Greasing the Turbines? Corruption and Access to Electricity in Africa[1]

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Abstract

Using survey data from the Afrobarometer, we document that respondents who live in areas where more people report having paid a bribe to access household services are more likely to have access to electricity. The existing literature suggests three mechanisms that could explain why more corruption increases access to electricity. Corruption could incentivize firms to operate in the shadow economy and facilitate them doing so. Corruption could reduce enforcement of the law for electricity theft. Finally, corruption could lower firms' costs by allowing them to reduce the burden of red tape and or ignore standards. The data do not support the first two of these mechanisms suggesting that corruption is "greasing the wheels" for firms in the electricity sector. Supporting this conclusion is the fact that this relationship between corruption and access is only statistically significant in countries where the ease of getting electricity is low and there is private participation in the electricity sector.

Keywords: Corruption, Infrastructure, Electricity Access, Regulation, Privatisation

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1. INTRODUCTION

Access to electricity has the potential to improve a host of development indicators such as income and living standards (Khandker et al, 2012; Khandker et al, 2013: van Gevelt, 2014), consumption (van de Walle et al, 2017), and education (Khandker et al, 2012; Khandker et al, 2013; Kumar and Rauniyar, forthcoming). Labour market supply and outcomes have also been shown to be responsive to electrification with different effects being present for males and females in different contexts (Chowdhury, 2010; Dinkelman, 2011; Grogan and Sadanand, 2013; Dasso and Fernandez, 2015; Salmon and Tanguy, 2016). As electrification reduces reliance on other sources of light and heat, it also improves pollution and health outcomes (Barnes et al, 2009; Barron and Torero, 2017). Studies have also demonstrated effects on economic and human development, and productivity (Lipscomb et al, 2013; Kitchens and Fishback, 2015).

Given this transformative potential, it is very important to establish what features of a society may impede access to electricity. Several studies document that more corrupt countries and regions tend to have lower quality infrastructure (Tanzi and Davoodi, 1997; Kenny, 2009; Gillanders, 2014). Underlying this are the corruption-induced distortions in the decision-making processes governing what is chosen to be invested in, where it is built, and who builds and maintains it. However, even in contexts of poor quality, some households may have access while others do not. This paper therefore asks if corruption in the utilities sector can explain a household's access to electricity. Using data from two rounds of the Afrobarometer we document a statistically significant relationship in which more corruption in utilities in one's locality predicts a higher likelihood of having access to electricity.

Three potential mechanisms for our, perhaps, counterintuitive result can be found in the corruption literature. One way in which corruption could facilitate household access to electricity is through an effect of corruption on the shadow economy. Theoretical models posit a complementary relationship between corruption and the size of the shadow economy and such theories have been supported empirically (Friedman et al., 2000; Lassen, 2007; Torgler and Schneider, 2009; Buehn and Schneider, 2012; Gillanders and Parviainen, forthcoming). Firms may seek informal status to avoid paying bribes to corrupt officials (Johnson et al. 1997) or indeed pay bribes to corrupt officials who will ensure that some or all of the firm's tax liability is overlooked (Hindriks et al., 1999; Hibbs and Piculescu, 2010). Auriol and Blanc (2009) note the role that the informal sector plays in servicing water and electricity demand in Africa. If a more corrupt utilities sector generates a larger informal electricity sector then this could explain our observed relationship.

Another plausible mechanism is that corruption could weaken the enforcement of laws (Polinksy and Shavell, 2001). Individuals in corrupt areas may be more readily able to pay public agents, be they officials or police, to look the other way in instances of outright electricity theft or meter misreporting. Smith (2004) illustrates that electricity theft occurs all over the world, including Africa, and that there is a correlation between transmission and distribution losses, a proxy for theft, and corruption. Gaur and Gupta (2016) focus on India and present some evidence that such losses are larger in states that are more corrupt. Therefore, corruption could facilitate access through an effect on enforcement of the law.

As a third mechanism, the oft cited "grease the wheels" hypothesis argues that in the context of poor governance and inefficiency, corruption can be efficiency enhancing as it allows economic actors to undertake projects that would otherwise be prohibitively costly (Leff, 1964;

Leys, 1965; Huntington, 1968). Such an effect is evident in the context of firm entry (Dreher and Gassebner, 2013) and aggregate efficiency (Méon and Weill, 2010), even though economic growth is not enhanced by corruption, even in poorly governed economies (Méon and Sekkat, 2005). In our context, corruption could allow firms, be they private or public, in the electricity sector to circumvent red tape and safety standards and thereby allow them to provide access to customers who would not otherwise be economically feasible. While we do not find evidence that would support the first two mechanisms, we do find evidence consistent with the "grease the wheels" story in the context of electricity.

We are not the first to examine the potential link between corruption and electricity access. Estache et al (2009), Ahlborg et al (2015), and Imam et al (2018) are notable contributions to this literature and they have each concluded that countries that are more corrupt have lower rates of electricity access. This is not in direct conflict with our conclusion that households in more corrupt parts of a country tend to have a higher chance of having access. In other words, the general level of corruption could reduce access on average across countries by harming the provision, quality, and maintenance of infrastructure, but, through the mechanisms outlined above, living in a relatively corrupt region of a given country could facilitate access relative to someone living in a less corrupt part of the same country. However, our study does have several advantages over the existing literature, the first of which relate to our metric of corruption. As we explain below, our measure is based on households' experiences as opposed to the country level measures of corruption perceptions. Several authors have noted the issue with perception biases in standard corruption indicators (Svensson, 2003; Reinikka and Svensson, 2006; Treisman, 2007; Fan et al., 2009). In the current context, one can imagine that when experts form their views on how corrupt a country is, one input into their mental model is the quality of infrastructure and this could in and of itself explain a correlation between perceived

corruption and access. Another advantage of the survey data that we employ is that it allows us to examine specifically the role of corruption in the provision of utilities. Through its effects on economic development, investment, and regulation, corruption in general could foster lower access to electricity even if corruption in the utilities domain could (under certain conditions) increase access.

