



Does Electrification Matter for Child Development? Evidence from Ethiopia

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Despite mixed empirical evidence, policymakers often justify costly electrification programs with their positive impact on child development (Bernard, 2012; Lee et al., 2020a; Koima, 2024). This paper examines the impacts of a large-scale grid-electrification program in rural Ethiopia using high-quality panel data on nearly 1,200 children and their families. Upon gaining access to electricity, there are important changes in children's daily routines, including reduced hours spent sleeping or helping their families. In addition, I document significant increases in children's educational investments, which – conditional on being enrolled – are particularly pronounced for girls.

Introduction

Access to electricity is often considered a key precondition for economic and social development. At the time of justifying the large financial costs of electrification programs, policymakers often point to the benefits that these programs entail for children (Bernard, 2012). The potential benefits of electrification for children are particularly important for Sub-Saharan Africa, a region with a notably young population, where over 570 million people still lacked access to electricity by 2019 (IEA, 2021). However – and perhaps surprisingly for some – these benefits for children are much less certain than one may expect. In fact, some recent high-quality research has yielded rather tightly estimated zero results regarding how electrification matters for children's educational outcomes (Lee et al., 2022).

Acknowledging the importance of context-specific research, in this project I evaluate the effects of a large-scale electrification program in Ethiopia. Concretely, I shed light on how electrification affects children's development concerning their routines and educational outcomes. In addition, I am interested in how children's age, gender, and their family composition matter for the effects.

Policy context

The electrification program that I exploit in this study is the Ethiopian Universal Energy Access Program (UEAP), which was launched in 2005. Over the years, it became one of the most successful electrification programs in Africa and led to the connection of over 5,000 new rural towns and villages to the electricity grid (World Bank, 2021). Although households needed to pay for their dwellings' connection themselves, a significant proportion of rural households eventually gained electricity access either by affording the costs to receive their own electricity meter from the authorities or by establishing connections to their neighbours' meters. This said, the possible



creation of new businesses and improved public services at the village level likely benefitted all members of a community regardless of their own electrification status.

In rural Ethiopia, life revolves around agricultural activities, with subsistence farming forming the backbone of livelihoods. The provision of essential services, such as electricity, water, healthcare, and education, is often insufficient, contributing to low levels of child health and education in these areas. Educational opportunities are constrained, with children often entering school late and progressing slowly through the grades. Completion rates for both primary and secondary education are limited, partly due to the challenges of accessing schools, exacerbated by the poor quality of teaching in rural settings.

Data and methodology

To evaluate the effects of newly established village-level connections, I rely on high-quality data from the Young Lives Surveys from 2002-2016. The surveys follow two cohorts of children throughout their lives, resulting in a rich panel data set with information on child, household, and village characteristics. For this study, I focus on non-migrant children in rural villages and inspect their time use, subjective well-being, and education over time. By comparing outcomes of otherwise similar children living in electrified versus non-electrified villages, I can infer how electrification altered children's lives over the medium to long term ("differences-in-differences estimation").

To complement the quantitative analysis with a qualitative approach, I conducted semi-structured interviews and focus group discussions in rural Ethiopia. The interviews took place in one electrified and one non-electrified village, that resemble the original Young Lives survey sites. Overall, I interviewed 48 mothers (35–45 years old) and 23 teenagers (15–17 years old) on the (expected) effects of village and household-level electrification. In the paper, I mainly rely on this qualitative approach to contextualise my quantitative findings, but – for the interested reader – I also include a more detailed qualitative analysis in the Appendix.

Results

The quantitative analysis reveals that village electrification is associated with statistically significant increases in household-level electricity connections. After three years, over 40% of households in electrified villages have acquired some grid connection, either by paying the fee for their own electricity meter or for (partial) access through their neighbours' connection. This share of electrified households in a village increases over time, reaching almost 60% ten years after electrification (see Figure 1). In addition, I estimate a small but statistically significant increase in the ownership of electronic devices (see Table 1). The ownership of mobile phones, TVs, and fridges increases by 5, 7, and 1 percentage points, respectively.

