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Electricity, a Brighter Future for Women?

Rural electrification and empowerment of women in Moçambique

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Abstract

In this paper we study the linkage between rural electrification and empowerment of women in Moçambique. The analysis is divided into two parts, one quantitative part using econometrics, and one qualitative field study where we interviewed women in rural areas in Moçambique. We look at three different aspects of empowerment: *Justification, Decision-making* and *Education*. We use a data set from Measure DHS and utilize a probit model and find that electricity has a positive effect on *Justification* and *Education*. *Decision-making* however is only significant for women below age 30, and is shown to be negatively affected by access to electricity. We complement the quantitative analysis with interviews with twelve Moçambican women in three different villages. Their responses show how they perceive electricity, how it affects their daily life, and how those benefits differ from their husbands'. Rural electrification can have great benefits for everyone, but we show that women and girls in particular benefit to a greater extent.

Key Words: Rural Electrification, Women Empowerment, Mozambique, gender inequality

JEL Classification: I24, I31, J16, O18

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1 - Introduction

Located on the east coast of Africa, between Tanzania and South Africa, Moçambique is with its population of 25 million one of the very poorest countries in the world (IMF, 2014). The former Portuguese colony has been plagued by civil war for 15 years between the factions Frelimo and RENAMO, holding back development and neglecting human rights with more than 1 million deaths and displacing 5 million refugees (USDS, 2014). Since the post-war Frelimo era, Moçambique has had a political tradition to advocate gender equality and empowerment of women. In the parliament of Moçambique 36% of the seats are held by women, but even so it is one of the countries with the largest gender inequalities in the world, and is one of the least developed countries in the world. (Christian Michelsen Institute, 2010). Gender inequalities are apparent in all regions, both urban and rural, but the inequality is greater in the rural areas (Duflo, 2012). In spite of the relatively high ratio of women in parliament in the country, this does not reflect the distribution of local parliaments around Moçambique. Women representation is low on both informal local levels but also at the more formal public levels. Furthermore, women have a lower employment rate, lower income and it is harder for them to obtain land plots and they have lower agricultural production. Additionally women have lower educational levels than men, as well as lower levels of health compared to men. (Christian Michelsen Institute, 2010).

In most of Sub-Saharan Africa, traditional gender roles and patriarchy have skewed the household workload distribution, sentencing women and girls to the vast majority of all household chores, as well as offering them few opportunities to seek a different path (Mathur & Mathur, 2005). In low-income countries all over the world, women do 52% of all the work (both domestic and professional work) but only get rewarded for 33% of that labor, while men only do 48% of the work but receive reward for 74. Consequently, the benefits from rural electrification have been shown to be greater for women than for men (Khandker, Samad, Ali, & Barnes, 2012; Mathur & Mathur, 2005; White, Blöndal, Rota, & Vajja, 2008). It is not only the distribution of workload in the household that differs between gender, but also the perception of the benefits from electricity. Studies have shown that women believe that more access to electricity would reduce their workload regarding daily chores[1],.improve their health status and reduce household costs. On the other hand men think that benefits from electrification is more leisure time, higher over-all quality of life and better education for their children. (Barnett (2000) in Clancy, Skutsch, & Batchelor, 2003). The connectivity rate to the power grid in the Moçambique as a whole is severely underdeveloped, at around only 23%, but looking only at the countryside it is as low as 2-3% in some areas (Kreitz & Ilskog, 2014).

Regarding the connection between access to electricity and standards of living, quality of life is significantly improved for the whole household when given access to electricity, but women in particular might be the greatest beneficiaries (Mathur & Mathur, 2005). There are numerous mechanisms in place that make access to electricity improve quality of life, especially in rural areas. Among other things, access to electricity on village level allows: access to safe water through electrical pumps, improved information and communication via television and internet in turn often lead to improved health, streetlights increase the safety at night, and electricity provides alternative means for cooking etc. These are all benefits that occur quite quickly after given access to the grid, thus many aspects of the improved life quality resulting from rural electrification is seen and felt in a very short time frame (Mathur & Mathur, 2005). Even though benefits occur quickly after the implementation of electricity the nature of the utility gained from Rural Electrification (RE) makes it difficult to measure its worth, especially for those who would benefit from it. For example collecting firewood might appear to be "free", but the opportunity cost of the time spent collecting it adds up quickly, as do the negative environmental effects, such as higher carbon pollution, not to mention the health hazard of indoor pollution. Furthermore, the effect of RE on schooling is great since good lighting at night allows children to do their homework at night, and since girls in particular have little time to study, RE has shown to increase both enrollment rates and the average number of years of completed schooling for girls in India. The lighting is considered so important for academic achievement that in 2003 and 2004 riots broke out in four cities in India when power cuts occurred during the standardized examination period (Mathur & Mathur, 2005).

[1] Collecting firewood and water could be replaced by electrical cooking appliances, and electrical water pumps will give a more local water source (Khandker, Samad, Ali, & Barnes, 2012). However, in Mozambique according to the DHS data set, only about 0.08% of rural households with electricity uses it for cooking.

The purpose of our study is to see, through a quantitative approach using econometrics, to what extent access to electricity can empower women living in rural areas in Moçambique, while complementing this with a qualitative study where we carry out interviews with women in rural areas in Moçambique, to provide a deeper understanding of their situation. The reason we have chosen to look at rural areas specifically is that we believe that the effects from electricity have a greater impact where it is scarce and underdeveloped. There are only a handful of other papers specifically studying rural electrification and empowerment of women using econometrics. Most of these studies have been conducted in Asia, predominately India, as for Africa however, we have been unable to find any previous published papers on the subject. On the other hand there are a lot of studies on rural electrification and its impact on different key economic factors, e.g. employment and household income, which we present in the literature review. Therefore, to study electrification in rural areas and how it affects women is very important as it might provide useful insight on how to approach the gender inequality problem in the developing world.

Empowerment is defined differently depending on whom you ask and there are many views on it. Therefore we have our own definition of what empowerment is. It is a composite of several definitions that would embody our goal with this study:

"Empowerment is a process, which helps individuals to achieve equal opportunities in life, increase own influence in everyday life and help individuals to be able to understand their own rights."

For the quantitative study we use an econometric approach and will be looking at three variables and areas in terms of empowerment: *Justification, Decision-making* and *Education.* The Justification variable is based on women's belief regarding whether it is ever justified to be beaten, for any reason, by your husband/partner. The *Decision*-making variable is based on questions regarding the daily household decisions. The third empowerment measure is the *Education* variable that we define as followed: Do girls and boys have the same opportunities in terms of education?

For robustness checks we estimate our benchmark estimations with a linear probability model using OLS. Since we use sample weights and stratification to control for the non-random sampling in the data set we are using, we will also estimate our benchmark estimations with only weights and no stratification, as well as neither weights nor stratification. As for heterogeneity, we control for differences between age groups and whether the head of household is male or female for all three dependent variables, while for *Decision-making* we extend the heterogeneity test to control for differences regarding marital status.

We find that empowerment in terms of *Justification* increases when gaining access to electricity, the expected probability that a woman would not justify being beating by her husband increases with 7.43%. In the analysis for *Decision-making*, we do not find support that empowerment increases, but actually decreases for women under 30, while for those of 30 and above we find no statistically significant effect. Our last dependent variable, *Education*, show positive results. While electricity increases probability that one attended school during the last year for all children, there is a statistically significant and robust difference between girls and boys. The boys' attendance increase with 9.6% while the girls' increase by 12.8%, and the benefit is greatest for children between age five and nine.

For the qualitative part of our study we traveled to southern Moçambique, where we interviewed 12 women, age 23 to 48, in three villages in rural areas in southern Moçambique. The interviews reveal how they perceive the effect of electricity on their daily life, and also how this differs from their husbands'. The women had no doubts that access to electricity had made their life easier through electric appliances and light. The cheap and effective electric light allows them to plan the day and to "extend" the day by several hours. Electricity also allowed their children to attend school to a greater extent due to the option/opportunity to study in the evening using electric lights. There was no difference between boys and girls however, out of all the women we talked to, all their children attended school. But roughly half the women reported that women benefit more than men from electricity in the household.

In the next section we present a literature review regarding rural electrification and empowerment. In Section 3 we present different views of empowerment. Sections 4 through 7 contain the quantitative sections and Sections 8 and 9 are the qualitative sections. In Section 4 we describe what type of data we use for our econometric analysis, restrictions to our data set and data characteristics. In addition to this we explain the methods we use in our econometric analysis. In this section we also define and explain the variables we use in the econometric analysis. Section 5 contains descriptive statistics of our variables of interest, while in Section 6 we explain our preferred econometric specifications in detail and discuss drawbacks and benefits of the model. Additionally we talk about which estimators we use and why. Section 7 presents our results, from the econometric analysis. In addition to the main results, we perform robustness checks and heterogeneity tests. Section 8 presents the methodology used for the interviews and the village characteristics. In Section 9 we present the results from the qualitative study, and in Section 10 we discuss and compare the findings from the quantitative and qualitative analyses. Lastly in Section 11 we have a conclusion where we summarize our study.

2 - Previous Research

In Mathur and Mathur's paper '*Dark Homes and Smoky Heaths: Rural Electrification and Women'* they investigate the direct and indirect benefits of RE on burden on women, health, education and agricultural productivity in India. Through a meta-study they conclude that RE leads to increased enrollment, as well as reduced dropout rates, and more so for girls than for boys. Moreover, they found that through a lower consumption of candles and kerosene fueled lights, which causes indoor pollution and may lead to premature death or chronic complications with the respiratory system, health levels increased. Switching from kerosene to electric lights also reduces cost greatly, with a consumer surplus of Rs 15-20 ($0.25-0.30) per kWh. They find that the likelihood of a household to have access to electricity increases with education and income level. However the causality is unclear, and might act in either direction. Their concluding remark is that they support the expansion of RE, that the benefits outweigh the costs. Their results indicate that RE leads to savings in household expenditures, as well as significantly improved quality of life for women in those areas. (Mathur & Mathur, 2005).

Bensch, Kluve and Peters (2011) studied the impact of RE in Rwanda. They collected data from 537 households from seven villages, four electrified and three non-electrified villages. Their variables of interest are lighting usage, study time at home, energy expenditure and income. They use a probit model and find a positive correlation between connectivity and years of education of head of household, and with income. The latter they discuss to have causality operating in both ways. They did not check for gender differences, but children spent roughly 20 minutes longer every day doing homework in electrified households compared to the non-electrified. Regarding whether RE is cost efficient they argue that the benefits from the new services, such as electric lighting and television etc., more than offsets the cost of connecting to the grid.

In the paper '*Who Benefits Most from Rural Electrification? Evidence in India'* Khandker et al. (2012) use an econometric approach to study how RE reduces time used to collect firewood, affects the time spent studying at home, labor supply and household income. By increasing the education level through longer study hours, RE is expected to improve economic growth in the long run. Other benefits mentioned are reduced indoor pollution, carbon emissions and business operations can operate for longer hours during the day. They find statistically significant results that wealth and education have a positive effect on demand and usage of electricity. They also find that when reliability and quality of the service increase, so do the adoption and consumption rates, 2.7% and 14.4% respectively. Enrollment increases for both boys and girls in electrified households, but girls' enrollment increases by 7.4% while that of boys increases by only 6%. Schooling years for girls increase by 0.2 years more than for boys. The biggest impact was on the employment rate, while it increased 1.5% for men, it increased 17% for women in electrified households. Critics have argued that the benefit for the poorest households is so low it might be better to use the money to improve their situation through other means, which have a greater impact. They run the regressions again but divided into expenditure quantiles, in order to see which income groups benefit the most. The two groups with the lowest household expenditures show no significant benefit at all from electrification, while the richest benefit the most. The authors discuss that this might be due to that rich households can utilize the electricity through a wider variety of appliances, while the poorer might only benefit from lighting. They address the issue of quality of electricity provision and find that villages without frequent power outages have a higher electrification rate (81%) than villages with severe power outages (38% electrification rate). In the villages with bad connections the kerosene consumption is not much lower than in those without electricity, meaning that it might be counter-productive to have electricity if it is not reliable. (Khandker et al. 2012).

A paper by Taryn Dinkelman (2011) contributes to the literature with a new angle on infrastructure in developing countries. In earlier studies the emphasis has been mostly on poverty, education outcomes and health issues, while this paper provides a new emphasis on employment and its effects. Dinkelman (2011) conducted a regression study in South Africa regarding rural electrification and its impact on employment rate. After the apartheid there was a big rollout project in rural areas. This was exploited in order to analyze the effect of new access to electricity on employment rate. The findings are that projects are heavily focused on areas that are doing worse over time. Moreover, in the OLS estimation the employment rate is higher for women in areas with electricity compared to areas without electricity and men have a lower employment rates compared to females. When using instrumental variables the IV estimates for females are significantly larger than those of the OLS estimation. The authors show that access to electricity increases the employment rate by 13.5 percentage points at a 95% significance level while for males the result is insignificant. The magnitude for females are quite big and if we only look at absolute numbers, access to electricity will increase the employment by approximately 22,500 women in South Africa. The group that is most likely to be affected by access to electrification is the middle-poor households. This group can afford to involve the new possibilities electricity brings to their table, for example invest in a small business. But the poorest households do not have the basic necessities to be able to make those kinds of choices. An additional finding is that women in their thirties and forties are more flexible to change, thus they can adjust more easily to the change electricity brings. One reason for this might be that these women are less likely to have any newborn babies requiring a lot of care, thus they are more susceptible for new technology and change. (Dinkelman, 2011).

