ECONOMIC DEVELOPMENT & INSTITUTIONS

EDI WORKING PAPER SERIES

PROMOTING ACCOUNTABILITY IN PUBLIC PROJECTS: DONORS, AUDITS, AND RURAL ELECTRIFICATION



Catherine D. Wolfram †
University of California, Berkeley

Edward Miguel
University of California, Berkeley

Eric Hsu
University of California, Berkeley

Susanna B. Berkouwer
University of Pennsylvania

March 2021

Oxford Policy Management · UKaid from the British people · Université de Namur · Paris School of Economics – École d'économie de Paris · ADE Analysis for economic decisions

Abstract

International donors and governments require contracting mechanisms that provide accountability in order to mitigate leakage and corruption in public infrastructure projects, especially when construction is outsourced to private sector contractors. This is an important goal because low-income countries spend on average 15% of GDP on public procurement. One mechanism that is less commonly studied is donor conditionality, where international aid donors attach stringent conditions to the financing provided. Does conditionality improve the quality of infrastructure construction, and how does this compare to independent audits? We study this question in the context of one of Kenya's largest public infrastructure projects: the Last Mile Connectivity Project, which seeks to achieve universal household electricity access by 2022. We exploit two sources of variation. First, to examine the impacts of donor conditionality, we exploit quasi-random donor assignment in the first phases of LMCP construction, in which construction sites across the country were assigned to be funded either by the World Bank or the African Development Bank. Second, to examine the impacts of third-party monitoring, prior to construction we announce construction audits for a randomly selected subset of construction sites. Our novel on-the-ground engineering assessments measure detailed site-level outcomes around the timing of construction progress and the quality of a host of network attributes, including transformers, conductors, poles, and household connections. We find that the World Bank's relatively stringent conditions, and our randomized independent auditing intervention, both improve construction outcomes by around 0.2 standard deviations on various outcomes. But, importantly, the World Bank's restrictions cause significant delays of several months on average. Future work will build on these preliminary findings by investigating the channels through which these results arise.

JEL codes: F35, H54, L94, O13, O18, O22, Q48.

Keywords: Value-added tax, size-based regulation, reporting rules, notches, bunching.

About Economic Development & Institutions
Institutions matter for growth and inclusive development. But despite increasing awareness of the importance of institutions on economic outcomes, there is little evidence on how positive institutional change can be achieved. The Economic Development and Institutions – EDI – research programme aims to fill this knowledge gap by working with some of the finest economic thinkers and social scientists across the globe.

The programme was launched in 2015 and will run until 2021. It is made up of four parallel research activities: path-finding papers, institutional diagnostic, coordinated randomised control trials, and case studies. The programme is funded with UK aid from the UK government. For more information see http://edi.opml.co.uk.

UKaid
from the British people

---

* Authors are ® Certified Random. Wolfram: U.S. Department of the Treasury, on leave from Haas School of Business, University of California, Berkeley and NBER, catherine.wolfram@treasury.gov. Miguel: Department of Economics, University of California, Berkeley and NBER, emiguel@berkeley.edu. Hsu: Department of Economics, University of California, Berkeley, eric.hsu@berkeley.edu. Berkouwer: The Wharton School, University of Pennsylvania, sberkou@wharton.upenn.edu. The views expressed in this article do not necessarily represent the views of the United States or the U.S. Department of the Treasury We thank the DFID Economic Development and Institutions initiative for generous financial support. Carolyne Nekesa, Jane Adungo, and Joseph Otieno superbly implemented field activities. We thank Oliver Kim, Nachiket Shah, Felipe Vial, Aidan Wang, and Katie Wright for excellent research assistance. A Pre-Analysis Plan was registered with the AEA RCT Registry (ID 2389). This project had IRB approval in Kenya (Maseno MSU/DRPC/MUERC/27/13) and in the U.S. (Berkeley CPHS 2016-11-9365).

1 Introduction

When a low-capacity state outsources public goods provision to private sector contractors, a lack of accountability mechanisms can lead to high rates of leakage and corruption. In rigorous and competitive democracies, electoral incentives may generate accountability (Briggs, 2019; Burgess et al., 2015; Casey, 2015). Independent monitoring has also been shown to increase state performance, especially when actors are engaged in a multi-period game credible threats where underperformance affects future outcomes. (Duflo et al., 2018; Ferraz and Finan, 2008; Finan et al., 2017; Olken, 2007). When these public goods are financed by large international donor agencies, as in foreign aid, a common accountability mechanism consists of stringent conditions on the usage of financing. However, the question of aid effectiveness and conditionality has long been outstanding (Easterly, 2003; Öhler et al., 2012; Temple, 2010).

We study these issues in the context of Kenya's national Last Mile Connectivity Project (LMCP), which aims to connect all Kenyan households to electricity by 2022. The first phase of the LMCP, costing USD 400-million, is funded by the World Bank and the African Development Bank (AfDB), in combination with Government of Kenya (GoK) funding. Each donor has its own set of conditions aimed at limiting corruption and improving construction quality at local construction sites that were assigned to that funder. Project implementation will be managed by the majority government-owned electric utility, the Kenya Power and Lighting Company ('Kenya Power'), but on-the-ground construction at the nearly 20,000 transformer sites will be outsourced to up to 42 individual private sector contractors, selected through an international competitive bidding process. In addition to limiting private leakage of funds, these processes were designed to prevent the mis-allocation of funds towards electoral activities in the recent 2017 Kenyan national elections, which we document in Wolfram et al. (2021).

First, we leverage quasi-random assignment of construction sites to follow the conditions of either the World Bank or the AfDB. Second, we notify independent contractors of a random subset of sites that were selected for independent monitoring. We then conduct on-the-ground engineering surveys of construction quality, and socioeconomic surveys on household construction, and combine this with administrative progress reports on infrastructure construction, to investigate how donor conditionality and independent monitoring affect infrastructure construction.

We generate three main findings. First, the World Bank contracting requirements cause significant construction delays, with households in World Bank-funded sites receiving electricity on average several months after households in AfDB-funded sites. Second, these delays lead to small improvements in the quality of network configuration, however we do not find significant improvements in overall construction quality, household installation quality, or reliability and safety. Finally, independent monitoring backed jointly by the utility and the two international donor agencies generates significant improvements in household installation quality and electricity usage, of similar magnitudes.