Furthermore, our dependent variable also differs meaningfully from that employed in the macro literature. The Afrobarometer allows us to capture whether or not a household has access to electricity. Due to data limitations, authors have generally been obliged to proxy for access rates with per capita consumption of electricity. This is arguably closer to a measure of the quality of electricity infrastructure than a measure of how many people have access as average consumption tells you nothing about the distribution of consumption.

In Section 2, we describe the data that we use and the methodological approach we take. Section 3 presents our main results and our exploration of the mechanisms at play. Section 4 concludes and discusses the implications of our findings for policy. In brief, we do not conclude from our analysis that corruption is "a good thing", however, our results do suggest that broad reform of the governance and red tape surrounding the electricity sector should be undertaken alongside anti-corruption initiatives.

2. DATA AND APPROACH

The data used in this paper come from Round 2 and Round 6 of the Afrobarometer. The Afrobarometer project conducts representative household surveys of political and economic conditions and attitudes in an increasing number of African countries. Round 2 was conducted

in 16 sub-Saharan countries in 2002 and 2003. Due to missing control variables, we exclude Zimbabwe from our analysis for Round 2.[1] Round 6 was carried out in 36 African countries in 2014 and 2015. Other rounds do not contain the necessary variables for our purposes. While the questions differ somewhat between rounds 2 and 6, employing two rounds of data more than a decade apart allows us to have greater confidence that any relationships we document are stable and not merely relationships that held due to time variant behaviours or technology.

We estimate probit models in which the dependent variable captures access to electricity. To measure household access to electricity in Round 2, we utilise responses to the following survey question: *"Over the past year, how often, if ever, have you or your family gone without electricity in your home?"* The possible answers are "never", "just once or twice", "several times", "many times", and "always." In addition, some countries allowed respondents to answer that they had no access to electricity. In these countries, the proportion choosing "always" is very low and so we consider having no connection to be equivalent to always going without electricity.[2] We create a binary variable from this information, *noelec*, that takes a value of one if the respondent answers "always" or "no access" and zero otherwise. The electricity access question in Round 6 is somewhat different in that it explicitly asks about the respondent's access to mains electricity: *"Do you have an electric connection to your home from the mains? [If yes] How often is the electricity actually available?"* We create a dummy variable, *nomains,* that takes a value of one for those who say they have no connection or that electricity is never actually available and zero for those who say the electricity is actually

[1] Running our models without these controls and therefore including Zimbabwe does not change our conclusions.
[2] If we look only at those countries that allowed this option and employ a dummy variable that takes a value of one for "no connection" and zero otherwise, we find that local corruption in services is a strong and significant predictor of having no connection.

available at least occasionally.[3] This is an important point of departure from much of the existing literature that has taken per capita electricity consumption as the metric of access, which is due to reliability issues with cross-country estimates of access stemming from

Table 1: Summary Statistics

	Round 2			*Round 6*		
	N	*mean*	*s.d*	*N*	*mean*	*s.d*
noelec	23997	0.53	0.50			
nomains				53706	0.46	0.50
servicebribe	23748	0.08	0.28	53503	0.05	0.22
otherbribe	22042	0.21	0.41	53935	0.18	0.38
grid	22915	0.52	0.50	53919	0.65	0.48
urban	24301	0.38	0.48	53935	0.42	0.49
shadow	22376	0.03	0.16			
enforce	23164	0.73	0.44			

Notes: All variables are binary. Table A1 fully describes all variables.

differences in sources and imputation and an understandable interest in understanding the quality of service (Ahlborg et al, 2015). Our use of the micro data in the Afrobarometer overcomes these concerns regarding data accuracy and while we agree that quality is important, understanding the factors that drive access is also worthwhile. A focus on per capita consumption rates also ignores the possibility of unequal consumption, which is problematic in light of research that links corruption to inequality outcomes through distortionary effects on policy and practice (Gupta et al, 2002). We also show that our results are present when utilising all of the available information in ordered probit models.

Table 1 presents summary statistics for our main variables. The means for *noelec* and *nomain* differ somewhat from estimates for electricity access from the World Bank of 29% and 38%

[3] If we include the "always" answers in the zero category, our main result regarding the association of local corruption in services with access is still statistically significant at the 10% level in the overall Round 6 data and at the 1% level if we restrict the sample to only those countries that were present in Round 2.

for sub-Saharan Africa in 2003 and 2015 respectively (World Bank, 2018). As noted above, these estimates are viewed with caution by some and furthermore, since Round 2 covers only 16 countries and the 36 countries in Round 6 include several North African economies, these differences are not overly concerning.

