

Electricity access through village grids in rural Senegal – The role of micro-finance

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Study location and anticipated timeline:

Senegal; December 2016 to end of May 2019

Date prepared: March 26, 2019

1. Description of the sample to be used in this study

For this study, we partnered with the Senegalese micro-finance institution U-IMCEC¹ to actively promote micro-finance products, using a clustered randomized controlled trial. The financial products were promoted in villages that were electrified under the village grid program called *Electrification Rurale au Sénégal* (ERSEN). The program connected around 250 villages between 2005 and 2016 using solar-diesel mini-grids. A subsample of 86 villages has been drawn out of this population to participate in this study. In a random subset of 44 villages U-IMCEC started to actively promote micro-finance products between December 2016 and March 2017.

Randomization was done on village level using a stratified re-randomization approach. In the selected treatment villages, our partner MFI visited each village and to market their services to the population during a village meeting. The visit of the MFI in the treatment villages increases the salience and accessibility of information. Moreover, households and enterprises were also able to open an account during these visits which represents a reduction in the transaction costs.

During these visits the MFI offered credits for both individuals and groups. The group lending is particularly relevant for so-called “groupement des femmes” (GDF) and “groupement des hommes” (GDH) which are associations of villagers that jointly produce goods. For individuals and groups, it is an inevitable precondition to have a savings account with a certain amount of money before receiving a credit. This minimum amount is used to cover the transaction costs of the credit.

In 2016 the researchers contacted the MFI and suggested the joint project. The researcher proposed that field agents of the MFI approach villages and inform them directly in village meetings about their products. The field agents were compensated for their time and travel costs by the researchers. A memorandum of understanding between MFI and researchers was signed that defined the approach as well as the treatment and control villages.

From this point onwards the researchers purposely backed off from the intervention and let the MFI handle the implementation without monitoring their actions or intervening at any point. This was done in

¹ <http://www.uimcec.sn/>

respond to increasing concerns that RCTs do not replicate when they are not comprehensively controlled by researchers. This approach also significantly reduces the costs of the intervention and it could easily be replicated or scaled-up (see for instance Bold et al. 2018 or <http://yrise.yale.edu/>). Given this uncontrolled intervention the focus of our analysis is on the uptake of financial services in the treatment villages to investigate whether such a low-cost intervention can increase financial inclusion in rural areas.

For tests of randomization balance, we will check balance of the following variables: prevalence of formal credits, prevalence of informal credits, prevalence of Ndjack (big mosque), enterprises per village, households per village, population per village, number of people migrated, distance to main road, access to public transport, existence of public infrastructure, households with electricity access.

2. Key Data Sources

A baseline was conducted between May and September 2014. In each village, the village chief was interviewed using a standardized questionnaire. Additional to general socio-economic information on the communities, the questionnaire includes detailed questions on enterprises in the village and energy sources used by households.

A follow-up survey similar to the baseline is foreseen to be implemented in early 2019. While the baseline survey did only collect data at village level, the follow-up survey will also include additional household and enterprise interviews. Due to the randomization no difference-in-differences is needed to ensure unconfoundness. The village questionnaire elicits data regarding (i) villages' infrastructure; (ii) socioeconomic information, financial services and (iii) migration. The household data elicits data regarding (i) household electricity usage; (ii) business activities; and (iii) financial services. The enterprise questionnaire elicits data on (i) business type, customers and market access; (ii) electricity usage (iii) appliances; (iv) revenues and costs; and (v) financial services.

3. Hypotheses to be tested

The main goal of this study is to investigate whether a hands-off, unobtrusive intervention can increase the uptake of financial services.

On the household level our hypotheses are:

- a. H_0/H_a : No impact (positive impact) of access to financial services on having a bank account for households.
- b. H_0/H_a : No impact (positive impact) of access to financial services on uptake of credits for households.

For these hypotheses we build on a representative random sample of households in the village. Additionally, we exploratively investigate in more detail whether savings or credits lead to a higher usage rate of appliances. For this purpose, we redraw a selective subsample from the representative sample of households focusing on households that have any financial product.