Studying accountability in the context of rural electrification is important because governments in low- and middle-income countries are increasingly implementing mass electrification programs.

Poor construction quality can lead to poor reliability and power quality, and this may limit the socioeconomic impacts of electrification. Blimpo and Cosgrove-Davies (2019) find that in some countries in Sub-Saharan Africa, "more than half of connected households reported receiving electricity less than 50 percent of the time in 2014," and that this may undermine the economic growth that household connections were designed to generate. Lee et al. (2020), for example, find that transformer outages in a similar rural region of Kenya frequently last for more than four months, and may therefore contribute to the low uptake and impacts of household electricity. Burlig and Preonas (2016) find similarly limited impacts in India's nationwide electrification project. To the extent that low quality infrastructure exacerbates poor power quality, in turn stagnating economic growth, identifying opportunities to improve construction quality may lead to significant improvements in economic outcomes.

The rest of this paper proceeds as follows. In Section 2 we provide additional background on electricity infrastructure construction. In Section 3 we present our empirical design and in Section 4 we describe our data collection process. Section 5 presents the results and Section 6 concludes.

2 Kenya's Last Mile Electricity Project

On May 27th, 2015, Kenya's President Uhuru Kenyatta announced the launch of the Last Mile Connectivity Project (LMCP), whose goal was *"to connect one million new customers to electricity each year"* (Kenya Presidency, 2015). The program would primarily target households living near existing transformers, who could be connected to the existing local electricity network at relatively low cost. In a press conference two weeks after President Kenyatta's announcement, Kenya Power's then Managing Director Ben Chumo added that the program was designed to facilitate *"the government's objective of providing 70% households with electricity by 2017 and universal access by 2020"* (Kenya Power, 2015b).

As of 2019, there were around 60,000 transformers across Kenya, which convert high- and medium voltage power (33kV or 11kV respectively) down to low voltage levels (usually 0.415kV) that can be connected to households via local conductors. In many rural areas, these transformers were constructed between 2005 and 2013 as part of a nationwide push by Kenya Power to connect all markets, schools, health centers, and water points to electricity (REA 2008, Berkouwer et al., 2018).

The LMCP aimed to extend the low voltage network to connect every household located within a 600 metre radius of the transformers selected for the program, a process referred to as 'maximization'.[1] The number of unconnected households to be connected per LMCP site was usually between 20 and 100. Eligible households benefit from a reduced price to get an electricity connection, from USD 350 down to USD 150. The program was also touted as reducing the red tape frequently associated with new electricity connections: the long and laborious process of applying for electric-

[1]Households could choose not to get connected. In practice, this was rare, although some (mostly elderly) residents did make this decision. While statistics of this phenomenon are not available nationwide, Lee et al. (2020) find that four percent of participants randomly selected2 to receive a free electricity connection chose not to receive one.

ity, which often required months of paperwork, would be replaced by a system where Kenya Power contractors proactively visit households to initiate connections, with minimal effort for households.

The total USD 500 million cost of the LMCP was jointly funded through loans from the AfDB and the World Bank, together with loans from the European Union and the Agence Française de Développement (AFD) as well as funding from the Government of Kenya (GoK). The AfDB portion of the LMCP consisted of two phases, each of which would maximize 5,320 existing transformers at a cost USD 135 million, of which almost 90 percent would be funded through an AfDB loan (Kenya Power, 2017). A World Bank loan of USD 150 million would cover the cost of the maximization of an additional 3,200 transformers, for a total of 13,840 transformers across these three phases.[2]

2.1 Site Selection

The process of selecting which 10,640 transformers would be included in Phase I of the LMCP consisted of several steps, implemented jointly by Kenya Power, the Government of Kenya, and the two international agencies. The first step was assigning how many transformers would be maximized in each of Kenya's 47 counties, and in each constituency within each county. The distribution of transformers across constituencies was intended up be done in a equitable fashion, with particular emphasis toward areas with less electricity access prior to the LMCP. Once each constituency had been assigned a number of transformers, Kenya Power engaged in a back-and-forth conversation with the local Member of Parliament (MP) for that constituency to determine exactly which transformers in the constituency would be maximized.

As will be discussed in Section 3.1, within our five-county study area, every constituency includes at least one transformer selected for AfDB Phase I and one transformer selected for World Bank Phase I. We therefore include constituency fixed effects in our main regressions. We discuss the quasi-random nature of donor assignment and our approach to the identification of causal effects in more detail in Section 3.1.

2.2 Corruption and Contracting

Events in recent years have raised widespread concerns that corruption within Kenya Power (including materials theft) and political interference could jeopardize the quality, cost-efficiency, timeliness, and equity of the construction process (ESI Africa, 2020; Kenya Power, 2018, 2020; The Star, 2018). In one egregious case of corruption, Kenya Power's CEO Ken Tarus and his immediate predecessor Ben Chumo were arrested in July 2018 alongside several other senior member's of Kenya Power's management (Reuters, 2018). They were eventually charged—alongside several other high-ranking Kenya Power officials—with various charges relating to corrupt procurement practices that resulted in the loss of more than USD 2 million worth of public funds, with Tarus charged with an additional

[2] Additional funding included funding by the World Bank to install 1,000 new transformers, as well as funding by the French Development Agency for maximization of additional transformers. Those projects are beyond the scope of this paper.

USD 1.5 million worth of fraudulent payments also related to fraudulent procurement practices.[3]

These types of events are not unique to Kenya. The World Bank defines corruption as *"the abuse of public funds and/or office for private or political gain"* (World Bank 2015)., and over the past 20 years has increased its efforts to combat corruption at all levels. One such lever is the blacklisting by the World Bank or AfDB of private contractor with egregious performance. This has happened several times to LMCP contractors (Kenya Power, 2018; Spotlight East Africa, 2020). Being blacklisted in this manner generally applies globally—underperformance in one country can lead to disqualification from contracts in other countries—which is why independent monitoring by agencies that frequently provide large contracts across multiple countries is a meaningful economic threat for contractors.

