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What Could Explain Low Uptake of Rural Electricity Programs in Africa?

Empirical Evidence from Rural Tanzania

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Remidius Denis Ruhinduka, Gunther Bensch, Onesmo Selejio, and Razack Lokina*

Abstract

Despite the great strides by the government of Tanzania in bolstering access to electricity in rural areas under its Rural Energy Agency (REA), rural connection rates have remained low. A substantial fraction of households residing "under the grid" remains unconnected despite the considerable state subsidy of this program. This study investigates the reasons for low uptake of seemingly highly subsidized, productive and modern energy. Using both bivariate and multivariate logit, we find that the distance between the household and the nearest electric pole matters. Households living farther away incur connection costs (associated with purchasing additional poles) beyond the subsidized price. Consistent with other energy literature, we find that both housing characteristics (e.g. size of dwelling, wall and roofing materials) and socio-economic characteristics (e.g. income, remittances and social network status) correlate with the decision to accept an electricity connection.

Keywords: electrification; household decision; Tanzania; multinomial logit analysis

JEL Codes: D12; O13; O33; Q41

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1. Introduction

The recently adopted Sustainable Development Goal (SDG) 7 aims at ensuring universal access to electricity by 2030. This is in response to the fact that more than 840 million people in the developing world have no access to electricity, with the majority residing in rural Sub-Saharan Africa (IEA et al. 2019). As a result, several governments in the region have invested billions of US dollars to improve rural access to on-grid electricity. Since 2007, the government of Tanzania has devoted significant effort and resources to a rural electrification program. Under this program, households need to pay only TZS 27,000 (equivalent to USD 13) to get connected to grid electricity, as opposed to the normal connection price of TZS 177,000 (USD 82)[1]. Despite such huge subsidies, actual connections by households have remained low even among those residing along the gridline. In light of the huge public investments already made and the ambitious goals set, the question 'why are connection rates so low?' is relevant both empirically and at a policy level.

The literature on large-scale rural electrification programs in developing countries tends to focus on the impacts of these interventions (see, for example, Lipscomb et al. 2013, Lenz et al. 2017, Bonan et al. 2017, as well as Lewis & Pattanayak 2012). However, the observation of low uptake, documented also by Lee et al. (2016) for Kenya, hints at the importance of looking into drivers of uptake and possible interventions that would increase the connection rate. Still in Kenya, Lee et al. (2016) assess the uptake of on-grid electricity, albeit restricting their analysis to connection costs as a potential driver.

In this paper, we complement Lee et al. (2016) by estimating the correlates of uptake of rural electricity in a different context. Unlike Kenya, the government of Tanzania has largely subsidized rural electricity connection fees. This raises a question about the relevance of high connection fees as a driver of the low uptake. While the running costs of electricity are another obvious and frequently cited reason for non-connection (Bos et al. 2018), this paper focusses on key household-specific characteristics as potential determinants.

We use information from both connected and non-connected households to identify potential drivers of low uptake. The study sample comprises 1774 households from 24 villages and 43 sub-villages in Mpwapwa district of Dodoma region in central Tanzania. Using binary and multinomial logit models, we find that distance of the house from the nearest electricity pole

[1] TANESCO. 2019. Service Line Application. Available at http://www.tanesco.co.tz/index.php/customer-service/service-line-application

(among other factors) negatively affects the connection rate. Paralleling the findings of other technology adoption studies, we also find that household income, housing characteristics and social network variables play important roles in connection status.

The remainder of this paper is organized as follows. Section 2 provides contextual background on energy access trends and interventions in rural Tanzania. Section 3 describes the methodology of the study, including sampling and data collection and the estimation strategies. Section 4 presents the results, including both descriptive statistics and main estimation results, along with discussion and recommendations. Section 5 presents the conclusion of the study.

2. Energy Access in Tanzania: Trends and Interventions

The household sector consumes the highest share of the country’s primary energy (73 percent) and 40 percent of electricity (URT 2015; Sander et al 2013; Lusambo 2016; Mkoma and Mabiki. 2011). By 2018, one-third of all households and 17 percent of rural households were connected to electricity (IEA et al. 2019), rates that are low even for Sub-Saharan African (SSA) standards (Blimpo & Cosgrove-Davies 2019).