On the enterprise level our hypotheses are:

- c. H_0/H_a : No impact (positive impact) of access to financial services on having a bank account for enterprises.
- d. H_0/H_a : No impact (positive impact) of access to financial services on uptake of credits for enterprises.
- e. H_0/H_a : No impact (positive impact) on number of appliances for enterprises.

For all hypothesis at enterprise level we collect information for all enterprises in the village.

Finally, we analyze whether the access to financial services stimulate business creation at village level:

- f. H_0/H_a : No impact (positive impact) of access to financial services on number of enterprises in the village

4. Measurement of key variables

Uptake of financial services

This is measured in two ways. First, at village level we collect information on the number of accounts and credits in the village. Second, we interview all enterprises with a short survey that includes questions on whether they have an account or credit. For the households we interview in each village 25 percent of all households with a short questionnaire that includes information on financial service uptake. Each GDF and GDH in the village is interviewed with a detailed questionnaire that includes information on financial services.

Business creation

This is measured with a short enterprise questionnaire that is conducted with all enterprises in the village. This survey collects information on the type of business and on financial services as well as the year of creation.

Appliance usage

This is measured at the household and enterprise level. A subsample of enterprises and households is interviewed with a detailed questionnaire including detailed information on the usage of appliances.

5. Empirical analysis

For our main estimation, we will employ the following simple model using Ordinary Least Squares which regresses the outcome indicator on the treatment status of individual i :

$$Y_{iPost} = \alpha + \beta T_i + V_i + \varepsilon_{iPost}$$

where Y_{iPost} is a variable reflecting the different outcomes of interest for individual i , measured after the intervention. The binary variable T_i indicates whether the individual lives in a village that was randomly

assigned to the treatment group. The vector V_v includes the baseline characteristics of village v : whether the village is located in the central or south region, total number of households per village, distance to main road, population per village, public goods available, whether the mini-grid is working, availability of informal credits. The estimation includes village fixed effects since the randomization was implemented at village level. Finally, ε_{iPost} represents the unobserved individual-specific residual. β measures the Intention-to-Treat effect.

6. Dealing with multiple outcomes and multiple hypothesis testing

We expect that village characteristics are likely to determine the benefits from the intervention. Hence, we will examine treatment heterogeneity according to the following dimensions:

Functionality of mini-grids

For enterprises the availability of reliable electricity can substantially facilitate the production process. It allows enterprises to use appliances that increase productivity or use electric lighting to extend their business hours. We therefore investigate whether the number of hours of electricity per day or the prevalence of breakdowns in the past affect uptake of financial services or business creation.

Distance to branch office

For all transactions the clients of U-IMCEC must travel to the next office. Depending on the village location this can take several hours and imposes high transactions costs. We therefore analysis whether the proximity to the next office affects uptake-behavior. We collect information on the distance as well as traveling time for each client.

7. Procedures for addressing survey attrition, outliers and missing data

Attrition

Since we do have baseline data at village level, attrition between rounds is not a relevant concern.

Outliers

We deal with outliers by capping unbounded variables at the 99th percentile of the observed values in our data.

Missing covariate values

To deal with missing values on our covariates, we follow Lin, Green and Coppock (2016):

- If no more than 10% of the covariate's values are missing, we will recode the missing values to the overall mean.
- If more than 10% of the covariate's values are missing, we will include a missingness dummy as an additional covariate and recode the missing values to 0.

Missing dependent variables

To deal with missing values on our outcome measures, we will adopt the approach described in Kling, Liebman and Katz (2007) and impute missing values by setting them equal to the mean of the respective outcome variable for the relevant treatment group.

References

Bold, T., Kimenyi, M., Mwabu, G., & Sandefur, J. 2018. "Experimental evidence on scaling up education reforms in Kenya." *Journal of Public Economics*, 168, 1-20.

Kling, Jeffrey R, Jeffrey B Liebman and Lawrence F Katz. 2007. "Experimental analysis of neighborhood effects." *Econometrica* 75(1):83–119.

Lin, Winston, Donald Green and Alexander Coppock. 2016. "Standard Operating Procedures: A Safety Net for Pre-Analysis Plans." *PS: Political Science & Politics*, 49 (3), 495-500.

Annex

Figure 1: Villages in the sample