> "To prevent fraud and corruption in a Bank project, the Borrower must strictly adhere to the commitments and procedures spelled out in the Loan Agreement with the Bank. The Loan Agreement implicitly or explicitly contains the Bank's anticorruption policy and specific clauses, relating to procurement, financial management, and disbursement procedures, that are designed to minimize the risk of corruption in the project."
>
> World Bank Staff Guide, 2000

For Phase I of the LMCP, Kenya Power awarded 35 contracts to domestic and international private sector contractors. Each contractor was responsible for a specific section of the construction process (detailed below), for all sites assigned to that funder that are located in a specific geographic area, often delineated as a subset of Kenya's 47 counties.

Beyond this basic setup, the two international agencies employed different contracting methodologies. The AfDB used what is known as a 'turn-key' system. For Phase 1, the nationwide list of transformers was subdivided into 10 geographically clustered lots, each consisting of several hundred transformers that were to be maximized. Whichever contractor won a particular lot would be responsible for the entire construction process of all transformers in that lot. This process included identifying unconnected and eligible households at each transformer site, developing engineering designs for an efficient extension of the low-voltage network to reach all households, procuring the materials required to complete those designs, and implementing construction. The only part of the process that was segregated was a single lot issued for the procurement of all meters nationwide, which was done to allow Kenya Power to have to connect its billing systems to only a single metering technology across all sites. Once all steps had been completed, the AfDB would hand off the site to Kenya Power for final activation of each connection.

Rather than providing turn-key contracts, the World Bank segregated contracts across construction phases. A single lot was first allocated for a single contractor to complete design of all sites nationwide. Procurement of materials was separated into 17 separate lots: 6 lots for the supply of wooden poles, 4 for concrete poles, 3 each for conductors and cables, and one lot to supply all meters

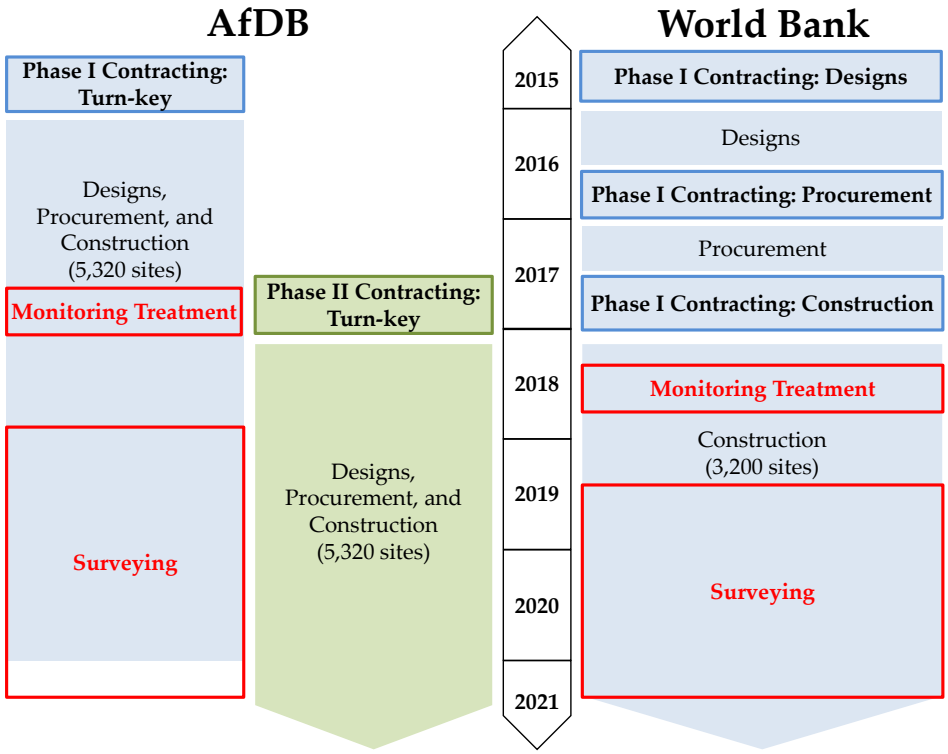
[3] As of mid-2020 litigation was still ongoing, and was experiencing further delays due to the Covid-19 pandemic (The Star, 2020).

nationwide. Once these contracts had been signed, the World Bank issued 6 lots for the construction of the proposed designs using the procured materials, with each lot containing a geographically clustered set of sites.

The staggered nature of the World Bank requirements causes significant delays. For example, the request for proposals for procurement contracts cannot be published until the engineering designs are finalized, as this determines procurement requirements. When factoring in bid writing, bid elicitation, bid review, and actual contracting, the whole contracting process can take months.

Kenya Power and the AfDB signed 11 contracts to launch Phase 1 in December 2015 and an additional 15 contracts to launch Phase 2 in November 2017 (Kenya Power, 2015a, 2017). Notably, in November 2017, when AfDB signed turn-key contracts for *Phase II*, the World Bank signed the final eight contracts required to commence construction for *Phase I*. Figure 1 compares the construction timeline for each donor agency.

Figure 1: Timeline of contracting and construction by donor



Timeline of the experimental components and the contracting process for each international donor agency. The timing of surveying was ordered to follow construction progress. The AfDB used turn-key contracting while the World Bank separated its contracting into individual stages. By the time the World Bank had completed its Phase I contracting process and was ready to begin construction in early 2018, the AfDB Phase I was approaching completion, and AfDB was launching its Phase II. AfDB sites that had been completed prior to the implementation of the monitoring treatment in late 2017 were excluded from randomization.

To monitor contractors, Kenya Power employed two consultants to track construction progress and inspect a small subset of projects post-construction. But this internal monitoring process is limited, of little consequence for future contracts, and, at least anecdotally, provides widespread

opportunities for leakage. Additional monitoring by an independent group that is not contracted by Kenya Power may therefore help reduce collusion in this context.

2.3 Construction specifications

The tender documentation for the World Bank and the AfDB contained highly detailed specifications for construction materials, including the exact materials and installation of poles, wiring, conductors, meters, fuses.