Figure 1: Adoption of household-level electricity connections

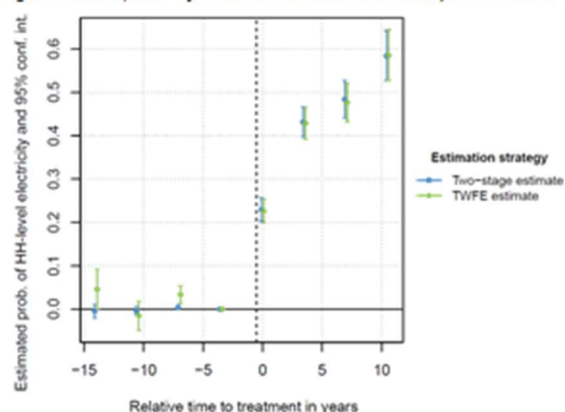


Table 1: Households' adoption of electric appliances

Dependent Variable	Treated	Standard Error	Observations	Adjusted R^2
Radio	0.009	(0.023)	6,951	-3.28×10^{-5}
Mobile phone	0.050***	(0.017)	6,951	0.00594
Television	0.069***	(0.008)	6,951	0.03052
Fridge	0.012***	(0.003)	5,544	0.00639

Notes: The outcome variables are coded as dummies that take the value of one whenever a household reports owning a certain electric appliance and zero otherwise. The coefficients of interest (Treated) are obtained by estimating equation 1 with household-fixed effects using the two-stage estimation framework by Gardner (2022). Besides controlling for household-fixed effects, I also control for households' access to safe drinking water, which can vary over time. Standard errors clustered at the household level are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Electrification also triggers significant changes in children's routines (see Table 2). After electrification, average sleeping hours fall by over 25 minutes per day, in line with the notion of improved lighting conditions after nightfall. Children's time devoted to helping their family with care-work, chores, and in the family business decreases consistently by over half an hour. This is in line with the notion that electricity reduces the burden of these tasks either by leading to an improved provision of local services (e.g., through cheaper milling or mobile charging opportunities or communal electric water pumps) and/or by improving the productivity of household chores (e.g., through the usage of electric appliances such as electric stoves or fridges).¹ While I observe a decrease in the time used on these activities for both girls and boys, I find some evidence for an intra-household redistribution of these tasks towards females.

Promisingly, I find substantial positive effects of electrification on children's educational investments. Overall, the time they spend on education increases by almost 1.5 hours. The latter effects are driven by both extensive and intensive margin responses. On the one hand, I document sizable increases in school attendance rates of over 12.6 percentage points. On the other hand, the time devoted to studying in and outside of school conditional on school attendance also increases significantly. In addition, I find stark improvements in standardised math test scores of about 6%. Restricting attention to those children who remain enrolled in school, girls benefit more than boys in terms of their educational improvements.

The qualitative evidence reaffirms that individuals do, in fact, value electrification very much – both at the household and at the village level. One prominent theme of the interviews is that respondents associate electricity access with a reduced burden of household chores. This aspect is perceived particularly beneficial for females, who are traditionally responsible for the bulk of household chores.

Table 2: Changes in children's routines (pooled over ages 8–12)

Dependent Variable:	Hours sleep		Hours family help		Hours education	
Model:	(1)	(2)	(1)	(2)	(1)	(2)
<i>Variables</i>						
Treated	-0.436*** (0.076) {0.002}	-0.424*** (0.074) {0.000}	-0.583*** (0.189) {0.273}	-0.653*** (0.186) {0.226}	1.410*** (0.178) {0.067}	1.465*** (0.186) {0.057}
<i>Fixed-effects</i>						
Village	✓		✓		✓	
Child		✓		✓		✓
Survey round	✓	✓	✓	✓	✓	✓
<i>Fit statistics</i>						
Observations	2,340	2,340	2,340	2,340	2,340	2,340
R ²	0.43303	0.61732	0.23624	0.49521	0.44512	0.63771
Within R ²	0.01442	0.01908	0.01089	0.00751	0.02763	0.03454

Notes: Hours refer to average daily hours. Hours of family help consist of the sum of hours spent on household tasks, chores, and care work. Hours spent on education consist of hours spent in school and studying outside of school. All models (1) control for gender, and across all models I control for households' access to safe drinking water. Standard errors clustered at the child level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Wild cluster bootstrapped p-values clustered at the village level and computed using Webb-weights are reported in curly brackets.