In a poor rural setting, lighting is the primary use of electricity. In the study area, households have clearly been moving away from kerosene towards grid and solar electricity. The share of rural households using kerosene as the main source of lighting energy declined sharply from 70 percent in 2011/12 to 9 percent in 2017/18. A large proportion switched to off-grid solar (33 percent), torch and rechargeable lamps (37.4 percent), while the share of households where lighting mainly comes from grid electricity increased merely from 4 to 10 percent in that period (URT 2013; 2019). This is far below the level in urban areas (64 percent), showing the clear urban-rural inequality when it comes to access to, and use of, main grid electricity.

These meagre improvements in the adoption of grid electricity access come despite considerable efforts to extend rural electricity grids. These efforts have been streamlined with the establishment of the Rural Energy Agency (REA) in 2008 as an autonomous body under the Ministry of Energy. The REA’s annual budget increased in real terms 50 times to US$239 million in 2016–17 (Godinho & Eberhard 2018).

There are several challenges to promoting access to grid electricity in rural Tanzania. Firstly, low population density; rural Tanzania is marked by sparse settlements. This attenuates the financial sustainability of infrastructure investments such as extension of the national electricity grid. Secondly, even in electrified villages, actual connection rates by households remains low. The most recent energy access report by the Government of Tanzania reveals that 49 percent of the rural population actually resides very close to the electricity grid lines[2].

3. Methodology

3.1 The Data

The data used in this study was collected in Mpwapwa district of Dodoma region in Tanzania. Dodoma is one of the 26 administrative regions in Mainland Tanzania and is the capital city of the country. The choice of Dodoma region for the study was prompted by its rural electricity connection rate, which is low and identical to the national rural connection average (URT 2017).

The survey was conducted at household and sub-village level. It included all 43 electrified sub-villages from 24 villages in a radius of 35 kilometers around the district office of the para-statal electricity utility company, TANESCO. The TANESCO district office served as a reference because technicians are sent from these offices when prospective customers request an electricity connection. The 35 km threshold ensured that there were no supply side restrictions on electrification, as it ensured that that all requests are met. TANESCO sometimes faces difficulties with requests from more remote places. This is due to poor rural road conditions and insufficiency of physical and human resources. TANESCO confirmed being able to reach villages within this radius easily. The sub-villages were all electrified in the context of the rural electrification schemes of the Rural Energy Agency (REA), REA I to REA III.

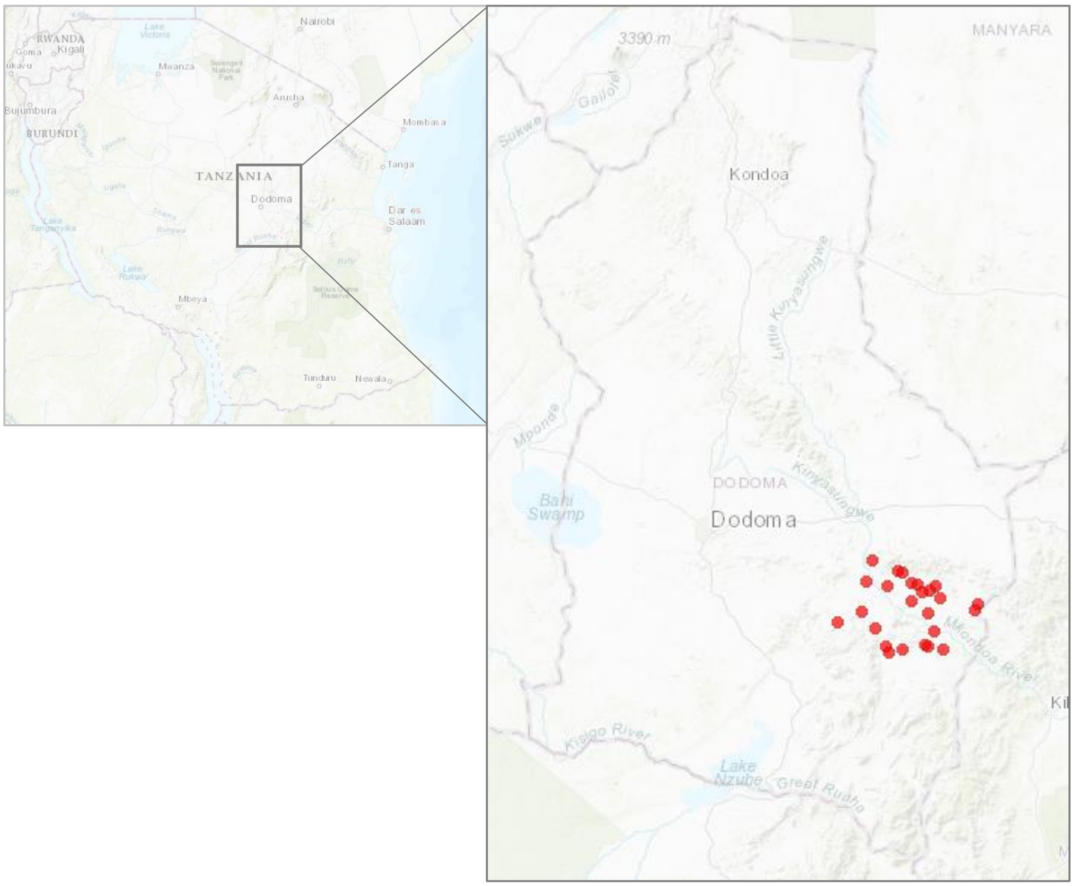
The study population comprised households living within reach of the electricity grid. After consultation with TANESCO, we defined households living at most 60 meters from the nearest electricity pole as 'within reach of the grid'. Those living farther away need to pay for additional poles which generally makes it prohibitive for individual households to connect. Sampling in this corridor used a census of non-connected households, which had been conducted for an earlier field experiment. Connected households were additionally and randomly sampled during the census exercise, by a ratio of 1:4 or 1:5 depending on the sub-village size[3]. Data collection took place in August 2019.