A correctly installed electricity connection with a functioning meter is of little use without the power sockets and lighting installed to allow households to benefit from that electricity. For many households, the most tangibly impactful component of construction was thus the final household connection. Prior to being connected under the LMCP, households were responsible for installing—or hiring a local handyman to install—internal wiring, which we define as anything between the meter and the appliances a household consumes. Our surveys indicate that households who were connected prior to the LMCP on average spent USD 125 on internal wiring.

For most households, the internal wiring was thus a significant financial and logistical barrier, on top of Kenya Power's connection fees. To address this issue, Kenya Power decided to provide certain low-income households with an electrical panel that would allow them to be connected without wiring being completed beforehand. In May 2015, President Kenyatta described this policy as follows: *"The Ministry of Energy has also come up with designs that will enable households that do not have internal wiring in their houses to use electricity by providing a 'ready board'. The ready board has switches, sockets and bulb holders and those who do not have wiring in their houses will be able to use electricity soon as they are connected."* (Kenya Presidency, 2015)

2.4 Electricity consumption

Beneficiaries under the LMCP are connected via 'pre-paid' Kenya Power meters, meaning they must buy electricity credits in advance of using electricity. Once they consume their prepaid electricity, they are disconnected, and only re-connected only after they buy more credits.

In addition to the lowered aggregate price, households also benefited from the option of paying via 36 monthly installments of around USD 4 per month. This cost was to be automatically added to their accounts on a monthly basis, and any electricity payments the household made were directed towards paying off this debt prior to being directed towards electricity credits. In other words, if a household runs out of electricity credit in January, and then does not consume any electricity in February or March, they would accrue 3 months worth of connection fees, and would have to pay at least USD 12.01 to be able to consume any electricity in April.

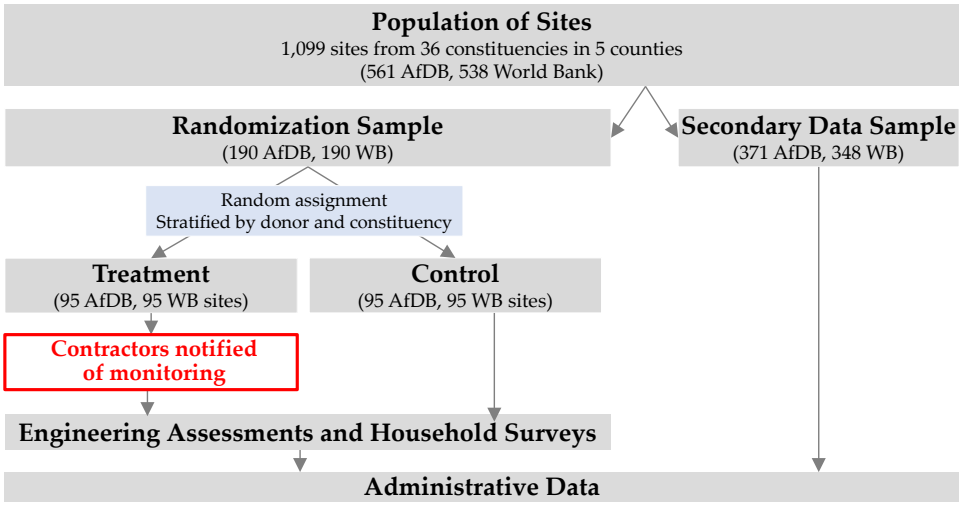
Anecdotally, it appears common not only that this poses a significant financial barrier for low-income households, but that this financial barrier was unanticipated. In other words, many households may not have been fully informed that connection would require them to make 36 monthly payments of more than USD 4 each. Kenya Power indicated that households should have been

informed in detail as part of the consent process, which was the very first step in the construction process. To verify whether this process was correctly implemented, and to test whether donor conditionality and monitoring can improve adherence to these guidelines, our household survey includes questions designed to measure the respondent's understanding of the aggregate costs of an electricity connection under the LMCP.

3 Research Design

To estimate the causal impact of two potential sources of accountability on construction outcomes, we implement a randomized monitoring program, and exploit quasi-random assignment of construction sites to two different international doors. In this section we describe these two sources of variation in more detail. Figure 2 provides an overview of these elements in the context of our research and data collection activities.

Figure 2: Project design



This figure displays the sample selection and randomization process. From the full population of sites in our 5 study counties, we select 380 to be included in the randomization sample. We randomly assign 190 to the monitoring treatment group and 190 to the monitoring control group, stratifying by donor and by constituency. We conduct engineering surveys at a subset of sites, and collect administrative data for the population of sites. The monitoring treatment was implemented in 2017-2018; assessments and surveys were done 2018-2021 (see Figure 1 for more detail). The Secondary Data Sample is left for future analysis.

3.1 Quasi-random international donor requirements

Strict upfront contracting procedures can provide one form of accountability. Despite the importance of 'donor conditionality' in much of the public discourse around foreign aid policy, the extent to which it improves construction quality remains largely an open question. Importantly for us, the two major donors of the Kenya LMCP—the World Bank and the AfDB—each attach starkly different conditions to the funding they have provided to Kenya Power for the project. To a first order, the World Bank's conditions are more stringent than the AfDB's, which World Bank officials hope will

prevent leakage of materials and funds. These conditions include greater involvement by the World Bank in the bidding process, the selection of contractors, the quality and costs of construction materials, and the detail with which Kenya Power can observe contractors' performance during the process. The AfDB takes a hands-off approach, largely delegating these procedures to Kenya Power in what they term a 'turn-key' approach. Anecdotally, we have heard some electricity sector officials assert that the World Bank conditions are actually quite onerous and can lead to unnecessary construction delays without delivering meaningful quality improvements.

Such conditions have potentially large implications for construction outcomes, but little is known empirically about the real-world effects of such donor conditionality. In particular, do World Bank conditions reduce leakage of materials, and improve objective project construction quality and timeliness? To explore these questions, we exploit the fact that LMCP sites were quasi-randomly assigned between World Bank funding and AfDB funding. Extensive conversations with officials at Kenya Power indicate that there was no systemic methodology for assigning sites to one donor or the other. Furthermore, nearly all local Kenyan constituencies contain both World Bank and AfDB constructed sites (allowing us to control for area fixed effects in the estimation).