In a recent paper by Chakravorty, Pelli, & Marchand (2012) the authors follow the same approach as Dinkelman. They use the land gradient to instrument electricity in different regions in India to see how it affects household income. Land gradient is highly correlated with the cost of expanding the electricity grid. It is less costly to expand the power grid on flat landscapes compared to a region where the terrain is characterized by mountains and hills. They chose to also study the intensive margin of electricity, i.e. the quality of the supplied electricity. They instrument the quality of supply by using the density of the transmission cables. A transmission cable of higher density increases the probability of receiving electricity with higher quality. They use a data set with approximately 10,000 observations and the results from their probit estimation are that the quality of supplied electricity might be as important as the connection to the grid. They conclude that connecting to the grid increases the average household income by 8-10 percent while a connection with high quality increases the average household income by 13-15 percent.

3 - Views on Empowerment

Empowerment can mean many different things depending on context and source. For the sake of our study and choice of variables, we will in this section give a short review of what empowerment of women can mean, and how we chose to define it for our paper.

The third goal in the United Nations Millennium Development Goals is to *Promote Gender Equality and Empower Women.* The targets for this goal include, among others, eliminating gender disparity in schooling, eliminate discrimination against women, and increase participation and decision-making (United Nations, 2014). Women empowerment and economic development is a bidirectional relationship. The first relationship is an indirect link to women empowerment, i.e. economic development decreases poverty, which in turn leads to a shrinking gap between genders. The second relationship is that women empowerment is fundamental in order to achieve the other Millennium Development Goals, which in turn leads to escaping poverty and further promote economic growth and human rights. There is an ongoing debate of this bidirectional relationship and policymakers tend to only focus on one of these relationships at a time. (Duflo, 2012). The scope of this paper is to focus on the first relationship, i.e. how accessibility to electricity affects women's empowerment, more specifically in rural areas of Moçambique. In order to do so we need to define what empowerment really is.

In the literature the word empowerment is often mentioned without a clear definition and if defined, the definition differs depending on whom you ask. If you were to ask an economist, s/he would probably define it as efficient processes that will result in a desired sustainable outcome. On the other side of the spectrum, a sociologist would define it as social justice or realization of rights. (Jupp & Ali, 2010). Below are a few definitions of empowerment:

"The process through which those who are currently disadvantaged achieve equal rights, resources and power." (Mayoux, 2008)

"The expansion of assets and capabilities of poor people to participate in, negotiate with, influence, control and hold accountable institutions that affect their lives." (Narayan, 2002)

"Empowerment is a multi-dimensional social process that helps people gain control over their own lives." (Page & Czuba, 1999)

In a paper by Alsop & Heinsohn (2005) called "Measuring Empowerment in Practice" the authors provide another definition of empowerment. They developed a framework on how to measure empowerment in practice. The framework is based on the empowerment definition that

"If a person or group is empowered, they possess the capacity to make effective choices; that is, to translate their choices into desired actions and outcomes."

Due to the fact that there is no unified definition of empowerment and the definitions available are in some cases very different from one another, we have chosen to define empowerment in our own way. All the above definitions of empowerment are highly suitable to define empowerment, and our definition of empowerment is a composition of the definitions above. In our study we will base empowerment of women on three pillars: equal opportunities in life, control over things in everyday life, and view of ones own rights as a person, and we have formulated the following definition:

"Empowerment is a process, which helps individuals to achieve equal opportunities in life, increase own influence in everyday life and help individuals to be able to understand their own rights."

As for equal opportunities in life we will focus on education, or rather difference in school attendance between boys and girls. We will look at decision-making in the household as a representation of control over ones everyday life. And finally how the women perceive their rights by looking at whether they ever think it is justified, for any reason, to be hit by their husband.

4 - Data and Methodology

For our study we use two different datasets from *Measure DHS -Demographic & Health Surveys*. The DHS surveys have been executed in over 90 countries and gather data regarding population, health, and nutrition for over 25 years, specifically for women between 15 and 50 years of age. In Moçambique the survey has been carried out in 1997, 2003 and 2011, though many of our variables of interest were not available from the 1997 and 2003 sets, so we will only use the latter one. In the individual data set 13,785 women were interviewed for the survey. The second data set was collected at the same time as the individual data set. Instead of only covering single individuals, it covers everyone in the household where the interview took place, and contains 62,750 observations. The questions asked during this survey were not as extensive as in the individual data set, and we do not have all the same control variables (religion and marital status is missing), but the great advantage of the household data set is that it covers children, both girls and boys, under the age of 15 and, among other things, describes their school attendance. Thus we can compare the relative advantage on schooling between genders as a result from electrification.

4.1 - Data Selection

As previously explained we restrict our sample to only rural households, as it is only these households that are relevant for this study. Regarding our choice of dependent variables, we chose to study three empowerment variables, which are representative for our definition of empowerment. The three variables of interest are a *Justification* variable, a *Decision-making* variable and an *Education* variable. In all of our regressions we include control variables. Regarding our choice of empowerment variables for the individual data set we are following the same approach as Upadhyay & Karasek (2012) to define empowerment, by using the justification variables and the decision-making variables in the individual DHS data set. Regarding the education aspect in our analysis, equal opportunities for boys and girls as part of the MDG's, and it is a human right that all children have a right to attend school. Since boys have a higher attendance as of now, if electricity helps girls more than boys it is in our interest to see how much.

Justification variable

In the data set there are five justification variables where the respondent is asked whether she thinks beating is justified for different reasons, the five questions are as followed: Beating justified if wife goes out without telling husband? Beating justified if wife neglects the children? Beating justified if wife argues with husband? Beating justified if wife refuses to have sex with husband? Beating justified if wife burns the food? We believe that women that do not think beating is justified in any of the above questions has a "higher level of empowerment" than women that believes that beating is justified for any of the above questions. In our analysis we create a new dummy variable that will take a value of 1 if the respondent answers that none of the reasons for beating are justified. Where 1 is defined as the respondent being empowered. If the respondent answers that one or more reason is justified we define the respondent as less empowered and the empowerment variable will take a value of 0.

In their study using the same data set, but for Guinea, Mali, Namibia and Zambia, Upadhyay & Karasek (2012) make an assumption that if the respondents answer no to four questions, but if for some reason they have a missing value for the fifth question the respondent is assumed to be empowered. We do not employ this method regarding missing values, as we believe it might give a bias towards being empowered[2]. Moreover, we have a big enough sample without making this assumption. Missing values are automatically dropped when performing our analysis.

Decision-making variable

Our second empowerment measure is based on the decision-making variables in the DHS data set. We are using the same approach for this variable as with the justification variable. The statements/questions being asked in the survey are the following: person who usually decides on respondent's health care, person who usually decides what to do with money husband/partner earns, person who usually decides on large household purchases and person who usually decides on visits to family or relatives. If a woman decides alone or jointly with her husband/partner regarding the above statements/questions we argue that she holds a higher level of empowerment than if she does not decide on the statements above. If the respondent answers that they decide or

[2] When talking about empowerment in this setting we refer to the evaluation of our dependent variables based on our definition, rather than the spectrum of what empowered might mean.

that they decide jointly with their husband/partner, we treat them as being empowered and if they answer that someone other than themselves decides on one of the statements/questions we treat the respondent as being less empowered. (Upadhyay & Karasek, 2012).

We create a dummy variable which will take the value 1 if the respondent alone or jointly with their husband decide on all the different variables and 0 if they do not decide on one or more of the questions/statements. For the decision-making variable we do not adapt the missing value approach either with the same argument as for the justification variable. Moreover, this sample will be smaller in comparison to the other samples we use. This is due to the restriction that the respondent needs to have a husband/partner to be eligible to answer the questions regarding decision-making. The sample size is reduced by approximately 2000 observations, but the sample size is still large enough, approximately 5600 observations. Missing values are automatically dropped when performing our analysis.

Education variable

In the Individual data set we know the women's education level, but we know nothing about their access to electricity during the time they went to school. Therefore one cannot say how electricity has affected their education in the past. Instead we use the Household data set in our education analysis, our dependent variable is *attended_school,* which is a dummy variable and equal to 1 if the individual has attended school during the last year. The advantage of this variable compared to 'grades completed' for example, is that we can compare age groups and see where the access to electricity is most beneficial. If we only looked at completed levels (primary, secondary, higher) our regression would be more restricted since the individuals are roughly the same age once they complete a level. Therefore we would not be able to see if age matters in attending school. Also our sub-sample groups would be much smaller since they would be divided into age groups corresponding to each school level, while using *attended_school,* we can look at the whole sample at once. Since *attended_school* has a shorter time frame and describes the previous year, the likelihood that their electricity status was the same then as it was during the DHS survey is much higher than for example 'grades completed'.

From here on we will refer to our dependent variables as *Justification, Decision-making* and *Education.*

Control variables

We use a large number of control variables in all of our regressions. We control for individuals' marital statuses, where we divide it as following: Individuals which never been in union with somebody else is grouped in one dummy variable, married in one, having a partner is the third variable and the last three is widowed, divorced and separated. In all regressions we omit *never_in_union* variable in order for our regressions to not exhibit multicollinearity. We chose to omit *never_in_union* as we see it as the initial marital status in life. In the Household data we do not have information on marital status, so we cannot control for this when looking at education.

We also control for region specific effects to distinguish if there are any differences between regions. We include all regions in Moçambique, which are, Niassa, Cabo Delgado, Nampula, Zambezia, Tete, Manica, Sofala, Imhambane, Gaza and Maputo Province. Maputo City is omitted as it is not a rural region and we omit Maputo_province, to not exhibit multicollinearity, due to the fact that in the rural parts of Moçambique, Maputo province is most likely the region with the highest density of electrified households.

We control for religion specific effects since there are numerous different religions in Moçambique and it is important to see if they differ with regard to our dependent variables. The religion dummies are: catholic, Islamic, zion, evangelical, angelican protestant, having no religious beliefs, other religion and unknown. We chose to omit catholic, as it is the biggest religious group in our sample and use this as our benchmark. Religion dummy variables are not included in the household survey sample.

For the *Justification* and *Decision-making* variables education is also important to control for, as education should have a big impact on our dependent variables, thus it should be large discrepancies between the different levels of education. We divide education into *no_educ, primary, secondary* and *higher* and code them as dummy variables. Where *no_educ* is defined as the individual having no formal education. *Primary, secondary* and *higher,* are defined as having education on primary level, secondary level and on a level higher than secondary level, respectively. We omit *no_educ*, with the same argument as for the marital status, it is the initial point in life regarding education, and thus it is most intuitively to omit it. In the regression with education as dependent variable we do not include education as a control variable.

Furthermore, we also control for age and we include an age-squared variable since we believe that insight and self-assertion comes with age. Moreover we control for the size of the household, in terms of individuals living in a household. There is no variable for individual or household income in the data sets, instead DHS has created a *wealth* variable, which is a composite of several different variables, including materials of the floor, walls, and roof of the household etc. but it also contains access to electricity. Since *Electricity* is our variable of interest our results would suffer from multicollinearity. We use a simple wealth index, which we call House standard, which is based on how the floor of your house is constructed. It is an ordinal variable from 1 to 5 that describes the floor materials in the household, if it is earth, wooden planks, adobe, concrete or tiles. This will of course not completely reflect the household income, but it will give us an idea of their situation. We test how well this variable correlates with the pre-coded wealth index. There is a 70.24% correlation between the DHS wealth variable and our house standard, which validates the use of it. The NGO Progress out of Poverty executes a similar approach, though they have several other variables, including schooling and electricity. (Progress out of Poverty, 2014).

4.2 - Method

For our analysis of the *Measure DHS* data sets we use an econometric approach. Due to the fact that our dependent variables are binary we use a probit model for most of our regressions. We perform both robustness checks and heterogeneity tests to check whether our benchmark estimations hold or not. For the robustness checks we run our benchmark estimation with a linear probability model using OLS, we estimate the models, using only weights and no stratification as well as neither weight nor stratification with a probit model. In the heterogeneity section we divide our sample in age groups to see if the sample is heterogeneous, as well as gender head of household and marital status. We also test to see if the possible difference between groups is significant.

4.3 - Data Characteristics

For our analysis to be as correct as possible, a few changes to the data set had to be done before starting our analysis. The households selected for the survey, for which the data set is based on, were not randomly selected. In some regions the surveyors did oversampling to have enough observations for that specific region, while in some regions they under-sampled due to time and budget constraints. To account for this we use a weighting variable provided by

Measured DHS to account for the non-randomization. This had to be done because Stata's default preference for data sets is that the data set is a randomized sample. Therefore, the analysis of a non-randomized sample can be misleading and we had to make these changes in order to make a proper analysis.

Regarding the weighting some claim that it is a mandatory condition when doing regression analysis of a survey data. On the other side of the spectrum, others claim that when dealing with individual observations it is inappropriate to use weighting. More and more of the DHS researchers advocate the use of weighting when conducting regression analysis. Although, measured DHS conclude that it is up to the researcher if weights should be used or not. With this information, we choose to use weighting for our study, due to the fact that some regions were under- and oversampled, and we want our sample to be unbiased with regards to this sampling. The weight variable used is a variable pre-coded by Measure DHS.

Furthermore we apply stratification to the sample. Stratification is used so that the standard errors of each coefficient are calculated correctly i.e. the standard errors shall be calculated on the whole sample and not only on the sub sample. This is an important step when doing regression analysis with this type of data, because if stratification is not applied one cannot interpret the significance of the coefficients. When applying stratification to the sample, one needs to define at what level clustering should be done. Therefore one does not need to define clustering level for each regression. The data set is clustered using a variable that is defined as a village variable. The variable is divided in groups of 25 neighboring households in 611 different regions. (DHS, 2014).

There might be a complication regarding non-randomization where the rural electrification network expands. There is literature that shows that there is a relationship that infrastructure projects are often focused on areas that are lagging behind in growth/development but still have a huge impact politically (Aschauer, 1989). Due to this non-randomization when deciding who gets electricity and who does not, the result from a study like this most likely exhibit some sort of bias, but is not something we can examine further with our current data.

