Imperial Journal of Interdisciplinary Research (IJIR)
Vol-3, Issue-10, 2017
ISSN: 2454-1362, http://www.onlinejournal.in

Impact of Small Islands Electrification on Household Expenditures in Seribu Islands, Jakarta

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Abstract: *In February 2008, the South Seribu Islands district enjoyed its first electricity connection via submarine cables from the main island Jakarta. In the second phase, the North Seribu Islands district received electricity connection in February 2012. Since the electrification is done gradually, it creates an ideal treatment and control group to conduct impact evaluation assessment. Using the Difference in Difference methodology, this study evaluates the impact of small islands electrification in Seribu Islands on household's welfare, which is represented by household expenditures. It utilizes the SUSENAS data from 2007 to 2011, the period before and after the electrification. The result shows that electrification gives a significant impacts on household expenditures particularly in the first two year after electrification. It increases the total, food, and nonfood expenditure. This shows that electrification can increase the community economic activity which is indicated by the increasing of household expenditures.***.**

1. Introduction

Electricity is a basic need for human being nowadays. Once households connect to the electricity grid, they can enjoy the many benefits of electricity. The households can use electricity for lighting and also for operating their electric appliances and equipment. By using electricity, they can improve their welfare and living standard.

However, not everyone can access electricity, especially for those who live in rural areas and small islands. Since the 1990s, many countries have made a massive effort to connect all their regions with the electricity grid. As a result, many rural areas and small islands in turn connected to the electricity grid and enjoy the benefits of electricity.

Responding those facts, many researchers have conducted impact evaluations(causal effect) of electrification, especially the impact on the community's welfare. Khandker, Barnes, and Samad (2012) found a positive impact of rural electrification in Bangladesh on income, expenditure and education. Again, Khandker, Barnes, and Samad (2013) reported that rural electrification in Vietnam causes a positive impact on household incomes and expenditures and also for children's education. van de Walle, Ravallion, Mendiratta, and Koolwal (2013) reported a similar finding in their research in rural India.

Most of the research on the impact of electrification is conducted in rural areas. However, there are just very limited studies on island electrification. The only reference for the impact of island electrification was provided by Chakrabarti and Chakrabarti (2002). They evaluated the impact of electrification in the Sagar Dweep islands of India. They found that the households reported an increase in income after electrification. However, they just used a very simple descriptive statistics technique, so it can not imply a causal effect of islands electrification.

Research on the impact of islands electrification remains relatively scant because it is very difficult to find adequate data and suitable control and treatment groups. So, we still have no strong evidence about the impact of islands electrification on the community's welfare, because the characteristics of rural areas and small islands in developing countries are different. Small islands are more isolated than rural area, because it is surrounded by the ocean. It is interesting to know whether islands electrification shows the similar impact like rural electrification or not.

This paper tries to fill this gap in the existing literature, regarding the question of how the impact of electrification in the small islands (archipelago) is. This paper evaluates the impact of small islands electrification in Indonesia on welfare, represented by household expenditures. Theoretically, we can use either consumption expenditures or income in estimating welfare. However, the World Bank Institute (2005) stated that consumption expenditures are a better indicator for well-being than income because of several reasons. First, consumption indicates how much money is required to meet their basic needs. While income shows how much money people get, but it does not tell about their basic needs. Second, income may fluctuate depending on

the job sector, but consumption tends to stable since it reflects the household living standard, so consumption may be a better indicator for well-being estimation than household income.

We specify this research on the small islands who connected to the electricity grid from the main islands using submarine cable. The definition of small islands is a group of islands with an area less than 2000 km^2. We focus on this category because the electricity being provided by submarine cable is considered powerful and reliable for the islands community. This electricity can be used for more than just lighting, but also for cooking, operating electronic appliances, equipment, and others purposes.

We use the Difference in Difference (DID) method in order to evaluate the impact of small islands electrification in Indonesia on household welfare. According to Gertler, Martinez, Premand, Rawlings, and Vermeersch (2011), DID is one of the five methods commonly used to evaluate a treatment/policy intervention. The DID method can reduce the bias from time invariant and time invariant of unobserved variables. We found a group of small islands who connected to electricity grid as the treatment group, and also a group of small islands were not connected as the control group. Those two groups of small islands are located in the same area and under the same governance management. So, we may assume that the characteristics of those two groups are equal. We utilize the SUSENAS (*National Socio-Economic Household Survey*) data from 2007 to 2011, the period before and after the treatment group connected to the electricity grid.

The objective of this study is to evaluate the impact of small islands electrification on the household's welfare by evaluating several types of household expenditures which may affected by electrification program, such as: total expenditure, food expenditure, nonfood expenditure, energy and water expenditure, home appliances expenditure, health expenditure, education expenditure, communication expenditure, body care expenditure, and transportation expenditure.