Panel A of Figure 3 provides a map of the nationwide distribution of construction sites, with each site colored according to the donor that funded it. In line with explanations provided by the donors and the electric utility, there do not appear to be systematic differences in how donors were assigned to sites. Within each county, roughly equal numbers of sites are assigned to each donor.

Out of 8,520 nationwide Phase I LMCP sites, we identify 1,139 that are located in five counties that we focus on in this study: Kakamega, Kericho, Kisumu, Nandi, and Vihiga.[4] Panel B of Figure 3 displays the locations of this subset of sites.

3.2 Randomized Monitoring

Out of the 1,139 sites in the region, we select 380 sites for inclusion in the randomized monitoring experiment.[5] We assign 190 of these sites to the treatment group and 190 sites to the control group. Treatment assignment is stratified by what constituency the site is in, and what donor the site is funded by.

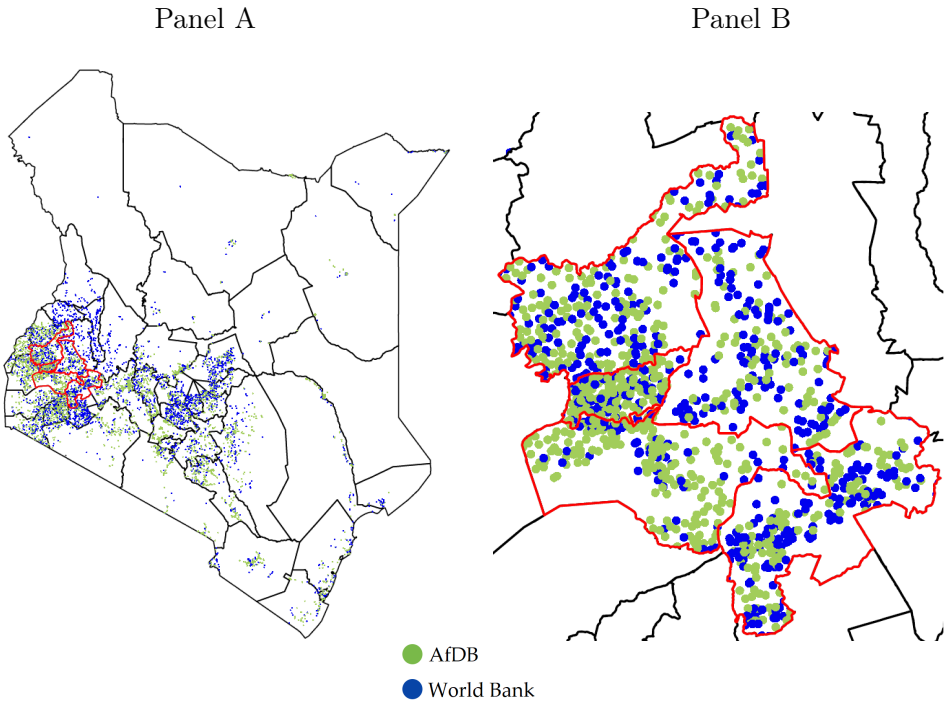
The randomized monitoring is implemented jointly with the World Bank and the AfDB as follows. During in-person meetings set up for this purpose, members of the research team notify contractors that an independent, international team of engineers will audit a specific list of selected sites once construction is complete. During the meeting they provide formal, written notification that is signed by senior management at Kenya Power, the World Bank, and the AfDB. This notification also includes the specific set of sites within their contract region that were selected to be audited. A copy of this notification is included in Figure A1.

In our communications with World Bank officials (in both Washington D.C. and Nairobi), the

[4]The location was missing for 1,123 LMCP Phase I transformers–it is possible that some of these were also located in one of the five study counties.

[5]This matches the sample size specified in our Pre-Analysis Plan, available via the AEA RCT Registry.

Figure 3: Sites by World Bank or African Development Bank status



Panel A displays locations of all LMCP sites nationwide by whether each site was funded by the World Bank or the African Development Bank. Highlighted in red are the five counties where we conduct engineering and socioeconomic surveys (Kakamega, Kericho, Kisumu, Nandi, and Vihiga). Panel B focuses on this area. There does not appear to be geographic clustering by donor in the study area.

World Bank indicated they would take contractor-level evidence of leakage (on both World Bank and AfDB funded projects) into account in future contracting. This setup can therefore be thought of as a repeated game environment. Contractors depend on their repeated relationship with international organizations such as the World Bank and the AfDB for future projects in many sectors (even beyond electricity), providing an incentive for contractors to implement high-quality infrastructure projects, or at least to be perceived as doing so. To exploit contractors' incentives to perform well during a given contract in order to win future contracts, the notification states this explicitly.

The list of sites that each contractor is told will be audited is in fact a randomly selected subset of the full set of sites that are surveyed by our research team. Given the random selection, any difference in construction outcomes between the sites about which contractors are notified and the control sites can be attributed to contractors' response to the monitoring.

4 Data

Our study design combines rich nationwide administrative and spatial planning data on construction progress at thousands of construction sites, provided by the electric utility, with on-the-ground engineering and socioeconomic surveys.

In line with our Pre-Analysis Plan, our survey team begins by conducting frequent short assessments at all 380 sites to determine the status of construction progress at each site (Berkouwer et al., 2019). As of March 15, 2021, we had completed surveying activities at 208 sites, Construction had still not been completed in 152 sites (77 of which had some partial construction), limiting our surveying activities to only short assessments of the expected timeline of construction. 11 sites had been dropped for logistical reasons. 9 sites were found to be completed shortly before our field activities ended. In future work, we may resume data collection at these small number of completed sites as well as sites with partially complete construction.

To minimize differences caused by the delay of construction, surveys are conducted between six and twelve months after construction is reported to have begun at a site.[6] Roughly half of our surveying sites are World Bank sites and half are AfDB sites.