In similar studies regarding electricity, the authors have used instrumental variables for electricity due to endogeneity problem. Dinkelman (2011) and Chakravorty et al. (2012) use land gradient and the latter paper also uses the density of the electricity cable to measure electricity. Our estimations might have endogeneity problems, although not to the same extent as in the papers metioned, e.g. Dinkelman (2011) studies empoloyment rate which has a big endogeneity problem with electricity, as the access to electricity in areas of interest is lowering the cost of opening new businesses. This will increase the supply of jobs and it will indirectly affect the employment rate. Due to a budget constraint we have not been able to adjust for possible endogeneity problems, as this type of data is costly to retrieve. We recommend for future studies, regarding electricity and empowerment, to instrument electicity with similar instruments as used by the authors mentioned above.

5 - Descriptive Statistics

Two of our three dependent variables are based on the individual data set, presented in Table 1. The first dependent variable, *Justification,* has a mean of approximately 0.77. Which translates into that the distribution is skewed towards 1 or as we define it, being more empowered. For the second dependent variable, *Decision-making,* the mean is approximately 0.4. Meaning that the distribution between less and more empowered is leaning to the less empowered.

Table 1: Summary Statistics individual data set

Variable	Obs	Mean	Std. Dev.	Min	Max
Electricity	7806	0.079	0.270	0	1
Justification	7546	0.768	0.422	0	1
Decision-making	5686	0.394	0.489	0	1
Age	7941	28.980	9.660	15	49
Age squared	7941	933.126	599.218	225	2401
Size household	7941	5.609	2.952	1	24
Head of household	7941	0.372	0.483	0	1
House standard	7794	2.198	1.432	1	5
No education	7941	0.398	0.490	0	1
Primary	7941	0.523	0.499	0	1
Secondary	7941	0.077	0.267	0	1
Higher	7941	0.001	0.034	0	1
Never in union	7941	0.140	0.347	0	1
Married	7941	0.493	0.500	0	1
With partner	7941	0.237	0.425	0	1
Widowed	7941	0.042	0.202	0	1
Divorced	7941	0.020	0.139	0	1
Separated	7941	0.069	0.253	0	1

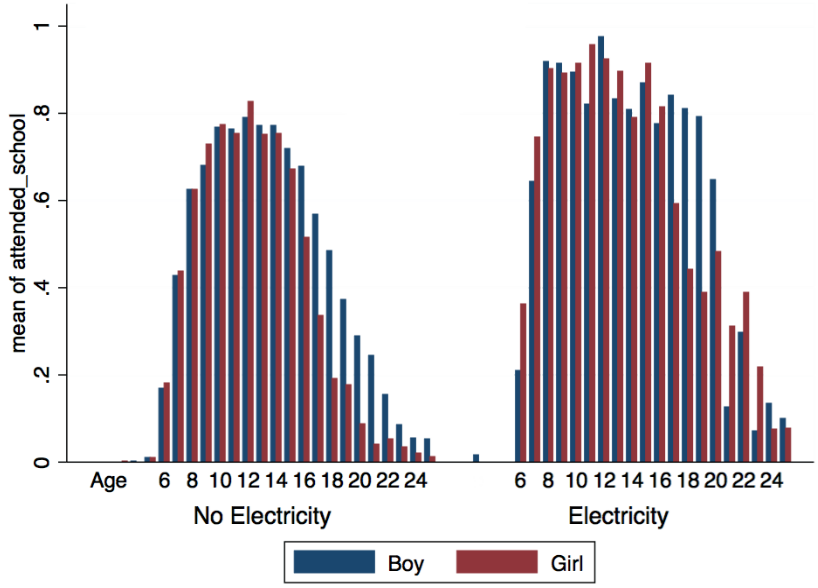
Our variable of interest, *Electricity,* has a mean value of approximately 0.08, which is what we expect as electricity is a rare commodity in the rural areas of Moçambique. Mean age of our sample is 29 years old with a standard deviation of 10 years. The size of the household, in terms of people in the household, has a mean value of 5.6 people with a range from 1 to 24. Regarding the head of household variable, the variable takes a value of 1 if the head of household is a woman and 0 if it is a man. It has a mean value of approximately 0.37, which means that there are more male heads of household than female, and it is not obvious here whether a husband is present in those households of which the woman is head.

House standard (which is our wealth index) has a mean value of approximately 2.19, which can be interpreted as that the house standard overall is low, and that the floor in the average house for our sample is made of either earth or adobe. For the education dummies we can tell, by looking at the mean values, that it is most common with a primary education as the highest attained education, and having no education is the second most common category. *Married* is the most common marital status and the second most common status is *living with partner*, followed by *never in union*. One important thing to notice is that half the women in the sample are married.

The distribution for the nine different regions in Moçambique is quite even. Some regions have a higher mean value, but as explained earlier this is due to the survey design, and the fact that the surveyors had to do over and under sampling in the regions. The three most common religions are catholic, zion and evangelical, with a mean value of approximately 0.25, 0.22 and 0.17, respectively. See Appendix Table A1 for the complete summary statistics table.

Figure 1 present a comparison between boys and girls' schooling from the household data set, i.e. whether they have attended school at all the previous year. In areas with no electricity the distribution between the genders are quite similar up to age 12, the girls even have a slightly higher attendance. But when it comes to secondary education, from age 12 and up, boys have a significantly higher attendance. What we see when comparing this to areas with electricity is that everyone's schooling increases greatly, but that girls in particular show increased attendance, though higher education is still dominated by boys.

Figure 1 – Age, Electricity, Gender and Attendance



Unlike the individual data set, the data in the household data set include females and males alike, but we have restricted it to those below age 25, since we know that only three individuals in the sample above the age of 24 attended school in the last year. The household summary statistics is presented in Table 2. With an average attendance ratio of 37.7%, divided into five-year cohorts we can see that the attendance ratio ranges from 8% to 77% between age groups, with standard error deviations around 0.45 except for the oldest group (0.27). The ratio of people with electricity is roughly 0.07, which is lower than in the individual data set. One likely possibility for this is that the average household size is greater in this subsample group compared to the whole sample in the individual data set, and thus there is an "overrepresentation" of people without electricity among households with individuals in school. Regarding the other control variables, *house_standard* and *female_hh* (female head of household) they do not differ considerately from the individual data set. The nine provinces show that the sampling distribution is quite even, but with some over- and underrepresentation, which is why we will use sample weights. Religion and marital status are not available in the household data. Additionally we can see in both Table 1 and 2 that the standard deviation is large for most of our variables, which means that we have a large variance in our data.

Table 2: Summary Statistics household data set

Variable	Obs	Mean	Std. Dev.	Min	Max
Electricity	25277	0.073	0.260	0	1
Attended school	25277	0.377	0.485	0	1
Att. School (age 5-9)	6661	0.548	0.498	0	1
Att. School (age 10-14)	5628	0.770	0.421	0	1
Att. School (age 15-19)	3275	0.409	0.492	0	1
Att. School (age 20-24)	2345	0.080	0.272	0	1
Age	25277	9.241	6.543	0	24
Age squared	25277	128.198	148.086	0	576
Size of household	25277	6.158	2.871	1	24
House standard	25235	2.166	1.411	1	5
Head of household	25277	0.338	0.473	0	1
Maputo Province	25277	0.038	0.190	0	1
Niassa	25277	0.100	0.300	0	1
Cabo Delgado	25277	0.098	0.297	0	1
Nampula	25277	0.082	0.274	0	1
Zambezia	25277	0.141	0.348	0	1
Tete	25277	0.124	0.330	0	1
Manica	25277	0.103	0.305	0	1
Sofala	25277	0.115	0.319	0	1
Imhambane	25277	0.093	0.291	0	1
Gaza	25277	0.106	0.308	0	1

6 - Econometric specifications

Our benchmark specification for the *Justification* variable and the *Decision-making* variable is a probit estimation. The two estimations are identical in terms of variable of interest and control variables used, except for marital status. As for the *Decision-making* estimation the sample is restricted to women that are married or in partnership. Thus, we do not control for marital status. Below are the econometric specifications for the *Justification* and the *Decision-making*.

$$Justification_i = \Phi(\alpha Electricity_i + \beta y_i + \gamma \eta_i + \delta \theta_i + \varphi \pi_i + \epsilon \omega_i + \varepsilon_i)$$

$$Decision\_making_i = \Phi(\alpha Electricity_i + \beta y_i + \gamma \eta_i + \varphi \pi_i + \epsilon \omega_i + \varepsilon_i)$$

We have a cumulative distribution, Φ, since we are using a probit model where i represent each individual. $Electricity_i$ is our variable of interest. y_i is a vector of mixed control variables: age, age-squared, size of household, head of household and house standard. η_i is a vector of the education dummy variables, Marital statuses are contained in θ_i as dummy variables and π_i is a vector of the region dummy variables. The last vector of control variable is ω_i, which is composed of a dummy variable for each religion. Lastly, ε_i is the error term.

For the third dependent variable, we use the household data set, and we will again use a probit model, now with the following specification:

$$Attended\_school_i = \Phi(\alpha Electricity_i + \beta y_i + \varphi\pi_i + \epsilon_i)$$

Where y_i is a vector of the same control variables as in the previous specification level: age, age-squared, size of household, head of household and house standard. The second vector of variables, π_i, control for the region, and ϵ_i is the error term. We do not control for education, since that is now our dependent variable, or for marital status since it is not contained in this data set. Since we are interested in individuals who still go to school, or did until last year, we limit the sample in this case to those over five years and below 25 years of age, since there are only 13 individuals under the age of five, and three individuals over the age of 24 that have attended school at all during the last year.

7 - Results

This section contains our main results, robustness checks as well as heterogeneity tests. Furthermore, all tables show the marginal effects from the probit regressions.

7.1 - Main Results

Justification

Table 3, Column 1 presents our benchmark estimation result for the *Justification* variable. Electricity is highly significant at a 1% significance level with a positive magnitude of 0.0743. Which can be translated to; when a household has electricity the women in the household has 7.43% higher probability of being empowered. Our proxy for wealth, *house_standard* is significant at a 1% significance level with a positive magnitude of 0.0206. If the house standard is being increased it will translate into an increase in probability of being empowered, by approximately 2%. In other words higher wealth increases the probability of the woman being empowered, which is as expected. Educational level is only significant at secondary level, where it is significant at a 5% significance level. If a woman has a secondary education it will increase the probability of being empowered by approximately 5.7%. Higher education (*higher*) is omitted from the probit estimations as it predicts the dependent variable perfectly. Although we do not see this as a problem because it is only 9 observations that drops out and it should not alter the result in a significant way. *Age, agesq, sizehh,* are insignificant as well as all the marital statuses.

Table 3: Estimations Justification variable

VARIABLES	(1) Benchmark	(2) OLS	(3) Only weight	(4) No weight/strata
electricity	0.0743***	0.0629***	0.0743**	0.0614**
	(0.0288)	(0.0230)	(0.0292)	(0.0246)
age	0.00326	0.00285	0.00326	0.00118
	(0.00437)	(0.00434)	(0.00434)	(0.00359)
agesq	-3.86e-05	-3.21e-05	-3.86e-05	-9.49e-07
	(6.86e-05)	(6.76e-05)	(6.80e-05)	(5.61e-05)
sizehh	-0.00310	-0.00295	-0.00310	-0.00247
	(0.00234)	(0.00238)	(0.00232)	(0.00217)
hohh	0.00218	0.000904	0.00218	0.00218
	(0.0146)	(0.0149)	(0.0145)	(0.0112)
house_standard	0.0206***	0.0181***	0.0206***	0.0148***
	(0.00591)	(0.00533)	(0.00613)	(0.00456)
primary	0.00987	0.0109	0.00987	0.0264**
	(0.0136)	(0.0141)	(0.0138)	(0.0116)
secondary	0.0574**	0.0525**	0.0574**	0.0594**
	(0.0261)	(0.0231)	(0.0264)	(0.0241)
higher		0.104***		
		(0.0358)		
married	0.0113	0.0119	0.0113	-0.00146
	(0.0247)	(0.0257)	(0.0255)	(0.0199)
with_partner	-0.00451	-0.00339	-0.00451	-0.00150
	(0.0237)	(0.0237)	(0.0237)	(0.0212)
widowed	0.0495	0.0508	0.0495	0.0281
	(0.0362)	(0.0335)	(0.0363)	(0.0282)
divorced	-0.0338	-0.0319	-0.0338	-0.0368
	(0.0419)	(0.0435)	(0.0417)	(0.0348)
separated	0.00772	0.0116	0.00772	-0.0182
	(0.0311)	(0.0311)	(0.0311)	(0.0257)
Observations	7,393	7,401	7,393	7,393

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Regarding region and religion, which is not shown in the table above, there are some significant results. For the full estimation table, see Appendix Table A2, Column 1. Maputo province is the benchmark region in our estimation. The regions that have a significant result are, Cabo Delgado, Nampula, Tete, Sofala, Imhambane and Gaza. All of these have a negative magnitude, which means that these regions have a negative effect on the dependent variable, relative to Maputo province. This suggests that place of residence has some impact on the level of empowerment. Regarding the religion variables, we omitted catholic, thus it is the benchmark religion. It is only *Islamic, Zion* and *Evangelical* that are significant. *Islamic* is significant at a 1% significance level and it has a positive magnitude. *Zion* is negative and significant at a 10% significance level. Lastly, *Evangelical* is positive and significant at a 5% significance level.

Decision-making

The result from our benchmark estimation for the *Decision-making* variable is presented in Table 4, Column 1. Our main variable of interest, *Electricity,* is insignificant and negative.