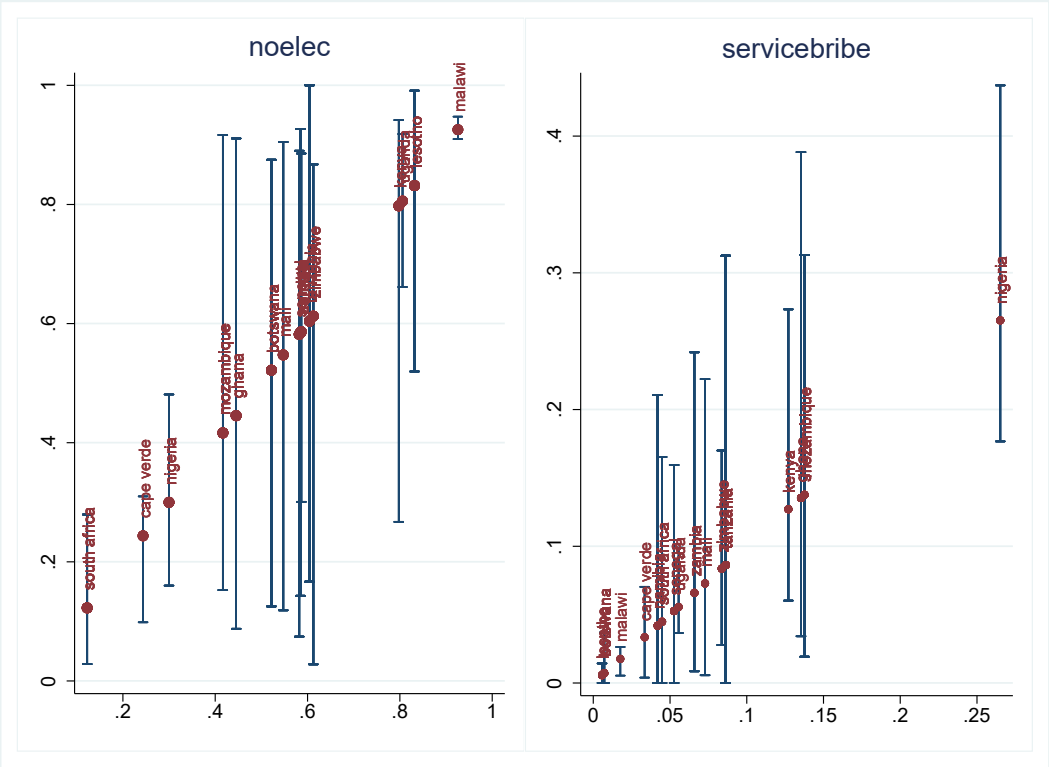
Our main explanatory variable of interest captures how corrupt the respondent's locality is in the specific domain of utilities provision. In Round 2, the survey asks how often in the past year has the individual or their family had to *"pay a bribe, give a gift, or do a favour to government officials in order to get a household service (like piped water, electricity, or phone)."* Round 6 asks a very similar question but specifies that the services in question are water, sanitation or electric services. In both cases, it is important to note that the question specifies that the bribe is being paid to a government employee. Furthermore, the Round 6 version makes it explicit that they are interested in situations in which services are being sought from the government. We first create a variable, *servicebribe*, that takes a value of one if the respondent reports ever having experienced bribery in this context and zero otherwise. By averaging this dummy variable over the respondent's home region, we create our particular explanatory variable of interest, *servicebribe average*, which captures the local intensity of corruption in utilities. These regions are not necessarily the real administrative divisions of each country but they allow us to generate proxies that capture the local environment in terms of corruption.[4] Figures 1 and 2 plot the country average of our outcome variables and explanatory variable of interest for each round. They also show that there can be large variations within a country both in access to electricity and in the incidence of corruption in utilities. While we are primarily interested in the importance of the local intensity of corruption

[4] For example, Nigeria is divided into seven regions in Round 2 and 34 in Round 6. Malawi in both rounds is divided into Central, North, and South, its actual regional divisions.

as captured by the coefficient of *servicebribe average,* we also control for the individual's own experience, *servicebribe,* as it is not unreasonable to expect that paying a bribe could improve access and that this individual experience will be correlated with the local intensity of corruption in utilities.

Through its deleterious effects on, inter alia, economic activity, (Mauro, 1995; Fisman and Svensson, 2007) and red tape (Breen and Gillanders, 2012), corruption in general could reduce the ability of a region to provide electricity even if corruption in utilities facilitates access on an individual basis. Furthermore, we noted above that a sizable literature links general