[2] Living close to an electric pole implies that a household does not need an additional electric pole in order to get connected. Hence the household can get connected by paying only the subsidized connection price.

[3] The ratio choice partly mimics low connection rates along the grid line. It is also due to the fact that the sampling framework is also meant to address another, broader objective of the project: randomly testing the role of various interventions among the non-connected households on the connection rates. Due to this, it is imperative that we oversample from the non-connected group of the households.

After using GPS data to verify that non-connected households in the sample lived within the 60-meters threshold, our final sample comprised 1774 households, of which 259 were ‘connected’.

Figure 1: Map of Mpwapwa District



3.2 Estimation Strategy

We estimate two types of models to study the demand factor correlates of electricity uptake using our survey data. First, we use a binary logit model, where household electricity access is regressed on a comprehensive set of predictor variables listed in Table 1, including socio-economic characteristics, social network and housing characteristics, as well as geo-referenced distance from the sampled households to nearby electricity poles and to the nearest TANESCO district office.

The decision to connect is given by the following equation:

$$Y_{ij} = X_{ij}\beta + u_{ij} \tag{1}$$

where Y_{ij} is an indicator of connection to the electricity grid of household *i* in sub-village *j*. Y takes the value 1 if household *i* is connected to the electricity grid, otherwise 0. β is a vector of parameter estimates. X_{ij} is a vector of regressors (introduced above), and u_{ij} is the error term. Eqn. (1) is estimated using a logit model which assumes logistic distribution of the error term.

Second, we adopt a multinomial logit model (MLM) with the same set of predictors. We thereby intend to uncover differences in the driving factors when it comes to the choices between grid electricity and other forms of electricity, i.e., solar, rechargeable batteries and individual generators. This is to account for the strong increase in off-grid electricity sources in rural Tanzania even among households residing close to electricity poles. MNL allows the analysis of decisions across more than two types of energy sources. In our case, the response variable includes three distinct main lighting energy alternatives: grid electricity, off-grid electricity and non-electricity sources (i.e., kerosene, candle and dry cell battery light).