Table 4: Estimations Decision-making variable

VARIABLES	(1) Benchmark	(2) OLS	(3) Only weight	(4) No weight/strata
electricity	-0.0237	-0.0256	-0.0237	-0.0591*
	(0.0362)	(0.0391)	(0.0363)	(0.0305)
age	0.0117**	0.0115**	0.0117**	0.0117**
	(0.00522)	(0.00514)	(0.00519)	(0.00482)
agesq	-0.000135*	-0.000132*	-0.000135*	-0.000124*
	(7.85e-05)	(7.80e-05)	(7.80e-05)	(7.29e-05)
sizehh	-0.00386	-0.00444	-0.00386	-0.00584*
	(0.00297)	(0.00308)	(0.00299)	(0.00302)
hohh	0.0482**	0.0495**	0.0482**	0.0180
	(0.0188)	(0.0197)	(0.0194)	(0.0169)
house_standard	0.0266***	0.0281***	0.0266***	0.0301***
	(0.00627)	(0.00656)	(0.00637)	(0.00557)
primary	0.00929	0.00796	0.00929	0.00212
	(0.0165)	(0.0165)	(0.0172)	(0.0159)
secondary	0.0966*	0.104*	0.0966*	0.0762**
	(0.0493)	(0.0535)	(0.0506)	(0.0332)
higher	0.187	0.210	0.187	0.104
	(0.171)	(0.182)	(0.171)	(0.113)
Observations	5,604	5,604	5,604	5,604

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Both *age* and its squared term is significant on a 5% and 10% significance level, respectively. *Age* has a magnitude of 0.0117, which means that when a woman gets older she has a higher probability to be part of the decision-making in the household. *Agesq* has a value of -0.000135, which means that there is a convex relationship, and decision-making will "peak" at a certain age, and then diminish.

The head of household variable is significant at a 5% significance level with a positive magnitude of 0.0482. This means that if the head of household is a woman, the probability of her being empowered is increased by 4.82%. *House_standard* is significant at a 1% significance level and a positive magnitude of 0.266. Same as for the justification estimation, secondary education level is the only level which is significant. It is significant at a 10% significance level. Since primary level focuses on the basic knowledge of reading and writing etc., secondary school might be more important than primary in terms of consciousness of ones rights from a gender, and human rights perspective.

Region and religion is not presented in the table above, for the complete estimation table see Appendix, Table A3, Column 1. Just as for the *Justification* variable, Maputo province is the omitted variable, thus it is the benchmark region. There are only three regions that are significant, *Nampula*, with a negative magnitude, *Imhambane* and *Tete* with a positive magnitude. *Nampula* and *Imhambane* are both statistically significant at a 1% significance level while *Tete* is significant at a 10% significance level. The results suggest that the place of residence and the level of empowerment only matter if you live in the regions named above.

Education

For *Education* we also get a few statistically significant independent variables: age is, as we could expect, a very significant and quite large determinant of school attendance, and we will explore this further in our heterogeneity tests. Our proxy-variable for income is also highly significant, and shows that those who live in a house of higher standard are more likely to have attended school during the last year. Looking at the regional differences in school attendance (see Appendix, Table A4, Column 1 and 2), five out of the nine provinces are statistically significant down to the 1% level and one down to the 5% level (while the other three are not significant at all) for girls. For boys it is only two provinces that are significant down to the 1% level, with another three provinces significant down to the 5% level. The marginal effects vary from -0.0554 to -0.142, which suggest that your place of residence have a great effect on schooling. Whether this is due to cultural differences or local government policies is unclear however. But we can clearly see that the enrollment is highest in the omitted region, Maputo Province, which is also the wealthiest.

As we are interested in the whole country of Moçambique and not specific regions we choose to not include it in the tables in the paper. Instead we present the full estimations in the appendix section. In the next sections we will not interpret the coefficients for the regions or the religions.

Table 5: Estimations Education variable I

	Benchmark		**OLS**	
	(1)	(2)	(3)	(4)
VARIABLES	Female	Male	Female	Male
electricity	0.128***	0.0960***	0.119***	0.0872***
	(0.0210)	(0.0170)	(0.0202)	(0.0172)
age	0.178***	0.171***	0.141***	0.148***
	(0.00335)	(0.00270)	(0.00340)	(0.00265)
agesq	-0.00761***	-0.00683***	-0.00599***	-0.00598***
	(0.000187)	(0.000149)	(0.000141)	(0.000127)
sizehh	0.00186	0.00178	0.00474**	0.00335
	(0.00195)	(0.00211)	(0.00209)	(0.00214)
house_standard	0.0183***	0.0115***	0.0200***	0.0108***
	(0.00345)	(0.00371)	(0.00365)	(0.00394)
female_hh	0.00423	0.00704	0.0115	0.0128
	(0.00957)	(0.0101)	(0.0102)	(0.0105)
Constant			-0.190***	-0.225***
Observations	38,652	38,652	38,695	38,695
Obs (Subsample)	12977	12258	12977	12258

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As for our variable of interest, *Electricity* does have a strong positive correlation with *Education*, which can be seen in Table 5, Column 1 and 2. The estimated coefficients are positive and highly statistically significant, down to the 1% level. The marginal effects from the probit estimation are greater for females than for males, indicating that access to electricity affects the probability that girls have attended school in the last year. Female attendance increases with 12.8%, 3.2% more than the 9.6% for the males.

As we discussed earlier, the most likely reasons for this increase in schooling is that access to lighting in the house enables the children to study during the evenings. The difference between the genders can be described by the fact that the girls spend more time doing household chores, thus this "extra" time in the evening makes up a bigger portion of their free-time, and in turn they receive a greater benefit from the electrification in terms of educational opportunities (Bensch, Kluve, & Peters, 2011).

7.2 - Robustness

We perform three robustness checks for each of our specifications. First we estimate the specifications with a linear probability model using OLS, to make sure that the non-linear probit model we are using does not affect the results. For the second robustness check we estimate the benchmark estimation with only the use of weights but no stratification, to see if weights and stratification affects the results. Lastly, we run the benchmark regression without both weights and stratification.

Justification

The Linear probability model (OLS) estimation for the *Justification* variable is presented in Table 3, Column 2. We can conclude that the estimates are more or less the same when we are estimating the model with a linear probability model. Electricity is highly significant at a 1% significance level and the sign of the coefficient is positive. The magnitude of the coefficient is smaller than in the probit estimation. If a household has electricity the woman in that household has 6.29% higher probability of being empowered. *House_standard* is still significant at the same level as in the probit estimation and the sign is positive. The magnitude is smaller, but not substantially. Education on secondary level is significant at a 5% significance level and also higher education is significant at a 1% significance level. If a woman has a secondary education, the probability of her being empowered is 5.25% higher compared to having no education. If the woman has higher education than secondary, the probability of her being empowered is 10.4% higher than if she would have had no education.

The second robustness check we estimate the benchmark estimation with weights and no stratification using a probit model. The result is presented in Table 3, Column 3. We can conclude that when including only weights in the estimation the coefficients is exactly the same as in the benchmark estimation. Which means that the weighting is correctly applied, as weights not including the stratification only the standard errors should be affected. For our variable of interest, *Electricity,* the significance level drops from 1% significance level in the benchmark estimation to a 5% significance level. Since no stratification is used, we have clustered standard errors on the same level as we used for the stratification. Moreover, *house_standard* is still significant at a 1% significance level and *secondary* have the same significance level as well. We can conclude from this robustness test that the results hold even without the use of stratification.

The third robustness check, is a probit estimation with no weight and no stratification, but with standard errors clustered at the cluster level used for the stratification, see Table 3, Column 4. With no weight and no stratification the marginal effect for *Electricity* has changed and the significance level has dropped to a 5% significance level and the marginal effect has dropped to 0.0614. *House_standard* is still significant at the same significance level, but the coefficient has dropped to 0.0148 from 0.0206. The biggest difference compared to the benchmark estimation is that primary schooling is now significant at a 5% significance level and in the benchmark estimation it was insignificant. From these three robustness checks we can conclude that our benchmark estimation holds. Furthermore, we are confident that the use of weights and stratification is the most appropriate approach when doing a regression analysis. But in this case it had a minor effect on the overall results.

Decision-making

For the *Decision-making* variable and the linear probability model using OLS, see Table 4, Column 2. *Electricity* is still insignificant and negative when estimating the model with OLS. Age and age squared are significant at a 5% and 10% significance level, respectively. The sign and magnitude are approximately the same as in the benchmark estimation. For the head of household variable, *hohh,* the significance level is the same as in the benchmark estimation, with approximately the same marginal effect. House standard is highly significant at a 1% significance level, still positive and the marginal effect is a bit higher. This can be translated into that higher wealth increase the probability of the woman in the household to be empowered by 2.81%. For the education dummy variables it is only secondary schooling that is significant, at a 1% significance level, same as for the benchmark estimation.

The probit estimation without stratification but with weights is presented in Table 4, Column 3. We cluster standard errors at the same cluster level used for the stratification. The result is similar to the benchmark estimation, in the sense that the significance level is the same for all variables. We can conclude that the use of weights but not stratification does not alter the result.

The last robustness check, a probit estimation with no weight and no stratification but with clustered standard errors at the cluster level used for stratification, is presented in Table 4, Column 4. *Electricity* is now significant at a 10% significance level and the magnitude is still negative. The significance level for *sizehh* has changed, and it is now significant at a 10% significance level compared to the benchmark estimation where it was insignificant. *Secondary* has also become significant. It is significant at a 5% significance level. The rest of the variables have the same significance level as in the benchmark estimation. We can conclude when using no stratification and no weighting the results change compared to the benchmark estimation. We believe that the benchmark result is still robust and the latter robustness check strengthens our argument regarding the use of weights and stratification. Without the use of weights and stratification we believe that the interpretation of the results would be incorrect, as the coefficient/marginal effect is not weighted and the standard errors are calculated based on the wrong sample size. And in this case, there is a big difference as *Electricity* is significant when not using weights and stratification, but is insignificant when using it.

Education

Regarding the *Education* variable and the household data set, in order to see how robust our results are we first run a linear probability model using OLS, see Table 5, Column 3 and 4. We find that the trend is unchanged, but the marginal effect decreases by about 1% for both boys and girls. The only other change from our benchmark results is that the *sizehh*, the household size, is now significant at the 5% level. In the light of these results, our findings do not depend on the choice of model. It seems very unlikely however, that the relationship between electricity and school attendance is perfectly linear. So due to the non-linear properties of the probit model and the fact that OLS does not know how to handle a binary dependent variable the probit model is more likely to reflect reality and that is why we use it for the benchmark results.

When running the benchmark regression using only weights and no stratification our results are unchanged in terms of significance; they are all still significant down to the 1% level. The new standard errors we get from this are almost completely unchanged; it only increased 0.0001 for boys, but is unchanged for the girls.

Table 6: Estimations Education II

	Only weight		No weight/strata	
	(1)	(2)	(3)	(4)
VARIABLES	Female	Male	Female	Male
electricity	0.128***	0.0960***	0.0938***	0.0838***
	(0.0210)	(0.0171)	(0.0167)	(0.0163)
age	0.178***	0.171***	0.180***	0.172***
	(0.00335)	(0.00280)	(0.00273)	(0.00212)
agesq	-0.00761***	-0.00683***	-0.00776***	-0.00686***
	(0.000187)	(0.000152)	(0.000154)	(0.000118)
sizehh	0.00186	0.00178	0.00238	0.000654
	(0.00195)	(0.00211)	(0.00153)	(0.00178)
house_standard	0.0183***	0.0115***	0.0159***	0.0105***
	(0.00344)	(0.00375)	(0.00293)	(0.00339)
female_hh	0.00423	0.00704	0.00359	0.00396
	(0.00951)	(0.0101)	(0.00779)	(0.00850)
Observations	12,977	12,258	12,977	12,258

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Just as with *Justification* and *Decision-making* the marginal effects are unchanged. When we drop the stratification as well, see Table 6, Column 3 and 4, the significance level is once again unchanged, and the marginal effect is greater than in the benchmark. The increase is more modest than the weights-only regression however, but either way our results withstand this last robustness check.

7.3 - Heterogeneity

We perform three heterogeneity tests. In the first test we divide the sample into two age groups, where we look at one age group below the age of 30 and the other age group above age of 29. Dinkelman (2011) found that women in their thirties and forties are more responsive regarding the benefits form electricity. Therefore, we choose to do the same division to see whether this is true for our sample. For the second heterogeneity test we test whether there is a difference between households with a female being the head of household and households with a male head of household. For the third test we test for differences between marital statuses. The latter one is only applied for the decision-making variable, while the other two tests are applied for all of our three dependent variables.

Justification

The age heterogeneity test is presented in Table 7, Column 1 and 2. As we can see *Electricity* is significant at a 5% significance level for women older than 29. For the second age group, below 30, the significance level is only at a 10% significance level. Furthermore, the marginal effect for women above 29 years old is 0.0872 and the marginal effect for the age group below 30 is 0.0669. We test whether this difference between the two age groups is significant or not, see Table A6, Column 1 in appendix.