Figure 1: Within Country Variation in Key Variables for Round 2

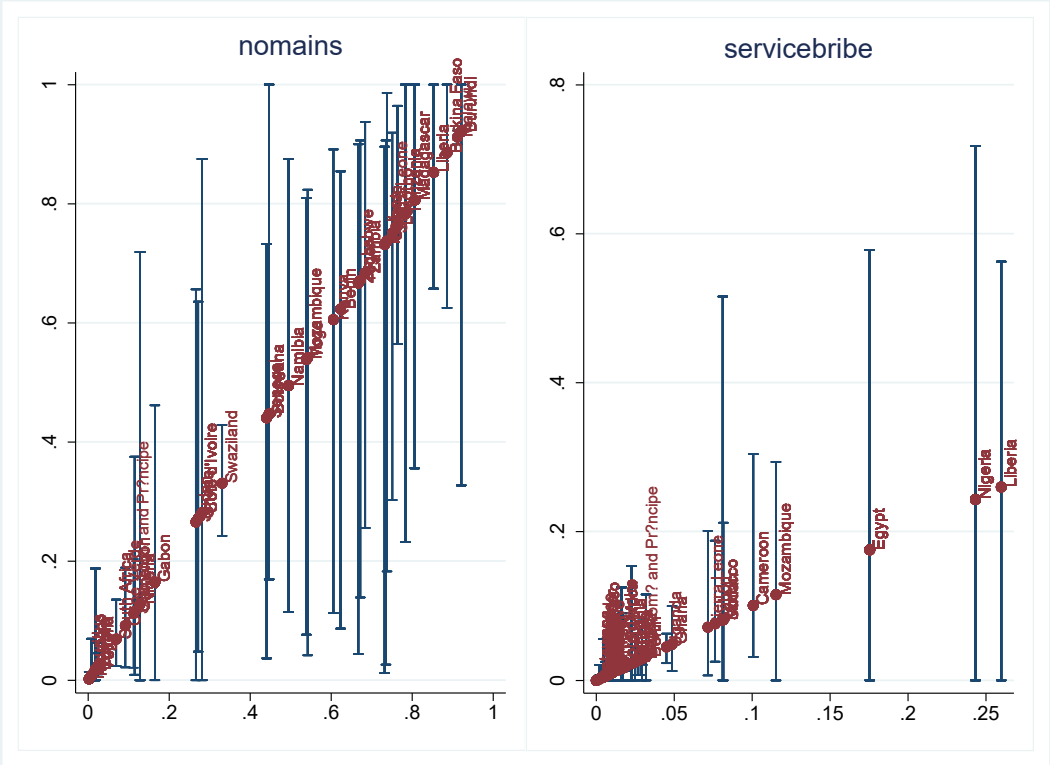


Note: Each graph has its own scale. The point displays the national average while the top and bottom of the bars indicate the maximum and minimum regional value for that country.

corruption to lower quality infrastructure. We are able to separate out the incidence of corruption in utilities from corruption in other contexts (*otherbribe average*). In the latter case, we control for the local incidence of bribery in the documentary, medical, and police spheres

– see Table A1 for the specification of *otherbribe* from which we calculate the average effect. While *servicebribe average* and *otherbribe average* are highly correlated, (approx. 0.8 in each round) the general level of corruption could conceivably have a different effect to utilities corruption. This allows us to point more precisely to the mechanism linking corruption and access as being one that operates through the bureaucracy that is responsible for utilities. As mentioned above, this could explain the difference between our study and the existing cross-country literature that has had to rely on country level corruption perceptions indicators (Estache et al 2009; Ahlborg et al, 2015: Imam et al, 2018) which cannot draw a distinction between corruption in, for example, tax administration and corruption in utilities and infrastructure.

Figure 2: Within Country Variation in Key Variables for Round 6



Note: Each graph has its own scale. The point displays the national average while the top and bottom of the bars indicate the maximum and minimum regional value for that country.

We also control for other characteristics that could plausibly have an effect on access, including the presence of an electrical grid. Therefore, we have proxies for the presence of infrastructural features that could influence access. We also include a dummy for urban areas and controls for income. In Round 2, we employ information on income decile and in Round 6 we make use of a question that asks how often the respondent or someone in their family has had to go without a cash income. We also include country dummies to account for cross-country differences in access arising from country level factors such as the level of economic development and infrastructural quality, and define country-region groups to cluster our standard errors. Full definitions of all variables are available in the appendix.

3. RESULTS

3.1 Main Result

As our dependent variable is binary, we estimate probit models of the following form:

$$Pr(noaccess_{ij} = 1) = \Phi(\beta_1 servicebribe_{ij} + \beta_2 servicebribeaverage_{jk} + \boldsymbol{\beta_3 X_{ij}} + \boldsymbol{\beta_4 d_j} + \varepsilon_{ij})$$

Where $noaccess_{ij}$ captures whether person *i* in country *j* has access to electricity or not (*noelec* and *nomains* in rounds 2 and 6, respectively), $servicebribe_{ij}$ and $servicebribeaverage_{jk}$ capture the individual's experience of bribe paying in utilities and the local incidence of such corruption, $\boldsymbol{X_{ij}}$ represents the control variables, $\boldsymbol{d_j}$indicates country fixed effects and ε_{ij} is the error term.

Table 2 presents our main results. The first two columns utilise the data from Round 2 and the remaining specifications draw on Round 6 data. We report the marginal effects obtained from probit models in which access to electricity is the outcome variable. Across all specifications,

the presence of an electrical grid in the area is significantly and meaningfully associated with a lower likelihood of being without electricity. This is unsurprising but it is important to control for the presence of enabling infrastructure when studying access. Any relationship between corruption and access that we detect takes into account the presence of a grid and is therefore not simply an artefact of corruption's well-documented deleterious effect on the quality of infrastructure (Tanzi and Davoodi, 1997; Kenny, 2009; Gillanders, 2014). We also find that income is an important determinant of access as is being in an urban setting. Finally, one's own experience of paying a bribe for household services (*servicebribe*) is negatively associated with a lack of access. Paying bribes seems to work in the narrow sense of increasing one's access (though of course a better outcome may obtain if nobody pays bribes).

Turning to our main concern, Column 1, which analyses Round 2 data, shows that people living in regions with a higher incidence of bribery in utilities are more likely to have access to electricity, *ceterus paribus*. This result says nothing at all about the quality of the service nor does it suggest that corruption is a desirable phenomenon at an individual or societal level. Our finding provides new insight but does not stand in contradiction to Tanzi and Davoodi (1997), Kenny (2009), Gillanders (2014), or any study that has found the quality of infrastructure to be worse in environments that are more corrupt. The access that corruption facilitates could be dangerous, unofficial, of poor quality, or all of the above. Column 2 includes corruption in other contexts, which is not statistically significant and does not change the magnitude or significance of our main result.

