherent set of observations available on the exchange. We assessed all country data available for comprehensiveness - we only used censuses that covered the country as a whole - and data quality - we only used censuses for which the variables required for analysis were generally available for all waterpoints. Further details on other available waterpoint censuses are provided at the Water Point Data Exchange: `www.waterpointdata.org`.

Identification of the characteristics of the waterpoints is done by physical inspection. The census data categorizes each waterpoint's technology as one of the following: Protected spring hand pump; Surface water (lake/river/stream) manual, Unprotected spring hand pump, Unprotected spring manual; Unprotected dug well manual; Protected dug well manual; Protected dug well hand pump; Unprotected dug well hand pump; Tube well or borehole hand pump; Tube well or borehole manual; Tube well or borehole gravity; Tube well or borehole motorized; Protected dug well motorized; Protected spring motorized. In our analysis, we create a binary indicator for whether the water resource was categorized as motorized or had a piped connection (the last six of the proceeding categories). Similarly, the census data specifies the nature of the implementer or provider of the waterpoint where available as public or private. We simply use this categorization as our dependant variable in our analysis of providers.

We combine data on water resources with data on the characteristics of districts using the Basic Statistics Portal for Tanzania [Tanzania Open Data Portal, 2020]. For Sierra Leone we use the 2004 Population and Housing Census; the 2004 Education Statistics of Sierra Leone; and the 2004 Integrated Household Survey. For Nigeria we use the 2006 National Core Welfare Indicators Survey and the Nigeria Data Portal [Nigeria Open Data Portal, 2020].

The population characteristic figures used in the paper are based on the latest available data from the Demographic and Health Surveys (2018 for Nigeria; 2013 for Sierra Leone; and 2016 for Tanzania). For these statistics, an improved water source is defined as one of the following sources: piped water, public taps, standpipes, tube wells, boreholes, protected dug wells and springs, rainwater, water delivered via a tanker truck or a cart with a small tank, and bottled water. Unimproved water sources include: unprotected wells, unprotected springs, and surface water (such as rivers, dams, lakes, ponds, streams, canals, and irrigation channels). The conflict data is the total number of conflicts recorded in the district per year, covering 1997 to 2020 from the Armed Conflict Location and Event Data Project (ACLED).

Our data on local elections for each country is from the African Elections Database and Adam Carr's Election Archive [Nunley, 2020; Carr, 2020]. In each country we study, we focus on elections corresponding to those officials with most substantive influence over the provision of water resources. Throughout the period we study, the responsibility for providing citizens with water resources has varied across time and the three countries we study. During most of the period in Nigeria and Tanzania, members of parliament and the executive offices over which they have influence have been either substantively involved in the delivery of water systems or have significant influence over their delivery. Thus, for consistency we focus on parliamentary elections throughout our analysis for those countries. For Sierra Leone, given our focus on a more recent time period, we note the fact that the Local Government Act of 2004 decentralized responsibility for water system construction and management to local governments, and thus our focus is on council elections there.

(a) Basic Water Source

(b) Medium Complexity Water Source

(c) High Complexity Water Source

Figure B: Different Types of Water Sources by Complexity