Table 7: Heterogeneity Justification variable

	Age groups		**Head of household**	
	(1)	(2)	(3)	(4)
VARIABLES	Above 29	Below 30	Female	Male
electricity	0.0872**	0.0669*	0.0213	0.112***
	(0.0355)	(0.0385)	(0.0384)	(0.0399)
age			0.00776	-0.000883
			(0.00659)	(0.00549)
agesq			-0.000131	3.58e-05
			(0.000104)	(8.40e-05)
sizehh	-0.00487	-0.000783	-0.00170	-0.00389
	(0.00314)	(0.00302)	(0.00419)	(0.00283)
house_standard	0.0288***	0.0122*	0.0277***	0.0182**
	(0.00766)	(0.00698)	(0.00822)	(0.00768)
never_in_union	0.00850	-0.0218	-0.00615	0.0102
	(0.0544)	(0.0334)	(0.0338)	(0.0565)
married	0.0107	-0.00271	-0.0288	0.0395
	(0.0324)	(0.0326)	(0.0280)	(0.0503)
with_partner	-0.0410	0.0126	0.0134	0.00101
	(0.0373)	(0.0386)	(0.0331)	(0.0585)
widowed	0.0272	0.118	0.0350	0.199*
	(0.0475)	(0.0775)	(0.0401)	(0.105)
divorced	-0.0536	-0.00842	-0.0283	-0.0623
	(0.0514)	(0.0660)	(0.0433)	(0.100)
hohh	-0.00685	0.0133		
	(0.0214)	(0.0178)		
Observations	7,660	7,524	7,636	7,546
Obs (subsample)	3,247	3,963	2,730	4,658

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The variable of interest in this regression is the interaction term, which is called *interaction_age.* If this variable is significant we can conclude that there is a significant difference between the two age groups. However, the variable is insignificant, thus we can reject the hypothesis that women in their thirties and forties are more responsive regarding *Electricity*, i.e. if it increases their level of empowerment more than for women below 30.

The second heterogeneity test is presented in Table 7, Column 3 and 4. If the head of household is female *Electricity* has no significant effect on the woman's empowerment level. If the head of household is male, then the effect is significant at a 1% significance level and the marginal effect is 0.112. This difference might be due to that a higher portion of the sample is male head of household. We test if this difference is significant or not, see Appendix Table A6, Column 2. The interaction term, *interaction_hohh* is insignificant, which means that the difference between the two groups is not statistically different.

Decision-making

Our results regarding *Decision-making* is insignificant, both in the benchmark estimation but also in all of our robustness estimations except when we are not using weights nor stratification. Even though we have insignificant results we want to investigate if there is any subgroup that have a major effect on the full sample.

The first heterogeneity test is the age group test, the two regressions are presented in Table 8, Column 1 and 2. *Electricity* is not statistically significant in age group above age of 29 but it is statistically significant for age group below 30. We test if the difference between the two age groups is statistically significant. See Table A6, Column 3 in appendix. The variable of interest is called *interaction_age*. It is significant, which means that there is a difference between the two age groups. Thus, the effect electricity has on women depends on their age. *Electricity* does not have a significant effect on women above the age of 29 but there is a significant effect on women below the age of 30, and the marginal effect is negative. Which means that *Electricity* lowers the probability of being empowered by 8.83%, for women below 30. This might be due to the fact that they are still young and when a household gets electricity the husband in the household decide over it, which will increase his decision-making share in the household and lower the woman's decision-making share. In turn this would explain the negative marginal effect for women below 30.

The second heterogeneity test, head of household, is presented in Table 8, Column 3 and 4. In both of the regressions (female and male head of household), the effect from *Electricity* is insignificant. *Interaction_hohh* in Table A6, Column 4 in appendix, is significant at a 10% significance level, which means that the difference between these two groups is statistically different. Although this difference is not very important as both of the groups had insignificant results regarding *Electricity.*

Table 8: Heterogeneity tests Decision-making

	Age groups		**Head of household**		**Marital status**	
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Above 29	Below 30	Female	Male	Married	With partner
electricity	0.0638	-0.0883**	-0.0792	0.0114	-0.0464	-0.0213
	(0.0594)	(0.0380)	(0.0517)	(0.0401)	(0.0429)	(0.0448)
age			0.0168	0.00973	0.0154**	0.00504
			(0.0115)	(0.00614)	(0.00710)	(0.00731)
agesq			-0.000162	-0.000120	-0.000185*	-3.39e-05
			(0.000176)	(9.24e-05)	(0.000107)	(0.000109)
sizehh	-0.00435	-0.000223	-0.0156**	-0.00141	-0.00351	-0.0102**
	(0.00417)	(0.00402)	(0.00693)	(0.00317)	(0.00391)	(0.00408)
house_standard	0.0242***	0.0293***	0.0369***	0.0228***	0.0522***	0.00426
	(0.00845)	(0.00902)	(0.0101)	(0.00799)	(0.00933)	(0.00770)
primary	-0.00501	0.0132	0.0119	0.00760	0.00286	0.0232
	(0.0214)	(0.0215)	(0.0306)	(0.0183)	(0.0198)	(0.0250)
secondary	0.00752	0.121**	0.144**	0.0699	0.0892	0.109*
	(0.0868)	(0.0510)	(0.0649)	(0.0603)	(0.0545)	(0.0643)
higher	0.231		0.224	0.176	-0.159***	0.240
	(0.239)		(0.180)	(0.314)	(0.0596)	(0.200)
hohh	0.0687***	0.0289			0.0815***	-0.00334
	(0.0265)	(0.0232)			(0.0225)	(0.0315)
Observations	6,976	6,418	6,373	7,019	7,721	7,763
Obs (Subsample)	2,743	2,857	1,467	4,131	3,789	1,815

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8, Column 5 and 6 present the two subgroups regarding marital status, married and with partner, respectively. The effect from *Electricity* on *Decision-making* is insignificant for married women and also insignificant for women with a partner. The difference between these two groups is not statistically significant, as the interaction term, *interaction_marital,* in is insignificant, see Appendix Table A6, Column 5. Therefore, we can conclude that there is no difference between the two marital statuses, married and with partner and that a subgroup does not affect our full sample estimation.

Education

What is quite important for our study is whether the difference in schooling between genders is statistically significant from each other. To check this we again use an interaction term, this time using *Electricity* and *Female*. In Appendix Table 17, Column 1 we can see that the interaction term is statistically significant on the 5% level. This means that access to electricity do in fact affect girls' schooling to a greater extent than for boys, and does not appear to be a spurious result.

Table 9: Heterogeneity I, household data set

	5-9		10-14		15-19		20-24	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Female	Male	Female	Male	Female	Male	Female	Male
electricity	0.194***	0.0921**	0.0956**	0.0552	0.227***	0.328***	0.111***	0.0527
	(0.0485)	(0.0437)	(0.0435)	(0.0433)	(0.0426)	(0.0510)	(0.0276)	(0.0444)
sizehh	-0.00609	-0.00162	-7.86e-05	-0.00174	0.0221***	0.00879*	0.00450	0.0215***
	(0.00410)	(0.00553)	(0.00432)	(0.00434)	(0.00422)	(0.00511)	(0.00300)	(0.00527)
house_standard	0.0328***	0.0155*	0.0244***	0.0206**	0.0390***	0.0338***	0.00728	0.00631
	(0.00870)	(0.00821)	(0.00901)	(0.00812)	(0.00984)	(0.0114)	(0.00554)	(0.0122)
female_hh	-0.0160	-0.00340	-0.00162	-0.0122	0.107***	0.0931***	-0.00741	0.0367
	(0.0249)	(0.0267)	(0.0222)	(0.0206)	(0.0283)	(0.0308)	(0.0151)	(0.0376)
Observations	38,652	38,652	38,652	38,652	38,652	38,652	38,652	38,652
Obs (Subsample)	3,384	3,269	3,805	2,813	1,705	1,563	1,360	979

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Additionally we wish to see if there are any sub-sample groups that drive our results, age group of the child and the gender of the head of household specifically. For the age analysis we divide our sample into four age groups spanning five years each and drop the *age* and *agesq* variables. We then run the probit regressions again, and the results are shown in Table 9. The results are similar to what we observed in Figure 1, the girls benefit at younger ages, while the boys attendance increases more for higher education. But for females the results are significant down to the 1% level for all age groups except 10-14, where its 5% significance. While for boys only one groups is significant at the 1% level, and one at the 5% level. In all cases but one are the results highly significant and the boys reach a higher attendance than the girls, age 15 to 19. Other than that, the advantage of access to electricity on school attendance is greater for girls, and iIn the youngest group the difference in increase is greater than 10%.

In Table 10 we have divided our sample into subgroups based on the gender of the head of household, and dropped the *female_hh* variable. It might be the case that if there is a female head of household she might be more prone to "favor" the girls, or the other way around with a male head of household.

Table 10: Heterogeneity II, household data set

	Female HoHH		**Male HoHH**	
	(1)	(2)	(3)	(4)
VARIABLES	Female	Male	Female	Male
electricity	0.0878***	0.0663***	0.0758***	0.0543***
	(0.0162)	(0.0162)	(0.0167)	(0.0136)
age	0.118***	0.112***	0.108***	0.104***
	(0.00324)	(0.00288)	(0.00251)	(0.00180)
agesq	-0.00506***	-0.00450***	-0.00463***	-0.00414***
	(0.000176)	(0.000157)	(0.000138)	(0.000103)
sizehh	-0.00201	0.00192	0.00241*	0.00105
	(0.00248)	(0.00260)	(0.00130)	(0.00149)
house_standard	0.00855**	0.00713**	0.0130***	0.00721**
	(0.00342)	(0.00364)	(0.00298)	(0.00280)
Observations	38,652	38,652	34,095	34,677
Obs (subsample)	4557	3975	8420	8283

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As can be seen in Table 10, the increase occur no matter the gender of the head of household, though a female head of household tends to "promote" education in general for both boys and girls compared to male head of households. But in both cases, the marginal effect is larger for girls compared to boys. However, the difference between these two are not statistically significant (see *interaction_hohh* in Appendix Table A7 Column 4) and we can dismiss the theory that either girls or boys might be "favored" depending on the gender of the head of household.

8 - Data and Methodology

8.1 - Data selection

The field study was carried out in the Maputo Province in Moçambique, we interviewed 12 women in three villages in rural areas. The selection of these villages was based on information from Electricidade de Moçambique (EDM), the Maputo main office and local district offices, as well as the local government in the district where the villages are located. The first two villages, Mbanchene and Madinguine (area 1 in Figure 2), are located within the Moamba district jurisdiction, and the third, Faftine (area 2) is within the city of Marracuene's jurisdiction.

Figure 2 – Maputo Province

Source: (Weather Forecast, 2014)

8.2 - Method

We designed our interview approach in accordance with structural and ethical guidelines by Family Health Planning (FHP) (Mack, Woodsong, MacQueen, Guest, & Namey, 2005). We conducted In-depth Interviews where the aim is to gain insight of personal experiences and viewpoints, and the questions are designed to describe and explain relationships. The questionnaire (which can be found in the appendix) consists mainly of open-ended questions, and was constructed in such a way that the women were encouraged to tell freely about a typical day before they had access to electricity (question 8). Then we asked them to contrast that to how a typical day was after they had gained access (question 9). The rest of the questions were asked as follow-up question in case it was not already answered in questions 8 and 9. We did not follow the numbering of the questions in our interviews, but rather adapted to each interview and asked in the order that would be most like a casual conversation, rather than mechanically asking one question after another, as suggested by Mack et al. (2005). Question 1-4 regarding age, marital status, education and children we asked when those topics arose in conversation, rather than starting with them. Generally we opened with asking for how long they have had access, followed by their view of electricity and then the main questions 8 and 9.

Our research form and method was approved by our supervisor, and do not violate the fundamental research ethics principles: *Respect for persons, Beneficence, Justice* and *Respect for communities* (Mack et al., 2005). Due to ethical reasons we decided not to include questions regarding the *Justification* variables from our data, the reason being that these questions are based on violence and we believe it might have been a completely different interview if we were to ask questions about their perception of domestic violence.

Once in the village we walked door to door and introduced ourselves with the help of our interpreter. We told the villagers that we are students from Sweden and are studying the impact of electricity in rural areas, and they were free to ask us any questions they wanted whether they are personal or relates to the field study. In the cases where the man was home as well; we asked that only the woman answered the questions, this occurred in four of the interviews. The women were informed that all information is confidential, no names would be recorded, and that they only answer those questions they are comfortable with, and gave us oral consent to use the material for our research. 10 out of the 12 women did not want us to record the interview, so in those cases we only took notes. One of us asked the questions that in turn were translated to Portuguese or Changana by our interpreter, while the other one focused only on taking notes.

8.3 - Village characteristics

Mbanchene was selected because the whole village was electrified in October 2013, so the respondents could clearly recollect the situation before the electrification, as well as the changes after access. We met with four women in Mbanchene. The next three interviews were conducted in Madinguine, where electricity was not accessible for all households, and those we interviewed gained access to electricity between 2006 and 2013. The general income level seemed lower than in Mbanchene. In the third village, Faftine, we interviewed five women. The houses and income were similar to those in Mbanchene, though it was located further from a marketplace than the other two villages.

9 - Results

In this section we present our main findings as well as robustness checks regarding our qualitative study.

9.1 - Main Results

Our sample consisted of 12 women, in the ages 25 to 48, with an average of 30 years old. Everyone were connected to the national grid via EDM and bought pre-paid quantities of electricity. The weekly expenditure on electricity is approximately MZN50, which is approximately $1.50.

Though a few were slightly suspicions of why we were doing these interviews, almost everyone was very friendly and open and shared their opinions. However, in six cases there was a man present, either husband or partner they were living together with. In those cases the answers were not as elaborate and the women seemed to take up less space. In two cases when asked about marital status the man answered that they were married while the woman either did not want to say anything when the man already answered, or she disagreed and said they were not. In these cases it was obvious that the woman would have answered that they were not married if the man would not have said that they were married.

Among the women we interviewed the most common use for electricity was lighting and television, followed by electric kettle and freezer. Nine respondents mentioned television and radio as one of the big differences, both in terms of entertainment as well as knowing what is happening throughout the country, especially now during the political turbulence in the central part of the country.

In terms of “our” empowerment measures, when it comes to education we found no indication that girls had a greater advantage over boys from electrification. All the women we asked had enrolled all their children who were old enough for school, boys and girls alike. Except in one case where none of the children went because it was too expensive (both the boys and girls had to stop going). The overall effect of electricity on schooling was positive though, 10 out of the 11 women whom had children reported that it enabled the kids to do homework in the evening, as well as preparing more for tests.