4.1 Engineering assessments

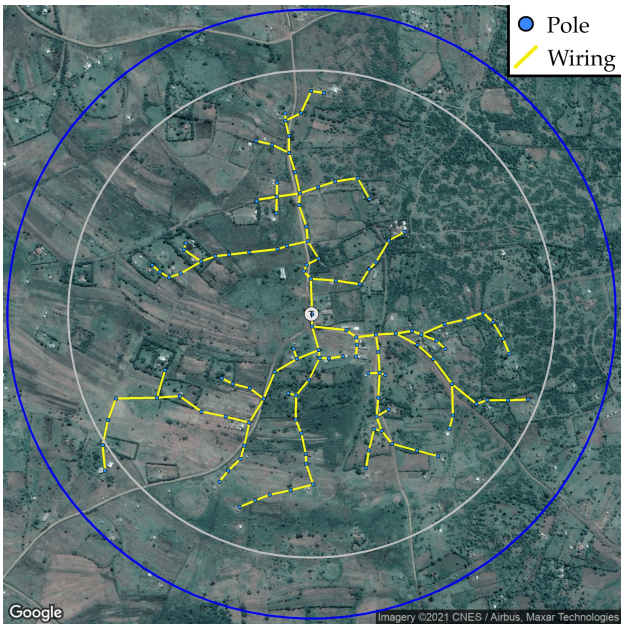
We deploy a novel technical engineering assessment to record detailed measurements on the quality of the materials and construction of the electricity network in each sample transformer community. The engineering assessment consists of two parts. In the initial infrastructure census, field officers systematically record the locations of all poles in the low-voltage network, as well as their connectivity, up to 700 meters from the existing transformer. As well, they document the number of poles in the low-voltage network that are further than 700 meters from the transformer and are within sight of the poles that surveyed in detail. The 700 meter radius exceeds the government guideline of 600 meters, and therefore allows us to test whether construction was completed beyond the eligible region. In cases where the local network was too large to complete in a single day, field officers selected a random subset of phases to assess, and then recorded all poles in every selected sub-phase. The field officers also recorded the number of drop-down cables (the final connection between a customer meter and the electricity network) connected to each pole, whether the drop-down cable connected a residential compound or a firm, as well as any unconnected compounds located near the pole. Figure 4 displays an example of the on-the-ground measurements record in this first part of the engineering assessment.

In the second part of the engineering assessment, the field officers record more detailed measurements for each pole and line in the network. The detailed measurements include quality measurements of the pole itself, such as angle relative to the ground, whether it is wood or concrete, whether it is firmly placed in the ground, whether it has a pole cap, and whether it has any visible cracks. Additional pole measurements include whether it has the appropriate grounding wires, stay wires, and struts; and whether the stay wires and struts are correctly installed and have correctly installed insulators (if applicable).[7] Measurements taken of the conductors (wiring) that connect the poles include whether it has appropriate ground clearance and clearance from other objects

[6] Due to logistical constraints, in some cases surveys were conducted several months earlier or later.

[7] For a random 10 percent subset of poles (or one out of every 6th pole in case the network has more than 120 poles) we also collect data on additional pole attributes, such as pole height, circumference at various points, and characteristics of each strut or stay that provides support for that pole

Figure 4: Infrastructure data collected (example site)



This map displays the construction data collected at an example site (Figure A2 presents additional examples of sites). The grey line denotes 600 meters and the blue line denotes 700 meters from the transformer ('T') at the center. We record the locations of poles, lines connecting poles, and infrastructure quality. After the infrastructure census, we conduct socioeconomic surveys at up to ten randomly selected residential compounds and firms. We describe this in Section 4.2.

(such as flora or structures), and whether any electric lines cross. Measurements of the drop-down cables from the pole to the customer include the distance between the pole and the customer's structure, and whether the cable ends at a meter or whether it appears to be an illegal connection. Finally, measurements of the central transformer at each site include whether the poles on which the transformer is mounted are leaning excessively, the number of missing or bypassed fuses, and whether the transformer has any other obvious defects.

4.2 Household and firm survey data

After the infrastructure census had been completed, a random subset of the (connected and unconnected) residential compounds and firms that had been recorded at the end of drop cables were selected for more detailed socioeconomic surveys.[8] Households and firms were surveyed after the construction has been completed to understand both their experience with the construction process, and potentially, how heterogeneous construction quality impacts community experiences with electricity. For example, we have heard anecdotally that some households have been asked to dig their own holes for distribution poles (against Kenya Power policy), so we can evaluate whether any of our three interventions impact the likelihood that this occurs. Higher quality construction and installation could also potentially reduce local power outages and increase power reliability, which

[8] Field officers were not always able to reach exactly six households and two firms.

could have tangible benefits for household well-being and firm productivity and profits. The original survey data will gather information on a wide range of household and firm economic outcomes and overall satisfaction with electrification.

We also ask how many meters are at the compound, and how many they requested. Anecdotal evidence suggests that multiple meters are often installed within a single home compound, suggesting that Kenya Power may be overstating the total number of households that are connected nationwide.

4.3 Summary Statistics

Table 1 presents summary statistics on transformers, poles, and households surveyed at 208 transformer sites.[9] At around one quarter of transformers at least one fuse was missing or had been bypassed. We surveyed on average 87 poles per site, of which about a quarter had a large crack. 95 percent of surveyed households were connected in 2016 later, and the median year in which households were connected was 2019.

Table 1: Summary statistics

	Mean	SD	25th	50th	75th	N
Transformer missing fuse	0.24	0.43	0	0	0	202
Number of transformer lines	3.18	1.01	3	3	4	202
Number of poles	87.22	36.63	63	82	109	206
Number of leaning poles (<85deg)	1.95	2.74	0	1	3	206
Number of cracked poles	23.36	18.23	11	19	33	206
Number of stays	55.92	24.97	38	53	71	206
Households surveyed	3.28	1.75	2	3	5	208
Connected households surveyed	2.63	1.67	1	2	4	208

5 Results

Table 2 presents the main results of regressions studying the impact of donor conditionality and independent monitoring on engineering and socioeconomic outcomes. The primary outcomes are indices of the outcomes described in Section 4. All indices are standardized to have a mean of 0 and a standard deviation of 1. First, we find that the randomized monitoring treatment generates a significant improvement of 0.29 standard deviations in the quality of household electricity connection installations. This included information on, for example, whether the household had a working electricity connection, a working meter, a readyboard, and whether they had the correct number of meters. This result is meaningful because, in turn, this generates a 0.17 standard deviation increase in household electricity usage. The index reflects recent purchases of electricity tokens, the hours of daily electricity usage, and the number of appliances the household owns.