In addition, respondents often emphasise that electrification leads to new business opportunities. This is considered an avenue for families to generate additional income, for females to take up flexible side jobs, and for children to find employment within their own village, preventing them from migrating to larger cities. Finally, one clear recurring theme in the interviews is that children will benefit from electrification in terms of their educational outcomes. Respondents mention that electricity would free up time for children to study instead of helping with burdensome household chores and allow them to (additionally) study for school after nightfall. In addition, mothers often mention that access to educational TV programs would be beneficial – especially for the preparation of national grade 12 school exams.

Policy impact

What policies can the research impact? Does the project provide counterfactual policy simulations? Which policy stakeholders has the project been in communication with? How might the research benefit these stakeholders?

As of 2019, around 55% of the Ethiopian population remains without access to electricity (IEA, 2019). As this project evaluates the impact of one of the key electrification programs in the country, the UEAP, it entails direct policy learnings for future Ethiopian electrification programs, such as the newly started National Electrification Program. More broadly, the findings of this project may also inform the strategies of other countries in Sub-Saharan Africa that exhibit similarly low shares of electrified households.

During the project, I have engaged in conversations with representatives from the Ministry of Water, Irrigation and Energy (MoWIE) and the Ethiopian Electric Utility (EEU). Both institutions expressed their interest in learning more about the key determinants behind private households' decisions to connect their dwellings to the grid and the type of appliances that are typically bought after that. The

slow uptake of large electric appliances (e.g., TVs or fridges) is informative for the decision to which extent energy sources of lower power capacities, such as home-based solar systems, represent an alternative to traditional grid electrification in the more rural settings of Ethiopia.

Ethiopian policymakers equally signalled their interest in an ongoing exchange about my findings of how electricity access affected the development outcomes of children post village-level grid connection. Overall, the results from this research project further justify the Ethiopian efforts to provide electricity access to rural areas: In the 3-10-year horizon considered in my study, I observe that newly granted electricity access is indeed associated with increased education investments and reduced child labour in unpaid family settings. My findings also underline the importance of considering heterogeneous impacts across different age groups and genders and highlight the potential for tailored accompanying measures to maximise the societal benefits of costly electrification programs.

For example, I find that upon electrification, young boys (aged 5-8) significantly increase the time spent in school, while similar positive effects are only visible for girls at older ages. It seems unfortunate that girls only benefit from these programs with a delay, and one may want to investigate ways in which to reduce this disparity. One reason for this may be the long trips that children often undertake to reach school. If parents perceive these trips as less safe for young girls than for boys, this may help explain the more reactive educational investment margin for boys relative to girls at young ages. If this is true, constructing schools closer to the villages' centre or providing transportation to existing schools may help create even more opportunities for both sexes to benefit from electrification. A second example, about which I learned through the qualitative data collection, is that Ethiopian high school students attribute much importance to whether they have access to additional school classes transmitted on nationwide TV. They believe that access to such TV lectures will enhance their opportunities to do well in the national grade-12 examinations. Making a TV available to newly electrified schools or communities may thus incentivise students to continue their education as their probability of success increases.

Importantly for policymakers, electrification could serve as a catalyst for female empowerment, given that women in Sub-Saharan African settings often bear the brunt of household chores (e.g., Dinkelman, 2011). The idea is that the introduction of electricity-powered appliances or public services could alleviate this burden, freeing up time for women to engage in economic activities. While my research primarily focuses on children, I indeed observe a reduction in the time spent on household chores and unpaid tasks upon village electrification. If these results can be extrapolated to adult household members, further electrification efforts could hold immense promise for advancing gender equality, inspiring a renewed commitment to this crucial cause.

Moving forward

The presented project led to new electrification data on 12 Ethiopian Young Lives villages becoming available to researchers.² As the Young Lives index children grow older, this data may be used to gain a better understanding of how the availability of electricity altered the school-to-work transition of youth and the types of employment that were available for them locally.

While the key advantage of the Young Lives data is surely the granular and high-quality data on children and their families, its main limitation is the limited sample size. While the Young Lives panel covers a long period, the data is collected in only 12 rural survey sites, which reduces the external validity and representativeness of my findings. Furthermore, the data impedes studying heterogeneities across different village types: If existing infrastructure, such as roads or schools, matters for the effects of electrification, it would be beneficial to assess the effects in villages with different facilities independently.³ Finally, the limited geographic coverage prevents the analysis of spillover effects that village electrification may entail concerning neighbouring villages. Future research in these directions may help inform policymakers in developing countries about optimal (grid) electricity rollout strategies.

References

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