The remaining columns use the data from the sixth round of the Afrobarometer. Column 3 suggests that our result holds on average in this larger sample of countries. However, when we include corruption in other contexts in Column 4, neither is statistically significant, although it

is worth recalling that the two are highly correlated. There are many more countries in the later round of the survey and so the final two columns split the Round 6 data into two groups. In Column 5, we consider only those countries that were in the second round of survey. Here we find a strong and significant effect. Given that there is more than a decade between the survey rounds, this suggest that the relationship between corruption and access is reasonably stable over time. However, in Column 6, where we drop the countries that were surveyed in Round 2, we do not find a statistically significant association of our variable of interest with access to electricity. This difference suggests that there are important country characteristics at play in the relationship and further motivates our sample splits below.

Table 2: Main Results

	(1)	(2)	(3)	(4)	(5)	(6)
	Round 2 Data				Round 6 Data	
	noelec	*noelec*	*nomains*	*nomains*	*nomains*	*nomains*
servicebribe	-0.11***	-0.11***	-0.09***	-0.09***	-0.06*	-0.11***
	(0.023)	(0.023)	(0.025)	(0.025)	(0.031)	(0.029)
servicebribe average	-0.77***	-0.78***	-0.51**	-0.27	-0.90***	0.04
	(0.172)	(0.216)	(0.227)	(0.336)	(0.231)	(0.355)
otherbribe average		0.01		-0.21		
		(0.021)		(0.218)		
grid	-0.30***	-0.30***	-0.62***	-0.62***	-0.56***	-0.66***
	(0.022)	(0.022)	(0.017)	(0.017)	(0.020)	(0.030)
4th to 7th Income Decile	-0.06***	-0.06***				
	(0.018)	(0.018)				
8th to 10th Income Decile	-0.23***	-0.23***				
	(0.026)	(0.026)				
urban	-0.23***	-0.23***	-0.29***	-0.29***	-0.33***	-0.20***
	(0.026)	(0.026)	(0.021)	(0.021)	(0.028)	(0.024)
Gone without cash income (Ref = Never)						
Just once or Twice			0.05***	0.05***	0.06***	0.01
			(0.014)	(0.014)	(0.016)	(0.020)
Several Times			0.10***	0.10***	0.11***	0.06**
			(0.016)	(0.016)	(0.019)	(0.025)
Many Times			0.17***	0.17***	0.18***	0.13***
			(0.015)	(0.015)	(0.018)	(0.024)
Always			0.23***	0.23***	0.24***	0.17***
			(0.018)	(0.017)	(0.019)	(0.031)
Country Fixed Effects	YES	YES	YES	YES	YES	YES
Observations	18,879	18879	53,071	53,071	29,476	23,595
Sample Restriction					Only countries that were in Round 2	Excludes countries that were in Round 2

Notes: Probit marginal effects reported. The corresponding standard errors are clustered by country and region and reported in parentheses., **, and *** indicates significance at the 10%, 5% and 1% levels respectively.*

Before moving on to examine potential mechanisms that underlie the observed relationship between corruption and access to electricity, we first demonstrate that said relationship is not the result of how we coded our access dummy variable. Table 3 presents marginal effects obtained from an ordered probit model estimated with the data from Round 2. A higher local incidence of corruption in services is associated with a statistically significantly higher likelihood of answering that one "never" has had to go without access to electricity and a lower likelihood of answering "always" or "no access." The options in between these poles are also more likely to be chosen as our local corruption indicator increases and the size of the effect decreases as one moves from "never" to "many times." If we estimate a similar model for the Round 6 data, we find similar results, but only when the sample is restricted to only those countries surveyed in Round 2 (results available on request). These models reflect closely the findings of Table 2 and therefore suggest that the use of binary indicators of access is appropriate.

Table 3: Ordered Probit Model for Round 2 Data

How Often Gone without Electricity?	(1) *"never"*	(2) *"just once or twice"*	(3) *"several times"*	(4) *"many times"*	(5) *"always\no access"*
servicebribe	0.021	0.003	0.004	0.001*	-0.031
	(0.015)	(0.002)	(0.003)	(0.001)	(0.020)
servicebribe average	0.390***	0.065***	0.086***	0.028***	-0.0569***
	(0.088)	(0.016)	(0.023)	(0.009)	(0.129)
grid	0.175***	0.029***	0.038***	0.012***	-0.253***
	(0.015)	(0.004)	(0.006)	(0.003)	(0.022)
4^{th} to 7^{th} Income Decile	0.046***	0.007***	0.009***	0.003***	-0.066***
	(0.012)	(0.002)	(0.002)	(0.001)	(0.016)
8^{th} to 10^{th} Income Decile	0.170***	0.020***	0.020***	0.002	-0.212***
	(0.025)	(0.002)	(0.003)	(0.002)	(0.024)
urban	0.112***	0.017***	0.021***	0.006***	-0.157***
	(0.019)	(0.003)	(0.004)	(0.001)	(0.024)
Country Fixed Effects	YES	YES	YES	YES	YES

Notes: Ordered Probit marginal effects reported. N = 18879. The corresponding standard errors are clustered by country and region and reported in parentheses., **, and *** indicates significance at the 10%, 5% and 1% levels respectively.*