We find that the World Bank conditions caused significant delays in construction progress by 0.73 standard deviations. We do not find any differences in aggregate construction quality, house-

[9] As of March 15, 2021, the collection, cleaning, and analysis of data for additional sites is still ongoing.

hold installation quality, or reliability. We do find a 0.31 standard deviation improvement in the network size and configuration index, and significant improvements in household knowledge of the electrification process and household electricity usage as well.

Finally, we find that construction progressed significantly more rapidly in areas that voted for the incumbent. For a more detailed treatment of possible political factors in this context, see Wolfram et al. (2021).

Table 2: Primary outcomes

	Audit Treatment		World Bank		Voted for Incumbent	
Outcome 1: Construction quality index	-0.07	196	-0.23	196	0.04	195
	(0.13)		(0.15)		(0.54)	
Outcome 2: Network size and	0.00	196	0.31**	196	-0.84	195
configuration index	(0.16)		(0.14)		(0.51)	
Outcome 3: Construction timing index	-0.07	196	-0.73***	196	0.97***	195
	(0.12)		(0.13)		(0.32)	
Outcome 4: Household installation	0.29***	659	0.12	659	-0.30**	468
quality index	(0.09)		(0.10)		(0.14)	
Outcome 5: Household cost, experience,	0.13	659	0.14	659	-0.23*	468
and bribery index	(0.10)		(0.09)		(0.12)	
Outcome 6: Reliability and safety index	0.09	659	0.08	659	-0.21	468
	(0.10)		(0.09)		(0.13)	
Outcome 7: Knowledge index	0.09	659	0.19*	659	-0.09	468
	(0.10)		(0.11)		(0.11)	
Outcome 8: Electricity Usage index	0.17**	659	0.16*	659	-0.26**	468
	(0.08)		(0.09)		(0.12)	

Outcome variables are indices constructed from groups of variables. Each column presents results when the treatment variable is either: (1) the randomized audit treatment, (2) World Bank funded, or (3) in a pro-government area. In rows 1 through 3, observations are transformer sites; standard errors are shown in parentheses. For rows 4 through 8, observations are occupants of connected compounds. Standard errors are clustered by transformer site and shown in parentheses. $^{*} \leq 0.10, ^{**} \leq .05, ^{***} \leq .01$.

6 Conclusion

In this research we evaluate whether donor conditionality and independent monitoring can provide accountability and improve infrastructure construction in when a government outsources public goods provision to private sector contractors. We study this topic in the context of the Last Mile Connectivity Project, which is one of Kenya's largest public infrastructure construction projects. The roughly USD 500 million cost of the program is financed in large part by international donors, including in particular the World Bank and the AfDB. We exploit quasi-random variation in the assignment of specific communities designated for inclusion in the LMCP to be funded by either the World Bank or the AfDB. Contractors who win bids issued by the World Bank are required to comply with the World Bank's relatively more stringent conditions. In addition, we implement an audit treatment where contractors are informed of a subset of sites that are selected for monitoring.

We find that the World Bank's requirements cause significant delays in implementation, with households usually receiving their household electricity connections months later than households in sites that are funded by the AfDB. However, we find modest evidence that these requirements improve the network configuration quality and the accuracy of households' information about the program. The randomized monitoring treatment generates between 0.15 and 0.2 standard deviation improvements in household installation quality and household electricity usage. Finally, an index of the pace of construction progress is almost one standard deviation higher in areas that voted for the incumbent, although we also find that construction of the low-voltage network is not always accompanied by widespread installation of household electricity meters. In ongoing work we disentangle the mechanisms that might contribute to these outcomes.

References

Aguilar, M. A., Gill, J. B., & Pino, L. (2000). Preventing fraud and corruption in world bank projects. *The International Bank for Reconstruction and Development*.

Berkouwer, S., Hsu, E., Miguel, E., & Wolfram, C. (2019). Pre-Analysis Plan for The Political Economy and Governance of Rural Electrification. https://www.socialscienceregistry.org/trials/2389

Berkouwer, S., Lee, K., & Walker, M. (2018). Secondary School Electrification in Western Kenya [AidData Working Paper 57].

Blimpo, M. P., & Cosgrove-Davies, M. (2019). Electricity access in sub-saharan africa : Uptake, reliability, and complementary factors for economic impact. *Africa Development Forum;. Washington, DC: World Bank*.

Briggs, R. C. (2019). Receiving foreign aid can reduce support for incumbent presidents. *Political Research Quarterly*, *72*(3), https://doi.org/10.1177/1065912918798489, 610–622. https://doi.org/10.1177/1065912918798489

Burgess, R., Jedwab, R., Miguel, E., Morjaria, A., & Padró i Miquel, G. (2015). The value of democracy: Evidence from road building in kenya. *American Economic Review*, *105*(6), 1817–51.

Burlig, F., & Preonas, L. (2016). Out of the darkness and into the light? development effects of rural electrification. *Energy Institute at Haas WP*, *268*, 26.

Casey, K. (2015). Crossing party lines: The effects of information on redistributive politics. *American Economic Review*, *105*(8), 2410–48.

Duflo, E., Greenstone, M., Pande, R., & Ryan, N. (2018). The value of regulatory discretion: Estimates from environmental inspections in india. *Econometrica*, *86*(6), 2123–2160.

Easterly, W. (2003). Can foreign aid buy growth? *Journal of Economic Perspectives*, *17*(3), 23–48.