Regarding decision-making in the household, electricity by itself did not seem to have a direct effect, however four women responded that they had gotten a bit more room in terms of deciding over expenditures. They mentioned that they decide when and how much electricity to buy, and in the case with one of the women whom had set up a small business she said she was deciding how to run it and what to sell.

Every one of the women we interview perceived the overall effect of electricity as something positive, though there were a few negative comments regarding the quality of electricity. Eight of the respondents talked about reoccurring power outages as well as unstable current that destroy electric equipment, which were two reasons that deterred them from starting a business.

Five of the women had taken advantage of the electricity in order to bring in extra income, and either had or was currently running small businesses, all of which included selling cold drinks or food using a fridge or freezer. Another three women told us that they would like to start selling water and soda, but needed to invest in a freezer.

An unexpected answer that we have not found in other studies was reported by a quarter of the women, and it was that they feel safer in regards to wild animals when they have electricity. With electricity and lighting they could see and be aware of the animals at night, snakes especially were a concern before.

When asked who benefit more from electricity (rephrased to who would get it tougher if they were disconnected from the grid, in the last 5 interviews), five women answered that there is no difference between the genders, though in two of the cases the husband/partner was present. Six women responded that the woman benefit more because she is always at the house and is the one doing all the household work. Regarding the household chores, access to electricity had the biggest impact on time fetching water “no electricity means no water” and time spent cooking. But importantly, electric lighting in practice prolongs that day for them, they can decide when to do what and also receive free-time that they did not have before. Before they had to rely on candles and kerosene lamps, which generate less light and are more expensive. One woman mentioned though that the workload is the same as before, she is able to work more effectively. This spare time was reported to be mostly spent watching television, both soap operas and news.

9.2 - Robustness

Out of the six interviews where the husband/partner was present, three sat with us and listened in during the interview. In interview 8 when asked about marital status when the “husband” was present he answered before she could open her mouth and said they were married. But our interpreter told us that she strongly believed that they were living together outside of marriage, but he did not want us to know that. In interview 9 the husband started to answer for his wife, and we had to ask him to be quiet and that we wanted her to answer. But even so, when asked if they were married they answered at the same time, she said no and he said yes. In both of these interviews the women seemed more quiet and timid, and their answers did not seem genuine when asked the gender-comparing question and whether they have more spare time. In interview 4 the father of the children was present, but they were not married. The man was married to another woman, but seemed to have a long-term affair and children together with the interviewee[3]. She seemed to speak her mind freely even though he was present and did not seem to withhold or alter any answers.

For a few questions during some interviews the interviewee did not understand the questions, and when our interpreter rephrased the question she would ask it in a leading manner.

[3] This interpretation was pointed out to us by our interpreter, but it seemed likely in the way they were interacting with each other.

This was most apparent and frequent in “What is your view on electricity?” Our hope was that they would answer with a sentence or more of how they perceive electricity in terms of their needs etc. What happened was that the interpreter would give a few examples of answers such as “good, bad, useful etc.”, so the answers to that question were in the majority of the cases just “electricity is good”. We tried to get them to elaborate more in the other answers, regarding how they day has changed due to access to electricity, to make up for this shortcoming.

Not knowing how the interviews would proceed or how hard it would be to get in contact with the women, we made a rough estimate that we would carry out at least six interviews, but after just the first day we carried seven, and we were able to carry out another five the next day, doubling our estimate and that increased the saturation of the answers in the interviews.

10 - Summary and Discussion

There is and has been a problem in quantifying benefits from RE and the returns have been exaggerated in many studies; the World Bank evaluated several reports and recalculated the expected returns and some were corrected from 60% down to around 12% of return on investment (White et al. 2008). However, according to the World Bank the reported willingness to pay for electricity in rural areas is $0.10-0.40 per kWh, while the long run supply cost is $0.05-0.12 per kWh, so the consumer surplus would be positive in the vast majority of cases. However, there is usually a quite expensive connection fee, which in many cases is too great for poorer households to pay in a lump sum, preventing people from connecting to the grid (White et al. 2008). Some also argued that there are potential downsides with giving premature access to electricity. If not the other factors for development are available it might just be a new cost that extracts important resources from other sectors, which might yield a higher return in terms of quality of life. In addition they speculate in that the poorest might not be able to afford electricity even if the infrastructure is there, and they might think they want a service they do not directly need or can afford, which in turn further worsens their situation. (Mathur & Mathur, 2005).

We have not found this to be the case however, in our interviews in the field women reported positive impacts only as a result from electrification. Our aim with this study was to see if and how the women in question could benefit from electricity in terms of empowerment.

We have looked at the effect of electricity on empowerment through three different channels; *Justification, Decision-making* and *Education*. For the first two variables we use a sample of 7941 women in rural areas in Moçambique, and for *Decision-making* we only look at those who are either married or living together since it would not make sense to see who makes the decision in a household with only one adult. For *Education* we use a data set with a sub-sample of 25277 individuals younger than 25, both boys and girls and compare the benefits of electricity between the genders.

10.1 - Justification

Our *Justification* approach looks at whether women justify getting beaten by their husbands or co-habitant. The benchmark specification regarding the *Justification* variable is robust through all of our robustness checks and heterogeneity tests. Which means that neither the non-linear model, nor the weights and stratification affects the result significantly in our benchmark specification. For the heterogeneity section we did not find any significant differences for the age groups as well as the gender head of household groups. Therefore, we can reject Dinkelman's (2011) hypothesis, that women in their thirties and forties are more receptive to electricity than younger women, using our sample. Due to the fact that all of our tests to see whether our benchmark estimation holds or not show no sign of non-robustness we believe the benchmark result is a good measure of how electricity affect a woman's empowerment level. Thus, if a woman lives in a household with electricity, it means that the probability of her being empowered in terms of our *Justification* variable increases by 7.43%. The impact *Electricity* has on a woman's empowerment level is quite substantial, but the direct relationship between *Electricity* and *Justification* is not very obvious. We argue that a household with electricity has the means to be more empowered in the sense that they can follow news on the television and radio, which will increase their overall knowledge. According to us, electricity should therefore indirectly affect the level of awareness women have about their rights in the society. This argument is backed up by our qualitative study. Women with a television in their household stated that it enabled them to follow the news and stay updated with the political situation in the country, though they also stated that they mostly watched soap operas. Even if the majority of the time they spend on watching television was for entertainment, we believe that this is also a channel of information for the women, and would therefore also increase their overall knowledge. As with most empirical studies, we cannot say anything about how the causality runs, although with the same argument as above (television/radio) we argue that the causality runs from electricity to empowerment and not the opposite.

Furthermore, this empowerment measure is based on a sensitive subject, violence. As a result the survey design might be biased in the sense that women that would answer no to the questions asked might instead not answer at all just because it is a sensitive subject and they do not want to state their true preference. This will result in missing values, thus it will not be included in the regression analysis. Therefore, the result might be biased towards being empowered. This is just speculations as we are not the surveyors and it is impossible for us to investigate it further.

10.2 - Decision-making

The next variable we investigated was *Decision-making,* whether electricity correlates to whom in the household that makes the most decisions. The results from our benchmark estimation for the *Decision-making* variable is robust, although the result is not in line with our hypothesis that electricity should enable women to be more active in household decision-making. But the full sample result tells us instead that *Electricity* has no effect on women's *Decision-making*. When looking at the sub groups we find some interesting results, *Electricity* has a significant negative effect on *Decision-making* for women below age of 30 but not for women of 30 and up, and this difference is statistically significant. We interpret the result that when households get electricity it enables the man in the household to decide over one additional thing in the household. Which in turn lowers the woman's *Decision-making* share in the household. This only holds for younger women though. This discrepancy can have several different explanations, one can simply be that a younger woman has more recently (compared to older women) moved away from home to her partner, and in most cases it is the woman that moves to the mans house. Therefore, when a household with a young woman gets electricity the man in the household will decide over electricity just because it is his house from the beginning, while for households with an older woman the decision distribution in the household is unchanged. Dinkelman (2011) found that women in their thirties and forties were more receptive to electricity, due to the fact that older women do not have newborns to tend to. In our case, we can interpret our results in a similar way. Older women are not affected by *Electricity,* while younger women are negatively affected. The effect from *Electricity* on older women is not significant, but compared to younger women there is a significant difference, thus there is a net effect on older women, relative to younger women.

Furthermore, we found differences depending on whether the head of household was male or female. The difference is significant but the marginal effect for each sub group is insignificant. Therefore, it is not much to say other than that the effect from *Electricity* is insignificant. The significant difference can be due to the difference in the sample size for the two sub groups. The sub group, male head of household, is almost three times the size of the female head of household sub group.

Comparing our results from the quantitative and qualitative study, we find that they are aligned to some extent; four of the twelve women we interviewed answered that electricity enabled them to decide over the use of, and spending's on electricity, while the remaining eight women answered "no" to the question. Which translates into that electricity did not enable the majority of the women interviewed to be more involved in households' decisions, which is in line with the result from the quantitative study.

There is also the dilemma with causality, but we believe it is unlikely that there is causality problem in this case. If the causality would go from *Decision-making* to *Electricity* it should mean that if the woman in a household were empowered it should decrease the probability of getting electricity. Our results from the qualitative study do in fact show that all women had a positive attitude towards electricity. This result strengthens our belief that there is no causality problem for the *Decision-making* variable, as empowered women most likely prefer to have electricity and not the opposite. And as explained above, electricity has a negative effect on younger women and no effect on older women. If our result were different in the sense that *Electricity* had a positive effect on *Decision-making* in the younger age group, causality would be harder to distinguish. E.g. if a woman was empowered it would increase the probability that the household got electricity, which is a plausible causality channel, especially because the dependent variable measures the level of decision-making a woman possess.

One important thing to remember for the *Justification* variable and the *Decision-making* variable is that the two empowerment measures are measured in two different ways. The *Justification* variable is based on questions where the woman state her belief about violence while the *Decision-making* variable is based on questions regarding the individuals experience.

The difference between these two is worth mentioning because it is easier for a woman to be categorized as empowered for the *Justification* variable than for the *Decision*-making variable. As it is only questions regarding what she thinks about violence while the *Decision-making* variable is based on a woman's actual decision-making level.

10.3 - Education

Regarding our *Education*-variable analysis, we found highly statistically significant results that access to electricity is correlated with school attendance in the last year. This goes hand in hand with findings by Khandker et al., (2012) and Mathur & Mathur (2005). Unlike most other studies we have looked at whether the children have attended school at some point during the last year, rather than grades completed or enrollment. Measuring education through enrollment rates has been criticized for not reflecting reality, that more children are enrolled than actually attending the classes. But at the same time, our attendance variable does not say how many times they have attended school, just that they have been at least once during the last year. Just as Mathur & Mathur's results, the effect is greater for girls than for boys, and in fact, we found that only half of the age groups showed a significant coefficient for the boys, while the girls had over all significant results. Across all age groups, our benchmark results show that access to electricity increases the expected likelihood that the child has attended school by 12.8% for girls, and 9.6% for boys. This is the same trend, but with slightly higher values, that Khandker et al. (2012) found in India. We test for heterogeneity whether the difference between genders is significantly different, and we find that in those cases when both girls and boys had significant results (age 5-9 and 15-19), our results hold for age 5-9. Since the other age groups were significant for girls but not boys, we conclude based on our result for the education part that girls benefit more than boys from electrification in 3 out of 4 age groups.

The main reason for the difference in attendance between boys and girls, according to previous studies (Mathur & Mathur, 2005; Khandker et al. 2012), is that since girls and women are the ones working the hardest, both domestically and professionally, they have less time than males to use for education etc. By ”extending” the day through access to electric light, household work can be planned for times of the day that was previously difficult or impossible, and homework can be planned for hours after sundown. In the interviews we carried out however, all women had all their children enrolled in school, so we could not observe a difference between the genders in those cases.

10.4 - Qualitative study

The qualitative study was carried out in southern Moçambique where we interviewed twelve women in small rural communities. The majority of the women did say that the workload/ working hours per day was the same as before having access to electricity. This is contradicting to what Raub (2013) stated in a master thesis; that electricity has some drawbacks, and she speculated that it could prolong the working day for women and they would be worse of than they were before having access to electricity. They referred to as "the dark side of the light side". We have no evidence from the qualitative study that this is the case. Women did answer that they can plan the day better and be more efficient when having electricity in their household, thus we reject the hypothesis regarding the "dark side of the light side" for our qualitative study in Moçambique.

Regarding the interviews, one thing that would most likely have compromised the responses in one way or another is the fact that we are two young European men, interviewing women in their home in rural areas of Moçambique where poverty is quite widely spread. The cultural gap is large, and though everyone was friendly and accommodating, we do believe that it would have been easier and we would have been able to get more elaborate and informative answers if we were either female, Moçambican, or both. Trying to compensate what we can for this, we hired a local, female interpreter with experience of interviews in similar settings. We did meet some suspicion and a few women gave very short answers and it seemed like they just wanted to get the interview over with. In trying to bridge the gap between us, we asked if they had any questions for us about anything, and said that we would answer with full disclosure. Some interviewees took us up on this and asked about how it was where we were from etc. One question we got asked a few times, was why we were writing this paper, and how it would directly impact on them. Since we did not know the results of our study at that time, we could not say for sure, but we explained that we hope that our paper might lead to further research in the RE area, and that hopefully it would lead to policies that would increase the RE rate. Overall the addition of the interviews to our analysis gave us a deeper insight into the issue, even though we have not been able to convey this completely in this paper, as that is much a subjective observation.

Even though the women's answers agree to quite a large extent with our quantitative results, we are not convinced that our sample was representative. Since all of the women we talked to had their children enrolled in school, both boys and girls, this does not quite agree with the statistics we got from DHS. The overall impression as well, was that the interviewees did not belong to the very poorest percentiles of the population, but also not close to middle class.