3.2 Potential Mechanisms: A Larger Shadow Economy or Less Effective Enforcement

As outlined in Section 1, two plausible mechanisms through which corruption could facilitate access are through an expansion in the shadow economy for electricity and a decrease in enforcement for electricity theft. Measuring such social outcomes is challenging in the context of survey data. However, Round 2 of the Afrobarometer contains questions that allow us to generate reasonable proxies. We create a variable, *shadow*, which takes a value of one if the respondent reports that they usually turn to "illicit" sources when they are unable to get electricity in their home. The shadow economy is usually understood to consist of goods and services that, while not necessarily inherently illegal, are being supplied in an illicit way – i.e. contrary to laws and regulation. Table 1 tells us that 3% of respondents avail of illicit sources when they need electricity. This may seem at odds with other estimates of the size of the shadow economy such as those discussed in Medina and Schneider (2018), but we are only

looking at a particular segment of the shadow economy. The average of this over the person's region serves as our proxy for the size of the informal electricity sector in the respondent's locality. Similarly, *enforce* takes a value of 1 if the respondent thinks it likely or very likely that "the authorities could enforce the law if a person like yourself obtained household services (like water and electricity) without paying." Roughly 73% of our sample hold this view. Averaging this over the respondent's region tells us something about (perceptions of) law enforcement for utilities theft but it is important to note that this is not intended to serve as a proxy for the general strength of law enforcement.[1]

Table 4 includes these factors as additional explanatory variables. Our proxy for the size of the shadow economy is a significant predictor of access but only when corruption is excluded from the model. In this model, individuals in regions with larger shadow economies for electricity are less likely to have access. When both are included, the significant association between corruption and access is present while the local average of *shadow* is insignificant. Enforcement is not a significant predictor of access and our main result is robust to inclusion of this factor and to the inclusion of both simultaneously. Holding the size of the shadow economy and the strength of enforcement constant, people in regions that have more corruption in utilities are more likely to have access to electricity

[1] This measure of enforcement is not a statistically significant predictor of either *servicebribe or servicebribe average* though the sign of the coefficient is negative. There is a positive and significant relationship between enforcement and the shadow economy, however, suggesting that a greater likelihood of being punished for theft incentivises people to seek other unofficial sources of electricity.

Table 4: Controlling for the Shadow Economy and Enforcement in Round 2

	(1) *noelec*	(2) *noelec*	(3) *noelec*	(4) *noelec*	(5) *noelec*
servicebribe	-0.15***	-0.15***	-0.12***	-0.11***	-0.12***
	(0.024)	(0.024)	(0.023)	(0.023)	(0.023)
servicebribe average			-0.75***	-0.77***	-0.76***
			(0.174)	(0.171)	(0.172)
shadow average	0.50*		0.46		0.47
	(0.293)		(0.315)		(0.329)
enforce average		0.05		0.02	-0.03
		(0.146)		(0.138)	(0.135)
grid	-0.30***	-0.30***	-0.30***	-0.30***	-0.30***
	(0.023)	(0.023)	(0.023)	(0.022)	(0.022)
4^{th} to 7^{th} Income Decile	-0.06***	-0.06***	-0.06***	-0.06***	-0.06***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
8^{th} to 10^{th} Income Decile	-0.23***	-0.23***	-0.23***	-0.23***	-0.23***
	(0.025)	(0.025)	(0.026)	(0.026)	(0.026)
urban	-0.24***	-0.24***	-0.23***	-0.23***	-0.23***
	(0.028)	(0.028)	(0.027)	(0.027)	(0.027)
Country Fixed Effects	YES	YES	YES	YES	YES
Observations	18,879	18,879	18,879	18,879	18,879

Notes: Probit marginal effects reported. The corresponding standard errors are clustered by country and region and reported in parentheses., **, and *** indicates significance at the 10%, 5% and 1% levels respectively.*

Table 5 further scrutinises these potential mechanisms estimating OLS models to ask if local corruption can explain the regional averages of *shadow* and *enforce.* Columns 1 and 2 show that neither corruption in utilities nor corruption in other contexts is a significant predictor of the extent of the local shadow economy. However, when we include both at the same time in Column 3, we find that they are significant at the 10% level. If anything, utilities corruption is associated with a smaller informal electricity sector. This supports the above conclusion that the main result of this paper is not being driven by a mechanism of corruption increasing access through an enlarged shadow economy. Corruption in other domains is, however, associated with a larger shadow economy in line with the studies cited above which find a complementary relationship between corruption and the shadow economy. We also fail to find evidence in

support of the enforcement mechanism. Corruption, in utilities or otherwise, is not a significant predictor of our proxy for the likelihood of sanction for electricity theft.

Table 5: Regional Corruption and Regional Shadow Economy and Enforcement Outcomes in Round 2

	(1) *shadow average*	(2) *shadow average*	(3) *shadow average*	(4) *enforce average*	(5) *enforce average*	(6) *enforce average*
servicebribe average	-0.09		-0.28*	-0.12		-0.01
	(0.067)		(0.159)	(0.119)		(0.193)
otherbribe average		0.01	0.15*		-0.10	-0.09
		(0.026)	(0.086)		(0.077)	(0.128)
Constant	0.00	-0.00	-0.00	0.81***	0.81***	0.81***
	(0.001)	(0.001)	(0.002)	(0.021)	(0.021)	(0.021)
Country Fixed Effects	YES	YES	YES	YES	YES	YES
Observations	148	148	148	148	148	148
R-squared	0.746	0.743	0.756	0.332	0.334	0.334

Notes: Estimation carried out with OLS. Robust standard errors are reported in parentheses., **, and *** indicates significance at the 10%, 5% and 1% levels respectively.*

3.3 Potential Mechanism: Grease the Wheels

The remaining mechanism that has theoretical support is a variant of the grease the wheels hypothesis in which firms avail of the possibility of paying bribes to avoid red tape and regulation, thereby allowing them to provide access to customers they would otherwise find uneconomical. There are wide ranging reforms of the electricity sector completed and ongoing in African countries, particularly in the sub-Saharan region. Key objectives of these electricity sector reforms are to improve access for customers and increase technical efficiency of infrastructure, achieved through decentralising state control to independent regulatory agencies and facilitating private participation (Imam et al 2018).