This study specifies an MNL model (discrete choice method) as follows (Greene 2003):

$$Prob(Y_i = j) = \frac{\exp(\beta_j' X_i)}{\sum_{k=0}^{2} \exp(\beta_k'' X_i)} \qquad (2)$$

where Y_i is the dependent variable representing the light energy source chosen by household i and takes the value j (and equivalently k) equal to 1 or 2 if the household has grid electricity or off-grid electricity, respectively. Non-electricity energy sources are thus used as the reference category, taking on the value of 0. Again, X_i represents a vector of explanatory variables, the same as those used in the binary logit model framework, and β represents the vector of estimated coefficients. The results of the MNL model are interpreted in terms of relative risk ratios, i.e., the probability of choosing one outcome category divided by the probability of choosing the reference category (Bensch et al. 2018).

Accordingly, a parameter above 1 indicates that the probability of choosing the alternative category (i.e. either grid or off-grid electricity) is higher than the probability of remaining without electricity sources, and vice versa.

4. Results and Discussion

4.1 Descriptive Statistics

Table 1 presents descriptive statistics of our sampled households, differentiated by connection status. We classify the variables into four main panels, namely Panel A (housing and geographic characteristics), Panel B (socio-economic factors), Panel C (social network related factors), and Panel D (electricity access). The classification is made to underscore different roles played by each of these sets of factors on the uptake of modern energy sources as articulated in the literature.

Panel A presents housing and geographic characteristics of our sampled households. On average, 93 percent of the houses are privately owned with an average size of 3.6 rooms per building. For safety purposes, iron-sheet roofs are a precondition for household connections imposed by the utility[4]. All households have sheet-iron roofs, a factor that we therefore do not include in the subsequent estimations; this structural requirement no longer represents a barrier to connection, as it did a few years ago (cf. Ahlborg & Hammar 2014). While there is no variation across connected and non-connected when it comes to roofing characteristics, we notice significant variation across the two groups in terms of the nature of ownership and house size: connected households have bigger houses which are more often privately owned. In addition, connected households live relatively closer to electricity poles (21 versus 25 meters on average). The average distance from the nearest TANESCO office is 21 km.

According to Panel B, the average age of our respondent is almost 46 years, with a household size of five people, which is consistent with the official population census. The majority of respondents are male (68 percent), married (73 percent), and have completed at least primary education (67 percent). Only 12 percent are engaged in off-farm activities. All socio-economic variables, other than age of household head, show significant differences between households with grid electricity and households without the connection. For example, the average daily expenditure over the past month, as a proxy for income, suggests that connected households are relatively richer (TZS 8,100 or USD 3.5 per day)[5] than non-connected households (TZS 5,700 or USD 2.5 per day).

We present the social network related variables in Panel C. The social network literature asserts that the decision to adopt a new technology could be influenced by the adoption choices of the household's network of family and friends (see for example Bandiera and Rasul 2006; Conley and Udry 2010). We measure the extent of social networks by a number of variables, including years lived in the village, number of relatives and friends connected to electricity both within and outside the village, and the amount of cash transfers (remittances in TZS value) received by the households from relatives or friends living outside the village. The number of friends and relatives

[4] Note that some households in the sampled villages do not have iron-sheet roofs. For the purpose of this study we needed to sample households that meet the minimum criteria for being connected so that we could better understand what other factors drive the low uptake of electricity, conditional to meeting the required criteria. The iron sheet variable is therefore more of an eligibility check which is then dropped once it is confirmed all sampled households meet this eligibility criterion.

[5] 1 USD was equivalent to approximately 2,270 TZS at the time of the survey.

who are connected to electricity and the value of remittances that households receive both show significant variations between households with and without grid electricity.

Finally, Panel D presents key electricity access data. Unlike Panels A to C, these variables are not used to assess potential determinants in the subsequent analysis. Instead, the data informs about main sources of lighting energy, our access indicator in the multivariate analysis introduced in the previous section. This data makes it clear that for virtually all connected households, grid electricity is also their main energy source of lighting. At the same time, 25 percent of non-connected households have an alternative off-grid electricity source at their disposal (mainly solar panels) and 74 percent rely on traditional sources of light (i.e. kerosene, candles, and dry-cell batteries). In addition, we collected information on the potential cost of doing in-house wiring (regardless of the wiring status) for each household, a necessary prerequisite before the house can get connected. Connected respondents estimate that it costs, on average, TZS 235,900 (USD 105) to do the in-house wiring of their whole house; this is far more than the subsidised connection fee of TZS 27,000. The estimate is also 37 percent higher than the average estimate of such costs made by non-connected households. While this can partly be explained by the larger share of connected households (see Panel A), it also hints at some underestimation of in-house wiring costs by the non-connected households (despite which they are not connecting). As an indicator on the community level – both for electricity access but also for broader socio-economic status – the table presents sub-village electrification rates "under the grid", i.e. in a 60m corridor along the main electric grid. This share amounts to roughly 55 percent.