It has been argued that access to electricity could create a demand for a good that was not a necessity before, and that the cost that comes with it may offset the benefits. But as in so many other areas, it is almost impossible to quantify the benefits when they are connected to quality of life rather than to monetary values. The greatest benefits are also the ones hardest to measure; reduced opportunity costs. Not having to spend several hours per day fetching water and firewood and instead use that time for rest and leisure time significantly changes the daily routine for the better. Even though not everyone can open their own business, having that extra time would at least increase the likelihood to be able to pursue alternative income sources. The women we interviewed said that their life had undoubtedly become easier after getting electricity, completely offsetting the cost. Worth noting again though, is that the women we interviewed did not seem to belong to the very poorest.

10.5 - Shortcomings quantitative study

One problematic aspect in our analysis is the method of the interviews used for the household data set. According to DHS, the head of household answered the questions asked about the household members, except for the women included in the individual data set (their answers are the same as in the individual data). We did conduct a heterogeneity test to see if there is a difference in attendance for children depending on the gender of the head of household. This tells us that gender of the head of household does not matter in attendance. However, since the head of household answered the survey for the household data set, and they were predominantly male, we do not know if there is a bias in the answers before we even run the regressions. We cannot say for sure how, or if, this will affect our results, but there is a possibility that male and female heads of household have different views on how to answer some of the questions. What we experienced in our interviews was that when the men were present, the problems or negative answers were less emphasized. If this holds true in the larger scale of this data collection, female school attendance and decision-making might be exaggerated, and it is hard to see how this would affect the justification questions. But on the other hand, there is just as big a chance that female head of household might understate female attendance.

On a related note, we do not know much about the data collection by DHS. If it holds any similarities to our interviews, the presence of the man might affect how they answer, especially when the questions relate to gender differences. We have not addressed this issue in our analysis, but we want to point it out for the sake of future studies.

11 - Conclusion

To summarize or study, we found that access to electricity in rural Moçambique has a positive effect on empowerment in terms of *Justification,* and *Education* of girls. The expected likelihood that women do not find it justified to be beaten by her husband for any reason increases with 7.43%. This is a very robust results though we can only speculate in the causality, though we believe it is more likely to go from electricity to empowerment. The expected likelihood that a girl have attended school during the last year increases by 3.2% more than it does for boys, 12.8% in total, as a result from getting access to electricity. The causality here is more straightforward, and we have an idea of the mechanisms in place, that electric light in the evenings allow for homework even though the girls have household chores. Our analysis of *Decision-making* did not support our hypothesis that RE increases empowerment, but rather that women below the age of 30 decide less when gaining access to electricity. In accordance with this, the majority of the respondents in our interviews stated that they did not have more control over household decisions after gaining access to electricity, though it greatly reduced the workload around the household, making their life easier.

After this study, our view is that rural electrification is something that definitely should be further developed, and the potential negative sides of it mentioned in other sources are clearly outweighed by the positives. Though this study is not fully conclusive, we believe that a greater focus on RE will help millions of women (and their families) to better lives, and promote equality by giving access to knowledge and education. Of course further research should be carried out, and implementation plans should be carefully constructed before pouring extreme money into RE. However, based on our results, we feel confident that this is a good channel for development and empowering women.

Bibliography

- Alsop, R., & Heinsohn, N. (2005). *Measuring Empowerment in Practice: Structuring Analysis and Framing Indicators* . Washington D.C: World Bank.
- Aschauer, D. A. (1989). Is public expenditure productive? *Journal of Monetary Economics* (23), 177-200.
- Bensch, G., Kluve, J., & Peters, J. (2011, December). Impacts of Rural Electrification in Rwanda. *Discussion Paper Series* , 1-38.
- Chakravorty, U., Pelli, M., & Marchand, B. U. (2012). Intensive Margin of Electrification: Evidence from Rural India.
- Christian Michelsen Institute. (2010). Gender and Poverty in Mozambique. *CMI Brief , 9* (6).
- Clancy, J. S., Skutsch, M., & Batchelor, S. (2003). *The Gender-Energy-Poverty Nexus: Finding the Energy to adress Gender concerns in Development.* London: UK Department for International Development .
- DHS. (2014, January 1). *DHS Frequently Asked Questions*. Retrieved April 22, 2014, from The DHS Program - Demographic and Health Surveys: http://dhsprogram.com/faq.cfm
- Dinkelman, T. (2011). The Effects of Rural Electrification on Employment: New Evidence from South Africa . *American Economic Review , 101* (7), 3078-3108.
- Duflo, E. (2012). Women Empowerment and Economic Development. *Journal of Economic Literature* , 1051–1079 .
- Eade, D., & Williams, S. (1995). *The Oxfam Handbook of Development and Relief* (Vol. 2). Oxfam.
- IMF. (2014, April 14). *Republic of Mozambique and the IMF*. Retrieved May 7, 2014, from International Monetary Fund: http://www.imf.org/external/country/MOZ/index.htm
- Interational Energy Agency. (2012). *World Energy Outlooks*. Retrieved February 9, 2014, from IEA: http://www.iea.org/publications/worldenergyoutlook/resources/energydevelopment/accesstoelectricity/
- Jupp, D., & Ali, S. I. (2010). *Measuring Empowerment.* Stockholm: Sida.
- Khandker, S. R., Samad, H. A., Ali, R., & Barnes, D. F. (2012). *Who Benefits Most from Rural Electrification? Evidence in India*.* Seattle: Agricultural & Applied Economics Association.
- Kreitz, A., & Ilskog, E. (2014, 2 6). Interview at Swedish Embassy, Rural Electrification. (D. Ternald, & G. Blomqvist, Interviewers) Maputo City, Maputo, Moçambique.
- Mack, N., Woodsong, C., MacQueen, K. M., Guest, G., & Namey, E. (2005). *Qualitative Research Methods: A Data Collector's Field Guide.* Research Triangle Park: Family Health International.

- Mathur, J. K., & Mathur, D. (2005, February). Dark Homes and Smoky Hearths: Rural Electrification and Women. 638-643.
- Mayoux, L. (2008). *Taking Gender Seriously: Towards a Gender Justice Protocol for a Diversified, Inclusive and Sustainable Financial Sector.* Oxford: Oxfam WEMAN programme.
- Narayan, D. (2002). *Empowerment and Poverty Reduction: A Sourcebook.* Washington D.C: World Bank.
- Page, N., & Czuba, C. E. (1999). Empowerment: What is it? *Journal of Extension , 37* (5).
- Progress out of Poverty. (2014, January 1). *About the PPI: A Poverty Measurement Tool*. Retrieved April 22, 2014, from Progress out of Povert: http://www.progressoutofpoverty.org/about-ppi
- Raub, V. (2013). *Rural Electrification in Senegal.* Lund Univeristy. Lund: Lund Univeristy.
- United Nations. (2014, January 1). *United Nations Development Goals*. Retrieved April 16, 2014, from Goal 3: Promote Gender Equality and Empower Women: http://www.un.org/millenniumgoals/gender.shtml
- Upadhyay, U. D., & Karasek, D. (2012). Women's Empowerment and Ideal Family Size: An Examination of DHS Empowerment Measures In Sub-Saharan Africa . *International Perspectives on Sexual and Reproductive Health , 38*, 78-89.
- *USDS*. (2014, February 25). Retrieved May 7, 2014, from U.S. Department of State: http://www.state.gov/r/pa/ei/bgn/7035.htm
- Weather Forecast. (2014). *Weather Forecast*. Retrieved February 2014, from Matola Location Guide: http://www.weather-forecast.com/locations/Matola
- White, H., Blöndal, N., Rota, M., & Vajja, A. (2008). *The Welfare Impact of Rural Electrification: A Reassessment of the Costs and Benefits.* World bank. Washington D.C.: World Bank.

Appendix

Table A1: Full summary statistics table individual data set

Variable	Obs	Mean	Std. Dev.	Min	Max
electricity	7806	.0794261	.2704199	0	1
justification	7546	.767824	.4222487	0	1
decision_making	5686	.3935983	.4885905	0	1
age	7941	28.97985	9.659524	15	49
agesq	7941	933.1264	599.2184	225	2401
sizehh	7941	5.608739	2.952081	1	24
hohh	7941	.3716157	.4832669	0	1
house_standard	7794	2.197844	1.432198	1	5
no_educ	7941	.3984385	.4896074	0	1
primary	7941	.5234857	.4994796	0	1
secondary	7941	.0769425	.2665169	0	1
higher	7941	.0011334	.0336484	0	1
never_in_union	7941	.139529	.3465195	0	1
married	7941	.4925072	.4999753	0	1
with_partner	7941	.2371238	.4253456	0	1
widowed	7941	.042438	.2015989	0	1
divorced	7941	.0197708	.1392206	0	1
separated	7941	.0686312	.2528418	0	1
niassa	7941	.0828611	.2756895	0	1
cabo_delgado	7941	.1001133	.30017	0	1
nampula	7941	.0788314	.2694924	0	1
zambezia	7941	.1394031	.3463885	0	1
tete	7941	.1154766	.3196164	0	1
manica	7941	.1052764	.3069286	0	1
sofala	7941	.1215212	.3267526	0	1
imhambane	7941	.1018763	.3025047	0	1
gaza	7941	.1138396	.3176363	0	1
maputo_pro~e	7941	.0408009	.1978412	0	1
catholic	7941	.2482055	.4319989	0	1
islamic	7941	.1669815	.3729828	0	1
zion	7941	.2210049	.4149499	0	1
evangelical	7941	.1735298	.3787285	0	1
angelican	7941	.0118373	.1081603	0	1
no_religion	7941	.1172396	.3217259	0	1
protestant	7941	.0497418	.2174248	0	1
other	7941	.010578	.1023105	0	1
unknown	7941	.0008815	.0296789	0	1

Table A2: Estimations Justification

VARIABLES	(1) Benchmark	(2) OLS	(3) Only weight	(4) No weight/strata
electricity	0.0743***	0.0629***	0.0743**	0.0614**
	(0.0288)	(0.0230)	(0.0292)	(0.0246)
age	0.00326	0.00285	0.00326	0.00118
	(0.00437)	(0.00434)	(0.00434)	(0.00359)
agesq	-3.86e-05	-3.21e-05	-3.86e-05	-9.49e-07
	(6.86e-05)	(6.76e-05)	(6.80e-05)	(5.61e-05)
sizehh	-0.00310	-0.00295	-0.00310	-0.00247
	(0.00234)	(0.00238)	(0.00232)	(0.00217)
hohh	0.00218	0.000904	0.00218	0.00218
	(0.0146)	(0.0149)	(0.0145)	(0.0112)
house_standard	0.0206***	0.0181***	0.0206***	0.0148***
	(0.00591)	(0.00533)	(0.00613)	(0.00456)
primary	0.00987	0.0109	0.00987	0.0264**
	(0.0136)	(0.0141)	(0.0138)	(0.0116)
secondary	0.0574**	0.0525**	0.0574**	0.0594**
	(0.0261)	(0.0231)	(0.0264)	(0.0241)
higher		0.104***		
		(0.0358)		
married	0.0113	0.0119	0.0113	-0.00146
	(0.0247)	(0.0257)	(0.0255)	(0.0199)
with_partner	-0.00451	-0.00339	-0.00451	-0.00150
	(0.0237)	(0.0237)	(0.0237)	(0.0212)
widowed	0.0495	0.0508	0.0495	0.0281
	(0.0362)	(0.0335)	(0.0363)	(0.0282)
divorced	-0.0338	-0.0319	-0.0338	-0.0368
	(0.0419)	(0.0435)	(0.0417)	(0.0348)
separated	0.00772	0.0116	0.00772	-0.0182
	(0.0311)	(0.0311)	(0.0311)	(0.0257)
niassa	0.0699	0.0437	0.0699	0.0956*
	(0.0632)	(0.0446)	(0.0623)	(0.0558)
cabo_delgado	-0.340***	-0.382***	-0.340***	-0.286***
	(0.0508)	(0.0443)	(0.0501)	(0.0477)
nampula	-0.116**	-0.0998**	-0.116**	-0.0664
	(0.0526)	(0.0438)	(0.0516)	(0.0475)
zambezia	-0.0325	-0.0200	-0.0325	-0.00434
	(0.0472)	(0.0349)	(0.0463)	(0.0439)
tete	-0.187***	-0.186***	-0.187***	-0.133***
	(0.0555)	(0.0515)	(0.0545)	(0.0493)
manica	-0.0677	-0.0476	-0.0677	-0.0208
	(0.0536)	(0.0412)	(0.0525)	(0.0463)
sofala	-0.148***	-0.137***	-0.148***	-0.115**
	(0.0531)	(0.0471)	(0.0520)	(0.0488)
imhambane	0.0973*	0.0695**	0.0973**	0.126***
	(0.0509)	(0.0320)	(0.0496)	(0.0465)
gaza	-0.0907*	-0.0701*	-0.0907*	-0.0348
	(0.0513)	(0.0402)	(0.0500)	(0.0472)
islamic	0.0620***	0.0625***	0.0620***	0.0573***
	(0.0226)	(0.0228)	(0.0226)	(0.0196)
zion	-0.0430*	-0.0442*	-0.0430*	-0.0472**
	(0.0226)	(0.0232)	(0.0228)	(0.0203)
evangelical	0.0590**	0.0562**	0.0590**	0.0350*
	(0.0290)	(0.0278)	(0.0290)	(0.0196)
angelican	0.0703	0.0590	0.0703	0.104*
	(0.0645)	(0.0509)	(0.0656)	(0.0536)
no_religion	-0.00259	-0.000374	-0.00259	-0.0125
	(0.0288)	(0.0310)	(0.0288)	(0.0222)
protestant	-0.0622	-0.0546	-0.0622	-0.0402
	(0.0414)	(0.0425)	(0.0411)	(0.0286)
other	-0.0336	-0.0330	-0.0336	-0.0308
	(0.0545)	(0.0575)	(0.0549)	(0.0536)
unknown	0.0919	0.0779	0.0919	0.0478
	(0.179)	(0.126)	(0.177)	(0.186)
Observations	7,393	7,401	7,393	7,393

