**POWER REALIABILITY AND GRID CONNECTION: EVIDENCE FROM RURAL GUATEMALA**

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## Overview

Although the worldwide electricity rate has been rising from 82% in 2008 to 89% in 2018, almost 800 million people do not have access to electricity (World Bank Data). As the Sustainable Development Goal 7 (SDG-7) stresses, access to electricity supply goes beyond the classic dichotomous variable of grid connection, and entails affordability, reliability and sustainability. Besides, these characteristics are not independent from each other, and access does not necessarily means truly and reliable connections. In other words, poor quality service could discourage new connections, although electricity access is available. Moreover, a faulty service could entail conflicts in the form of unpaid bills, theft and illegal connections.

There is an electricity gap in access and reliable service between rural and urban areas worldwide, specially in Guatemala. Ending a civil war in 1996 and starting a reform process, it enhanced the rural electrification rate from 48% to 74% in a decade (World Bank). However, according to 2018 Census, 77.7% of rural households uses the grid as the first way of lightning, while 12.5% still remains using candle or 2.4% even gas. On the contrary, this proportion reaches 95.8% in urban households. Additionally, firewood is still the main primary energy source in the country -specially for cooking and heating in rural areas- entailing indoor pollution.

Likewise, the electricity supplied quality gap is notorious. In the last decade, on average, rural area suffered 35% of more service interruption in duration, and 14% in frequency. Therefore, we want to explore how the lack of reliability behaves as an electrification barrier to rural households in Guatemala.

## Methods

We combine two different household dataset with a complete register of electricity quality service in rural Guatemala at municipality level. Exploiting the particular evolution of power reliability and the precision of Census database, we find evidence that power reliability affects rural household willingness to connect to power grid.

The quality measure is System Average Interruption Duration Index (SAIDI) provided by the National Comission of Electricity Energy (CNEE). This official record avoids us two classical empirical issues: measurement error and selection bias.

The first household database is the ENCOVI 2011 and ENCOVI 2014. It is a National Survey that gathers information regarding dwelling conditions and household characteristics (e.g.: education, health, labor, income). Geographical aggregation is at department level (22 states in Guatemala). The second database is National Population Census that took place in 2018 with 3.2 million household observations at -340- municipality level.

After 2011, following a series of management changes, rural Guatemala suddenly increased the number of outages in comparison to the capital areas. We take advantage of that to study the causal relationship between power reliability on rural households disposal to connect to the grid.

We perform two different regression setups according to available information, in concordance with household database. We exploit spatial -at state level- and time variation in ENCOVI, and more detailed spatial variation in Census.

Our estimates are robust to different model specifications, including an IV strategy using rainfall as an instrument of SAIDI. We use and comparte two possible rainfall database: weather stations data and NASA satellite estimation images.

## Results

* SAIDI results negative and significative. The less reliable, the less willing to connect for rural households.
* In the first regression setup for the period 2011-2014 we find that a 1% reduction in outages duration at department level, increases probability of grid connection between 23-39 percentage points.
* In the second regression setup, with a more stable quality level in 2018, a 1% reduction in outages duration at municipality level increases probability in 2 percentage points.
* Results suggests an heterogenous effect of SAIDI over municipalities depending, on one hand on current level (being larger the effect, at larger levels of SAIDI, and on the other, on past performance: the worse the reputation, the worse is the conditional probability to grid connect.

## Conclusions

The main contribution of this paper would be one of the few that focus on reliability as a barrier to rural households electrification, as well as using a unique database that does not rely on memory nor in people perceptions.

Our findings are aligned with Millien (2017) and Kennedy et al. (2019). In terms of policy implications, keeping a good quality service would be as important as grid extension. Furthermore, bearing in mind the similarities that Chakravorty et al. (2014) document for the Indian case, we also advocate their suggestion that bringing new households to the grid is as important as providing high quality service because they had at least an equally significant and positive effect on household incomes. Efforts to expand the grid should analyzed in concordance with actual power grid quality levels.

## Some References

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