ESI Africa. (2020, February 24). *Kenya Power contests High Court ruling over its tender cancellation* [News Article]. Retrieved January 29, 2021, from https://www.esi-africa.com/industry-sectors/finance-and-policy/kenya-power-contests-high-court-ruling-over-its-tender-cancellation/

Ferraz, C., & Finan, F. (2008). Exposing corrupt politicians: The effects of brazil's publicly released audits on electoral outcomes. *The Quarterly journal of economics*, *123*(2), 703–745.

Finan, F., Olken, B. A., & Pande, R. (2017). The personnel economics of the developing state, In *Handbook of economic field experiments*. Elsevier.

Kenya Power. (2015a, December 10). *KPLC awards contracts for implementation of the Last Mile Project* [Press Release]. Retrieved January 29, 2021, from https://www.kplc.co.ke/content/item/1226/kplc-awards-contracts-for-implementation-of-the-last-mile-project

Kenya Power. (2015b, June 9). *Notes by Dr. Ben Chumo, Kenya Power Managing Director and Chief Executive Officer, During the Press Conference on Implementation of the Last Mile Project* [Press Conference]. Retrieved January 29, 2021, from https://kplc.co.ke/img/full/2nPEsH9Dge4K_Notes%20-%20MD%20-%20Press%20Conference.pdf

Kenya Power. (2017, November 8). *Kenya Power signs contracts for implementation of the Last Mile Connectivity Project* [Press Release]. Retrieved January 29, 2021, from https://www.kplc.co.ke/content/item/2272/kenya-power-signs-contracts-for-implementation-of-the-last-mile-connectivity-project

Kenya Power. (2018, May 24). *Kenya Power to blacklist contractors for shoddy work* [Press Release]. Retrieved January 29, 2021, from https://www.kplc.co.ke/content/item/2513/kenya-power-to-blacklist-contractors-for-shoddy-work

Kenya Power. (2020, March 18). *Kenya Power staff and several other suspects arrested over various crimes undermining quality power supply* [Press Release]. Retrieved March 10, 2021, from https://www.kplc.co.ke/content/item/3484/kenya-power-staff-and-several-other-suspects-arrested-over-various-crimes-undermining-quality-power-supply

Kenya Presidency. (2015, May 27). *Cost Of Installing Electricity Drops To Ksh15,000 With Option Of Instalments*. Retrieved January 29, 2021, from https://www.president.go.ke/2015/05/27/cost-of-installing-electricity-drops-to-ksh15000-with-option-of-instalments/

Lee, K., Miguel, E., & Wolfram, C. (2020). Experimental evidence on the economics of rural electrification. *Journal of Political Economy*, *128*(4).

Öhler, H., Nunnenkamp, P., & Dreher, A. (2012). Does conditionality work? a test for an innovative us aid scheme. *European Economic Review*, *56*(1), 138–153.

Olken, B. A. (2007). Monitoring corruption: Evidence from a field experiment in indonesia. *Journal of Political Economy*, *115*(2), 200–249.

Reuters. (2018, July 16). *Kenya Power's CEO charged in court over economic crime*. Retrieved March 10, 2021, from https://www.reuters.com/article/us-kenya-corruption/kenya-powers-ceo-charged-in-court-over-economic-crime-idUSKBN1K60WG

Rural Electrification Authority. (2008). Strategic plan 2008-2012.

Spotlight East Africa. (2020, May 7). *AfDB blacklists another Chinese Kenya Power contractor over fraud*. Retrieved March 10, 2021, from https://www.spotlighteastafrica.com/post/afdb-blacklists-another-chinese-kenya-power-contractor-over-fraud

Temple, J. (2010). Aid and conditionality (D. Rodrik & M. Rosenzweig, Eds.). In D. Rodrik & M. Rosenzweig (Eds.). Elsevier.

The Star. (2018, December 18). *State lost Sh201m in Kenya Power scandal*. Retrieved March 10, 2021, from https://www.the-star.co.ke/news/2018-12-18-state-lost-sh201m-in-kenya-power-scandal/

The Star. (2020, July 2). *How virus has slowed some high-profile corruption cases*. Retrieved March 10, 2021, from https://www.the-star.co.ke/news/big-read/2020-07-02-how-virus-has-slowed-some-high-profile-corruption-cases/

The World Bank. (2015). Proposed guarantee in an amount equivalent to us$200 million to the republic of kenya for an electricity modernization project.

Wolfram, C. D., Hsu, E., Berkouwer, S. B., Kim, O. W., Vial, F., & Miguel, E. (2021). Decomposing Political Favoritism in Kenyan Mass Electrification [Working Paper].

Appendix Figures

Figure A1: Monitoring Intervention



THE WORLD BANK
IBRD • IDA

Kenya Power

Contractor XYZ
ADDRESS
P.O. Box YYY-ZZZ
Nairobi, Kenya

31 March 2017

TO: CONTRACTOR NAME
RE: ENHANCED MONITORING PROGRAM ("EMP") FOR LMCP MAXIMIZATION SITES

Dear Sir/Madame:

Kenya Power aims to provide the highest quality of electricity to all Kenyans. To achieve this goal, an international team of engineers will closely audit the quality of construction at a number of LMCP maximization sites. These independent audits will be performed as part of the Enhanced Monitoring Program ("EMP"), and will apply to both World Bank and African Development Bank sites. The results of the EMP audits will be shared with project supervisors, financiers, and other international agencies, all of which may impose consequences on future work as they see fit.

Upon project completion, EMP technicians will extensively measure the quality of various aspects of construction, including:

- Distance between poles
- Line sag
- Quality of connection between transformer and LV wiring
- Blackouts and electricity reliability post-connection

We wish to inform you that NN sites that have been awarded to XYZ Contractors have been selected for the EMP. Please find attached a list of these NN sites.

Sincerely yours,

Title. Name	Title. Name	Title. Name
Position	Position	Position
Kenya Power	World Bank	AfDB

This figure displays the monitoring intervention sent to contractors. Each contractor's name, contact information, and site details were entered individually. The names and positions of the relevant representatives from Kenya Power, the World Bank, and the AfDB were entered, and the letter was signed by these parties. The letters were then hand-delivered to management at the relevant contractors by members of our research team to ensure receipt, together with the list of treatment sites referenced in the letter.

Figure A2: Engineering data collected (nine example sites)