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A3: Estimations Decision-making

VARIABLES	(1) Benchmark	(2) OLS	(3) Only weight	(4) No weight/strata
electricity	-0.0237	-0.0256	-0.0237	-0.0591*
	(0.0362)	(0.0391)	(0.0363)	(0.0305)
age	0.0117**	0.0115**	0.0117**	0.0117**
	(0.00522)	(0.00514)	(0.00519)	(0.00482)
agesq	-0.000135*	-0.000132*	-0.000135*	-0.000124*
	(7.85e-05)	(7.80e-05)	(7.80e-05)	(7.29e-05)
sizehh	-0.00386	-0.00444	-0.00386	-0.00584*
	(0.00297)	(0.00308)	(0.00299)	(0.00302)
hohh	0.0482**	0.0495**	0.0482**	0.0180
	(0.0188)	(0.0197)	(0.0194)	(0.0169)
house_standard	0.0266***	0.0281***	0.0266***	0.0301***
	(0.00627)	(0.00656)	(0.00637)	(0.00557)
primary	0.00929	0.00796	0.00929	0.00212
	(0.0165)	(0.0165)	(0.0172)	(0.0159)
secondary	0.0966*	0.104*	0.0966*	0.0762**
	(0.0493)	(0.0535)	(0.0506)	(0.0332)
higher	0.187	0.210	0.187	0.104
	(0.171)	(0.182)	(0.171)	(0.113)
niassa	0.000479	-0.0108	0.000479	-0.0466
	(0.0643)	(0.0659)	(0.0643)	(0.0564)
cabo_delgado	0.0641	0.0588	0.0641	0.0272
	(0.0616)	(0.0652)	(0.0614)	(0.0540)
nampula	-0.250***	-0.208***	-0.250***	-0.322***
	(0.0618)	(0.0606)	(0.0612)	(0.0568)
zambezia	0.000656	-0.00297	0.000656	-0.0484
	(0.0536)	(0.0583)	(0.0526)	(0.0499)
tete	0.0841*	0.0884	0.0841*	0.0406
	(0.0491)	(0.0542)	(0.0481)	(0.0481)
manica	0.0484	0.0522	0.0484	0.0342
	(0.0447)	(0.0495)	(0.0435)	(0.0447)
sofala	0.0242	0.0241	0.0242	0.00438
	(0.0597)	(0.0649)	(0.0585)	(0.0569)
imhambane	0.320***	0.352***	0.320***	0.324***
	(0.0468)	(0.0506)	(0.0456)	(0.0462)
gaza	0.0799	0.0899	0.0799	0.0763
	(0.0512)	(0.0569)	(0.0500)	(0.0508)
islamic	-0.0513	-0.0417	-0.0513	-0.0392
	(0.0372)	(0.0302)	(0.0378)	(0.0274)
zion	-0.0128	-0.0143	-0.0128	-0.0296
	(0.0339)	(0.0359)	(0.0341)	(0.0264)
evangelical	-0.0241	-0.0264	-0.0241	-0.0358
	(0.0313)	(0.0330)	(0.0314)	(0.0250)
angelican	-0.0314	-0.0309	-0.0314	-0.0333
	(0.0656)	(0.0659)	(0.0657)	(0.0502)
no_religion	-0.00654	-0.00572	-0.00654	-0.0226
	(0.0313)	(0.0333)	(0.0312)	(0.0278)
protestant	0.00988	0.0129	0.00988	-0.0345
	(0.0478)	(0.0510)	(0.0479)	(0.0380)
other	0.0123	0.0162	0.0123	0.0132
	(0.0852)	(0.0928)	(0.0846)	(0.0835)
unknown	0.356**	0.377***	0.356**	0.205
	(0.175)	(0.143)	(0.173)	(0.131)
Observations	5,604	5,604	5,604	5,604

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A4: Estimations Education I

	Benchmark		OLS	
	(1)	(2)	(3)	(4)
VARIABLES	Female	Male	Female	Male
electricity	0.128***	0.0960***	0.119***	0.0872***
	(0.0210)	(0.0170)	(0.0202)	(0.0172)
age	0.178***	0.171***	0.141***	0.148***
	(0.00335)	(0.00270)	(0.00340)	(0.00265)
agesq	-0.00761***	-0.00683***	-0.00599***	-0.00598***
	(0.000187)	(0.000149)	(0.000141)	(0.000127)
sizehh	0.00186	0.00178	0.00474**	0.00335
	(0.00195)	(0.00211)	(0.00209)	(0.00214)
house_standard	0.0183***	0.0115***	0.0200***	0.0108***
	(0.00345)	(0.00371)	(0.00365)	(0.00394)
female_hh	0.00423	0.00704	0.0115	0.0128
	(0.00957)	(0.0101)	(0.0102)	(0.0105)
niassa	-0.122***	-0.0671**	-0.116***	-0.0797***
	(0.0271)	(0.0272)	(0.0272)	(0.0276)
cabo_delgado	-0.142***	-0.111***	-0.134***	-0.114***
	(0.0314)	(0.0254)	(0.0297)	(0.0269)
nampula	-0.105***	-0.0554**	-0.100***	-0.0677**
	(0.0391)	(0.0280)	(0.0343)	(0.0293)
zambezia	-0.0527**	0.0142	-0.0508**	0.00768
	(0.0233)	(0.0238)	(0.0232)	(0.0243)
tete	-0.0983***	-0.0562**	-0.0973***	-0.0663**
	(0.0255)	(0.0247)	(0.0234)	(0.0276)
manica	-0.0190	0.0185	-0.0244	0.00732
	(0.0192)	(0.0225)	(0.0169)	(0.0229)
sofala	-0.137***	-0.00310	-0.149***	-0.0222
	(0.0309)	(0.0254)	(0.0312)	(0.0257)
imhambane	-0.00509	-0.00407	0.00533	-0.00864
	(0.0240)	(0.0242)	(0.0226)	(0.0247)
gaza	-0.0316	-0.0249	-0.0264	-0.0282
	(0.0225)	(0.0259)	(0.0217)	(0.0278)
Constant			-0.190***	-0.225***
			(0.0265)	(0.0281)
Observations	25,235	25,235	25,256	25,256
R-squared			0.367	0.377

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A5: Estimations Education II

	Only weight		**No weight/strata**	
	(1)	**(2)**	**(3)**	(4)
VARIABLES	Female	Male	Female	Male
electricity	0.128***	0.0960***	0.0938***	0.0838***
	(0.0210)	(0.0171)	(0.0167)	(0.0163)
age	0.178***	0.171***	0.180***	0.172***
	(0.00335)	(0.00280)	(0.00273)	(0.00212)
agesq	-0.00761***	-0.00683***	-0.00776***	-0.00686***
	(0.000187)	(0.000152)	(0.000154)	(0.000118)
sizehh	0.00186	0.00178	0.00238	0.000654
	(0.00195)	(0.00211)	(0.00153)	(0.00178)
house_standard	0.0183***	0.0115***	0.0159***	0.0105***
	(0.00344)	(0.00375)	(0.00293)	(0.00339)
female_hh	0.00423	0.00704	0.00359	0.00396
	(0.00951)	(0.0101)	(0.00779)	(0.00850)
niassa	-0.122***	-0.0671**	-0.123***	-0.0511*
	(0.0266)	(0.0267)	(0.0264)	(0.0272)
cabo_delgado	-0.142***	-0.111***	-0.148***	-0.110***
	(0.0309)	(0.0249)	(0.0299)	(0.0258)
nampula	-0.105***	-0.0554**	-0.109***	-0.0565**
	(0.0385)	(0.0275)	(0.0256)	(0.0266)
zambezia	-0.0527**	0.0142	-0.0545**	0.0304
	(0.0228)	(0.0233)	(0.0221)	(0.0239)
tete	-0.0983***	-0.0562**	-0.115***	-0.0575**
	(0.0251)	(0.0242)	(0.0245)	(0.0249)
manica	-0.0190	0.0185	-0.0246	0.0224
	(0.0187)	(0.0219)	(0.0198)	(0.0230)
sofala	-0.137***	-0.00310	-0.137***	0.0141
	(0.0303)	(0.0248)	(0.0282)	(0.0254)
imhambane	-0.00509	-0.00407	-0.0168	0.00790
	(0.0235)	(0.0237)	(0.0233)	(0.0244)
gaza	-0.0316	-0.0249	-0.0339	-0.0155
	(0.0220)	(0.0253)	(0.0221)	(0.0248)
Observations	12,977	12,258	12,977	12,258

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A6: Heterogeneity - Interaction terms individual data

	Justification		Decision-making		
	(1)	(2)	(3)	(4)	(5)
VARIABLES	Age	Hohh	Age	Hohh	Marital
electricity	0.0542	0.0913**	-0.0835**	0.0150	-0.0535
	(0.0381)	(0.0357)	(0.0384)	(0.0385)	(0.0551)
interaction_age	**0.0493**		**0.128****		
	(0.0474)		**(0.0632)**		
interaction_hohh		**-0.0422**		**-0.119****	
		(0.0511)		**(0.0589)**	
interaction_marital					**0.0406**
					(0.0644)
age	0.00307	0.00322	0.0108**	0.0118**	0.0105**
	(0.00440)	(0.00436)	(0.00516)	(0.00521)	(0.00528)
agesq	-3.70e-05	-3.79e-05	-0.000126	-0.000137*	-0.000121
	(6.88e-05)	(6.84e-05)	(7.76e-05)	(7.83e-05)	(7.89e-05)
sizehh	-0.00312	-0.00311	-0.00366	-0.00405	-0.00498*
	(0.00234)	(0.00233)	(0.00297)	(0.00295)	(0.00295)
hohh	0.00187	0.00467	0.0482**	0.0574***	0.0546***
	(0.0146)	(0.0152)	(0.0189)	(0.0193)	(0.0192)
house_standard	0.0205***	0.0206***	0.0262***	0.0267***	0.0287***
	(0.00594)	(0.00590)	(0.00631)	(0.00627)	(0.00651)
primary	0.00960	0.00978	0.00857	0.00890	0.00699
	(0.0136)	(0.0136)	(0.0165)	(0.0165)	(0.0163)
secondary	0.0598**	0.0569**	0.102**	0.0917*	0.0938*
	(0.0265)	(0.0261)	(0.0495)	(0.0496)	(0.0503)
married	0.0117	0.0113			
	(0.0247)	(0.0248)			
with_partner	-0.00430	-0.00449			
	(0.0237)	(0.0237)			
widowed	0.0500	0.0486			
	(0.0362)	(0.0361)			
divorced	-0.0348	-0.0337			
	(0.0422)	(0.0417)			
separated	0.00821	0.00668			
	(0.0309)	(0.0309)			
higher			0.147	0.204	0.203
			(0.177)	(0.154)	(0.184)
Observations	7,393	7,393	5,604	5,604	5,604

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A7: Heterogeneity - Interaction terms household data

VARIABLES	(1) All ages	(2) Age 5 to 9	(3) Age 15 to 19	(4) HoHH
electricity	0.0906***	0.0679	0.289***	0.107***
	(0.0183)	(0.0451)	(0.0486)	(0.0213)
female	-0.0402***	-0.00290	-0.205***	
	(0.00698)	(0.0154)	(0.0226)	
interaction_gender	**0.0410****	**0.143***	**-0.0119**	
	(0.0167)	**(0.0735)**	**(0.0684)**	
interaction_hohh				**0.0148**
				(0.0241)
age	0.174***			0.174***
	(0.00238)			(0.00237)
agesq	-0.00717***			-0.00719***
	(0.000135)			(0.000135)
sizehh	0.00225	-0.00422	0.0161***	0.00234
	(0.00175)	(0.00372)	(0.00370)	(0.00170)
house_standard	0.0151***	0.0246***	0.0374***	0.0150***
	(0.00298)	(0.00593)	(0.00755)	(0.00300)
female_hh	0.00552	-0.00902	0.102***	
	(0.00772)	(0.0187)	(0.0212)	
Observations	25,235	25,235	25,235	25,235

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Interview questionnaire

“We are conducting a field study regarding electricity and how it impacts the life in rural villages of Mocambique. Therefore we want to ask you some question regarding your view of electricity and how it has affected you.

Everything we talk about here is strictly confidential, and nothing you say will be possible to connect to you, no names will be published. You do not have to answer any questions you do not want to, we just wish to learn from what you are willing to share of your experience”

Personal details

1. Age
2. Marital status
3. Education
4. Children

Describe (open questions)

5. For how long have you had electricity in your household?
6. Do you get it from the national power grid, or from a different source, e.g. solar power?
7. What is your view of electricity?
8. Could you please describe a normal day before you gained access to electricity?
9. Could you please describe a normal day after you gained access to electricity?

Additional main questions

(Following questions are to follow up with if not answered within 5 & 6)

Electricity

10. How much do you pay for electricity per week/month?
11. What is the main electric equipment used?
    a. E.g. television, light, washing machine, stove etc.
12. Did electricity enable you to search for out-of-household work that yielded income?
13. Did electricity give you more time to do other things?
    a. How and why?
    b. How do you use this “extra” time?
14. What is your perception of the advantages with electricity?
15. What is your perception of the disadvantages with electricity?
16. What is the children’s view of electricity?
    a. E.g. can study in the evenings
17. Does access to electricity affect men and women in different ways?
    a. How?
18. Since your household got electricity, have you been more involved in daily household decision-making?