These results already suggest that social and economic differences correlate to some degree with the uptake of electricity in rural Tanzania. These findings are analysed in greater detail in the following section.

Table 1: Descriptive Statistics

Variable description	Connected Households		Non-connected Households		Connected vs. non-connected
	mean	sd	mean	sd	*p*-value
Panel A: Housing and geographic characteristics					
Housing wall is made of brick/stone/cement	0.69		0.47		0.00***
House is privately owned	0.97		0.93		0.03**
House has an iron-sheet roof	1.00		1.00		0.31
Number of rooms in the house	4.15	1.39	3.47	1.04	0.00***
Distance from the nearest electric pole, in meters (GPS measured)	20.87	10.75	25.02	13.21	0.00***
Distance to the district TANESCO offices, in kms	21.14	14.96	20.55	14.52	0.55
Panel B: Socio-economic factors					
Age of respondent	44.20	12.60	45.83	16.24	0.13
Respondent is male	0.78		0.66		0.00***
Respondent is married living with spouse	0.88		0.70		0.00***
Respondent has at least completed primary education	0.75		0.66		0.00***
Respondent is employed or running own business	0.18		0.11		0.00***
Household size	5.60	2.13	4.68	2.08	0.00***
Monthly family expenditure on basic needs, in TZS	8,100	17,200	5,700	17,300	0.04**
Any household member owns a bank account	0.11		0.05		0.00***
Panel C: Social network related factors					
Number of years lived in the village	17.07	13.38	15.75	14.59	0.17
Number of closest neighbors connected to electricity	2.35	2.20	2.15	1.83	0.12
Number of friends/relatives connected to electricity within the village	3.51	5.08	2.52	3.21	0.00***
Amount of remittance received from friends/relatives within past 6 months, in TZS	29,000	68,000	20,100	57,000	0.02**
Panel D: Electricity access					
Main source of lighting energy					
kerosene, candle or dry-cell battery	0.04		0.74		0.00***
individual solar systems (or other electricity source)	0.01		0.25		0.00***
main grid electricity	0.95		0.00		0.00***
Average cost to do inhouse wiring of the whole house, in TZS (self-stated)	235,900	113,700	172,300	104,800	0.00***
Sub-village electrification rate (in 60m corridor along the electric grid)	0.57		0.52		0.00***
Number of observations	259		1515		1774

Note: p-values refer to two-sided t-test on equality in means between connected and non-connected households. *** p<0.01, ** p<0.05, * p<0.1

4.2 Main Results and Discussion

Table 2, we present the results from the binary logit model estimation, expressed as marginal effects. In column (1), we show the estimation results on the determinants of connection for a parsimonious model that only controls for five key variables falling under Panel A of Table 1. Adding further controls enables us to assess other relevant correlates of the electricity connection in rural Tanzania.

The results suggest that households located farther from the nearest electric pole are somewhat less likely to have their houses connected to grid electricity even under the current restriction of 60 meters radius. Specifically, an extra ten meters from the electric pole reduces the likelihood of connection by 3 percentage points, other factors held constant. On the other hand, distance from the TANESCO office has no effect on choosing to connect to grid electricity, which confirms our sample selection criterion of including only villages in the sample that are sufficiently close to that office. The results are qualitatively the same when it comes to the distance from the TANESCO office, but they are quantitatively lower at the margin. Housing characteristics as measured by the number of rooms and walling materials are robust predictors of connection status. Households with bigger houses and those with strong walling structures (i.e. brick, cement or stone walls) are more likely than their counterparts to be connected to grid electricity. While wall characteristics could put an indirect physical constraint on connection (e.g. through the convenience of house wiring), we believe that the mechanism through which housing size could influence connection is primarily as another proxy for household's income.