To examine this possibility, Table 6 splits our Round 6 sample along several governance dimensions. Our first splits utilise the World Bank's Control of Corruption and Rule of Law indicators as broad proxies for overall institutional quality. For both of these institutional variables, we compare countries that are above and below the average score for the 36 African

states in our sample. In columns 1 to 4, our central conclusion regrading corruption and access to electricity is evident, albeit at the 10% level in Column 4. However, the size of the association is, contrary to what one might expect, larger in the better governance samples (columns 2 and 3). While this may seem to refute the grease hypotheses in the context of electricity access, other metrics of governance and regulation – studied next – allow us to focus more precisely on the electricity sector. General governance quality could moderate the relationship between utilities corruption and access in a different way to the specific governance of the electricity sector. Better-governed countries tend to have better infrastructural quality (Tanzi and Davoodi, 1997; Kenny, 2009; Gillanders, 2014) and therefore corruption in the utilities sector could be more effective in terms of access for the simple reason that these countries tend to have somewhat better electricity infrastructure.

Columns 5 and 6 split the sample into groups defined by above and below the sample's average performance on the World Bank's Ease of Getting Electricity metric from its Doing Business project. This captures how difficult it is for a firm to establish a connection for a new warehouse, how reliable the supply is and what mechanisms exist to monitor and prevent outages, and transparency in tariffs. While not focused on the individual consumer, we believe this serves as a reasonable proxy for electricity sector governance. Only in the countries with relatively worse governance of the electricity sector do we find a statistically significant relationship between utilities corruption and access. This is consistent with a grease the wheels story in which firms faced with long delays and formal costs turn to corruption to facilitate their business activities which in turn provides access to consumers.

Table 6: Sample Splits for Round 6

	(1) Above Average Corruption	(2) Below Average Corruption	(3) Above Average Rule of Law	(4) Below Average Rule of Law	(5) Above Average Ease of Getting Electricity	(6) Below Average Ease of Getting Electricity	(7) Private Participation	(8) No Private Participation	(9) Below Average Ease of Getting Electricity and Private Participation	(10) Below Average Ease of Getting Electricity and No Private Participation
	nomains	*nomains*	*nomains*	*nomains*	*nomains*	*nomains*	*nomains*	*nomains*	*nomains*	*nomains*
servicebribe	-0.09***	-0.04*	-0.06	-0.10***	-0.08***	-0.08**	-0.06**	-0.15***	-0.04	-0.11**
	(0.029)	(0.023)	(0.045)	(0.030)	(0.023)	(0.036)	(0.027)	(0.049)	(0.037)	(0.049)
servicebribe average	-0.44**	-1.56***	-1.77***	-0.44*	-0.03	-0.60**	-0.77***	0.17	-0.81***	-0.03
	(0.214)	(0.553)	(0.582)	(0.234)	(0.318)	(0.240)	(0.234)	(0.508)	(0.230)	(0.390)
grid	-0.55***	-0.62***	-0.63***	-0.60***	-0.64***	-0.56***	-0.60***	-0.57***	-0.58***	-0.47***
	(0.021)	(0.032)	(0.025)	(0.023)	(0.030)	(0.022)	(0.018)	(0.042)	(0.022)	(0.059)
Gone without cash income (Ref = Never)										
Just once or Twice	0.04**	0.04***	0.07***	0.02	0.07***	-0.00	0.05***	0.03	-0.01	0.01
	(0.017)	(0.013)	(0.016)	(0.022)	(0.016)	(0.020)	(0.016)	(0.023)	(0.026)	(0.023)
Several Times	0.10***	0.06***	0.11***	0.08***	0.11***	0.05**	0.10***	0.08***	0.05*	0.04
	(0.020)	(0.015)	(0.018)	(0.026)	(0.019)	(0.021)	(0.018)	(0.029)	(0.027)	(0.028)
Many Times	0.16***	0.13***	0.19***	0.15***	0.18***	0.11***	0.18***	0.12***	0.13***	0.07***
	(0.018)	(0.018)	(0.020)	(0.023)	(0.019)	(0.020)	(0.017)	(0.028)	(0.027)	(0.024)
Always	0.20***	0.18***	0.27***	0.20***	0.23***	0.17***	0.24***	0.17***	0.20***	0.09***
	(0.020)	(0.021)	(0.023)	(0.027)	(0.023)	(0.022)	(0.019)	(0.030)	(0.028)	(0.027)
urban	-0.34***	-0.13***	-0.23***	-0.34***	-0.21***	-0.32***	-0.32***	-0.20***	-0.35***	-0.19***
	(0.029)	(0.018)	(0.023)	(0.034)	(0.024)	(0.030)	(0.026)	(0.034)	(0.037)	(0.036)
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	32,955	20,116	23,692	29,379	25,946	27,125	37,775	9,462	20,036	5,931

Notes: Probit marginal effects reported. The corresponding standard errors are clustered by country and region and reported in parentheses., **, and *** indicates significance at the 10%, 5% and 1% levels respectively.*

Private participation has been identified as a determinant of electricity sector performance and indeed economic performance (Parker and Kirkpatrick, 2005; Zhang et al., 2005; Fumagalli et al., 2007; Polemis and Stengos, 2017). Therefore, we also split our sample using data from Imam et al (2008) that documents the presence of private participation in the electricity market, which, as identified above, is an important objective of electricity sector reform. Columns 7 and 8 demonstrate that only in economies in which there is private participation do we find a statistically significant relationship between our proxy for how corrupt public officials in the utilities sector are and individual access to electricity. This too supports the grease hypothesis in this very specific context.