In addition, we present the estimation results for other potential correlates of connection in column (2). Unsurprisingly, the sub-village electrification rate shows the highest correlation, expressed by the marginal effects. We find that relatively older household heads are less likely than their younger counterparts to have their houses connected to grid electricity, all else equal. However, the relationship is different when it comes to the married respondents living with their partners, suggesting that having a stable family is more likely to increase the demand for electricity compared to those living alone (i.e. non-married or divorced), all else equal. When it comes to the role of social networks, we find that the more social connections one has does not influence the household's decision to connect, all else equal. This also applies for the amount of remittances (value in TZS) received from close relatives and friends. Interestingly, household average expenditure, which we use as a proxy for income, show no impact on electricity connection. However, the number of years one has lived in the village is found to influence connection.

Table 2: Binary Logit Estimates on Correlates of Connection

Dependent variable:	electricity source	
	(1)	(2)
Housing wall is made of brick/stone/cement	0.101***	0.068***
	(0.016)	(0.016)
House is privately owned	0.051*	0.036
	(0.027)	(0.027)
Number of rooms in the house	0.047***	0.035***
	(0.006)	(0.006)
Distance from the nearest electric pole, in meters (GPS measured)	-0.003***	-0.003***
	(0.001)	(0.001)
Distance to the district TANESCO offices, in kms	0.000	0.000
	(0.001)	(0.000)
Age of respondent		-0.002**
		(0.001)
Respondent is male		-0.005
		(0.022)
Respondent is married living with spouse		0.077***
		(0.017)
Respondent has at least completed primary school		0.015
		(0.016)
Respondent is employed or running an own business		0.023
		(0.024)
Household size		0.008**
		(0.003)
Monthly family expenditure on basic needs, in TZS		0.000
		(0.000)
Any household member owns a bank account		0.044
		(0.037)
Number of years lived in the village		0.001**
		(0.001)
Number of closest neighbors connected to electricity		-0.003
		(0.005)
Number of friends/relatives connected to electricity within the village		0.002
		(0.002)
Remittance received from friends/relatives within past 6 months, in TZS		0.000
		(0.000)
Sub-village electrification rate		0.177***
		(0.050)
Observations	1,774	1,774

Note: Coefficient estimates show marginal effects. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

We next present the multinomial logit model results in Table 3. Column (1) and (4) show marginal effects, as in

Table ***2***, whereas columns (2), (3), (5), and (6) show relative risk ratios (rrr), both again controlling for different sets of covariates. The interpretation of the results is in reference to the base category mentioned at the bottom of the table, either traditional lighting energy sources (i.e. kerosene, candles and dry-cell batteries) or solar energy sources, allowing us to understand potential drivers of choices of grid connection.

Starting with the marginal effects in columns (1) and (4), results are qualitatively the same as those in

Table ***2***. Considering the differentiation in the base case between the estimations expressed in terms of rrr, we see that changes in the distance from an electric pole not only makes it less likely to be grid connected compared to relying on traditional lighting sources, but also compared to using solar sources. This implies that those farther from electric poles not only have a lower probability of connecting to grid electricity, but are also relatively more likely to use off-grid electric sources. These results are robust even after controlling for additional covariates as presented in columns (5) and (6). Consistent with previous results, we find that in most cases housing characteristics correlate significantly with the probability of using grid electricity over traditional lighting sources or over solar energy. On average, households with more rooms and households with walls made of brick, stone, or cement (as opposed to lower-cost traditional building materials) are more likely to opt for grid electricity rather than using kerosene/candles or solar energy as main lighting sources, all else equal. Again, these results are stable and robust when controlling for other covariates.

Looking deeper into the extended set of controls in columns (5) and (6), results confirm our previous results in that married families and households that have lived longer in the village are more likely to use grid electricity as opposed to the traditional sources, all else equal. Monthly family expenditure (as a proxy for income) does have a significant but economically minimal effect on the likelihood of connection to grid electricity. The number of friends/relatives connected to grid electricity within the village does not increase the likelihood of using a connection to the grid as opposed to traditional energy sources or solar energy sources.

The results in Table 3 are very consistent with those presented in

Table ***2***, suggesting that the choice of any given lighting source, including the uptake of REA electricity, is not random but rather influenced by a set of parameters.

Table 3: Multinomial Logit Model on Correlates of Lighting Energy Choices

Estimate:	mfx	rrr	rrr	mfx	rrr	rrr
Dependent variable:			grid connected			
	(1)	(2)	(3)	(4)	(5)	(6)
Housing wall is made of brick/stone/cement	0.103***	3.003***	1.922***	0.068***	2.276***	1.649***
	(0.016)	(0.467)	(0.336)	(0.016)	(0.390)	(0.316)
House is privately owned	0.056**	2.044*	1.769	0.041	1.775	1.498
	(0.026)	(0.852)	(0.788)	(0.026)	(0.741)	(0.688)
Number of rooms in the house	0.054***	1.859***	1.232***	0.043***	1.762***	1.191***
	(0.007)	(0.134)	(0.075)	(0.006)	(0.141)	(0.080)
Distance from the nearest electric pole, in meters (GPS measured)	-0.003***	0.975***	0.965***	-0.003***	0.973***	0.964***
	(0.001)	(0.005)	(0.006)	(0.001)	(0.006)	(0.006)
Distance to the district TANESCO offices, in kms	-0.000	1.003	0.991	0.000	1.008	0.998
	(0.001)	(0.006)	(0.006)	(0.000)	(0.006)	(0.006)
Age of respondent				-0.002***	0.976***	0.990
				(0.001)	(0.007)	(0.008)
Respondent is male				-0.002	0.967	1.012
				(0.021)	(0.228)	(0.266)
Respondent is married living with spouse				0.082***	3.378***	1.777*
				(0.017)	(0.936)	(0.545)
Respondent has at least completed primary school				0.020	1.309	1.098
				(0.015)	(0.238)	(0.224)
Respondent is employed or running an own business				0.040	1.596**	1.184
				(0.025)	(0.375)	(0.293)
Household size				0.006*	1.073*	1.031
				(0.003)	(0.041)	(0.042)
Monthly family expenditure on basic needs, in TZS				0.000**	1.000**	1.000
				(0.000)	(0.000)	(0.000)
Any household member owns a bank account				0.040	1.573	1.224
				(0.036)	(0.516)	(0.401)
Number of years lived in the village				0.002***	1.022***	1.018**
				(0.001)	(0.007)	(0.008)
Number of closest neighbors connected to electricity				-0.003	0.958	0.990
				(0.004)	(0.049)	(0.052)
Number of friends/relatives connected to electricity within the village				0.003	1.044*	0.997
				(0.002)	(0.027)	(0.024)
Remittance received from friends/relatives within past 6 months, in TZS				0.000	1.000*	1.000
				(0.000)	(0.000)	(0.000)
Sub-village electrification rate				0.199***	8.004***	12.302***
				(0.049)	(4.524)	(7.757)
Observations	1,774	1,774	1,774	1,774	1,774	1,774

Reference category	non-connected	non-connected	solar	non-connected	non-connected	solar

Note: Coefficient estimates in columns 1 and 4 are marginal effects (mfx). Coefficient estimates in columns 2, 3, 5, and 6 are relative risk ratios (rrr). The rrr expresses the probability of being connected to the grid divided by the probability of the base case when an independent variable changes by one unit while the other variables in the model are held constant.
Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

5. Conclusion and Recommendation

In recent years, Tanzanian government policy has been to extend electricity to rural villages and provide connection subsidies. Despite these efforts by the government, the rate of connection has been very low. In this paper we examine the factors that influence household electrification. Using a carefully designed instrument, we collected detailed information that enabled us to identify the potential drivers of low uptake using parametric analysis. The analysis shows that household electrification depends on household characteristics, the extent of community electrification, and the distance of the house to the nearest electricity pole. Households that are located far away from an electricity pole are less likely to have their houses connected. We also found that social network characteristics are important in influencing one's decision to connect to electricity. Consistently, households that are connected to electricity seem to have lived in the village much longer than those that are not connected to electricity.

Although connection to grid electricity is highly subsidized, household wealth status seems to contribute significantly to the decision at household level whether or not to connect. Household expenditure increases the likelihood of connection to modern energy sources as compared to traditional sources. This could partly be because wealthier households are more likely to be able afford not only the connection cost but also the ultimate purchase of other electric appliances (e.g. radio, television, etc.), something that could act as a motivating factor.

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