Parker and Kirkpatrick (2005) note that privatisation works best in developing countries when coupled with broader structural reform. This motivates us in taking a more nuanced view in explaining the privatisation effect we observe. Columns 9 and 10 support the grease the wheels mechanism in the current context in that they consider only countries with poor electricity governance and divide this sample into groups defined by the presence or absence of private participation. In this sample of countries with poor governance of the electricity sector, only in those with private participation do we see an association between utilities corruption and access. Thus, our sample splits along governance lines suggest that the mechanism underlying our key result is one in which private firms in the electricity sector faced with poor governance pay bribes to corrupt officials to bypass and expedite regulatory and safety requirements. In turn, this allows them to provide access to households that would otherwise not be economically feasible. The implications of these findings are discussed in our concluding section.

4. CONCLUSION AND POLICY IMPLICATIONS

This paper, utilising data from two rounds of the Afrobarometer survey of African households, finds that respondents living in regions in which there is a higher incidence of corruption in utilities have a greater chance of having access to electricity in their homes. We did not find evidence that would support the notion that this operates through decreased enforcement for electricity theft or an expansion in the size of the "illicit" economy. We did however find evidence consistent with a variant of the grease the wheels hypothesis. In poorly governed electricity sectors with private participation, corruption increases access for households.

None of this, of course, constitutes evidence that corruption is a desirable phenomenon. While we demonstrate in this paper that corruption can facilitate access, *ceteris paribus,* corruption is a driver of low quality infrastructure (Tanzi and Davoodi, 1997; Kenny, 2009; Gillanders, 2014). When discussing any variant of the grease the wheels hypothesis it must be noted that there is a clear problem of reverse causality in that poor governance performance can be due to corruption (Banerjee, 1997; Djankov et al, 2002; Guriev 2004; Breen and Gillanders 2012). In addition, Dal Bó and Rossi (2007) illustrate that corruption has a deleterious effect on the efficiency of Latin American electricity distribution firms. Furthermore, the access that corruption facilitates could be dangerous to the consumer or to others – especially as the mechanism may conceivably operate in part through a bypassing of safety regulations.

However, our results are useful for policymakers in that they suggest that there may be a trade-off between anti-corruption and electrification efforts in some contexts. An implication is that tackling the governance failure that is corruption should go hand in hand with tackling more prosaic governance failures in the electricity sector of the sort captured by the World Bank's

Ease of Getting Electricity metric. In the second best world of poor electricity governance, corruption increases the likelihood that a household will have access to electricity.

Policymakers interested in the potential for private participation to serve as a policy tool to increase electricity access may also find our results interesting. Evidence is respect of the impact of private participation on electricity (and utility infrastructure generally) is mixed (Devkar et al, 2015; John et al, 2014). Better outcomes generally require appropriate monitoring and incentive structures (John et al, 2015), and regulation, sector reform and organisational change (Devkar et al, 2013). The effect of corruption has not been considered though. We show that the interaction of poor electricity sector regulation and participation of private actors can moderate the effects of other variables and create incentives and mechanisms that may not have been anticipated. Policymakers in this space should be aware of the corruption dimension to the interplay between market structure, regulation, and governance. Future research could usefully examine other regions of the world and other infrastructure sectors, particularly those with private participation, such as telecommunications.

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APPENDIX

Table A1: Variable Definitions

Label	Definition
noelec	Takes a value of 1 if the respondent reports that they or their family have in the past year gone without electricity in their home "always" or reports having no connection
nomains	Takes a value of 1 if the respondent reports that they have no mains electric supply or connection to the home or that electricity is "never" actually available.
servicebribe	**Round 2:** Takes a value of 1 if the respondent reports having had to, in the past year, "pay a bribe, give a gift, or do a favour to government officials in order to get a household service (like piped water, electricity, or phone)" **Round 6:** Takes a value of one if the respondent reports having had to pay a bribe, give a gift, or do a favour for a government official in the course of trying to get water, sanitation or electric services from the government
otherbribe	**Round 2:** Takes a value of 1 if the respondent reports having had to, in the past year, "pay a bribe, give a gift, or do a favour to government officials" in the context of avoiding problems with the police, getting a child into school, or getting a document or permit. **Round 6:** Takes a value of one if the respondent reports having had to pay a bribe, give a gift, or do a favour in the course of trying to get an identity document from the government, get the services they needed from schools, or avoid a problem like passing a checkpoint or avoiding a fine or arrest.
shadow	Takes a value of 1 if the respondent reports that they usually turn to "illicit" sources when they are unable to get electricity in their home
enforce	Takes a value of 1 if the respondent thinks it likely or very likely that "the authorities could enforce the law if a person like yourself obtained household services (like water and electricity) without paying"
grid	Takes a value of 1 if the survey enumerator reports that there was an electricity grid that most houses could access in the primary sampling unit/enumeration area
urban	Takes a value of 1 if the primary sampling unit was urban