2. Electrification in Seribu Islands

Indonesia is a developing country in the Southeast Asia with the fourth largest population in the world. With the total number of islands is around 17,508, Indonesia becomes the biggest islands country in the world. With this huge number of islands, Indonesia government faces a big problem in providing electricity for all citizen particularly for the small islands community. A project to provide a stable and reliable electricity in those small islands usually are not feasible because the population in those small islands is just in small number and the location of small islands scattered in all Indonesia ocean. Indonesia government usually uses small diesel power plants, solar home systems, micro hydro power plants or wind power plants to provide electricity for the small islands community. However, those electricity power plants only generate a small amount of electricity. It only can provide several hours night lighting without any opportunity to utilize electricity for using electronic devices and appliances in their houses.

Starting from 2008, Indonesia government employed a new method to electrify small islands by connecting the small islands grid to the main island electricity grid through submarine cable. The Seribu Islands Regency is the first small islands who connected to the main island electricity grid by submarine cable. Seribu Islands is a regency governance level under management of Jakarta province. It is located in the North side of Jakarta city main island. Seribu Islands Regency has two districts: the South Seribu Islands district and the North Seribu Islands district.

The South Seribu Islands district is connected to the electricity grid of the main island using submarine cable in February 2008. It consists of five populated small islands: Panggang, Pramuka, Kelapa, Kelapa Dua and Harapan island. Household in those five islands enjoyed electricity at the same time in February 2008 because the Jakarta Province government connected all households to the grid before the submarine project. So, once the project of submarine cable finished, the community could use the electricity directly. Then the next stage was the North Seribu Islands district in February 2012. The North Seribu Islands district is located just next to the South Seribu Islands district. This new electrification method was successfully implemented in Seribu Islands Regency. This paper focuses on evaluating the impact of small islands electrification on Seribu Islands Regency because of data availability. We use those two district as treatment and control group in our DID model in the 2007 to 2011 period. The South Seribu Islands district becomes the treatment group since they are connected to the electricity grid by submarine cable in 2008, while the North Seribu Islands district is assigned as control group because they have no electricity in that period, as shown in Table 1.

In fact, the North Seribu Islands district is the most suitable control group for South Seribu Islands district among others small islands in Indonesia. Gertler *et al* (2011) said that control and treatment group should have similar characteristics. There are several similarities of South Seribu Islands district and North Seribu Islands district:

1. In the same location
2. Under the same governance management
3. Similar socio-economic characteristics
4. Similar geographical characteristics

Table 1. Research Design

No	Assignment	Name of Islands	Connected in
1	Treatment group	South Seribu islands district ➢ UntungJawa ➢ Payung ➢ Lancang ➢ Tidung ➢ Pari	February 2008
2	Control group	North Seribu islands district ➢ Panggang ➢ Kelapa Dua ➢ Pramuka ➢ Harapan ➢ Kelapa ➢ Sebira	February 2012

3. Data and Variable

This research uses SUSENAS (*National Socio-Economic Household Survey*) data. This survey is conducted by the Central Bureau of Statistics (BPS) Indonesia yearly since 1963. SUSENAS is a series of large-scale multi-purpose socioeconomic household survey in Indonesia. Total sample of SUSENAS for each year is around 200,000 households and its covers all City/Regency levels in Indonesia.

We use the SUSENAS data of the Seribu Islands Regency for the period 2007 – 2011. So, we have SUSENAS data period from 2007 (one year before South Seribu Islands district had electricity), until 2011 (before the North Seribu Islands district connected to electricity grid). Table 2 shows the SUSENAS data has been used in this research.

Table 2. Data

No	Data	South Seribu Islands district	North Seribu Islands district	Total
1	SUSENAS 2007	112 HH	208 HH	320 HH
2	SUSENAS 2008	111 HH	208 HH	319 HH
3	SUSENAS 2009	64 HH	256 HH	320 HH
4	SUSENAS 2010	127 HH	190 HH	317 HH
5	SUSENAS 2011	40 HH	193 HH	233 HH
Total sample		454 HH	1055 HH	1509 HH

Note : Unit of observation in household (HH) level

This research evaluates the impacts of electrification in South Seribu Islands district on household expenditures. There are ten types of household expenditure who suspected receiving some impacts of electrification as described below :

1. Total expenditure (totalexp).
   Total expenditure is the summation of nonfood and food expenditure. This is the average of total household expenses per month. Previous literature from Khandker *et al* (2012), Khandker *et al* (2013) and van de Walle *et al* (2013) found that electrification in rural area increases the total household expenditure.
2. Food expenditure (foodexp).
   This expenditure stands for all household expenditure relates with food needs.
   We suspect that electrification rises the food expenditure. Based on Barron and Torero (2014), electricity encourages people to buy refrigerator. They can preserve their foods in the refrigerator, so we predict they spend more money on food than before.
3. Nonfood expenditure (nonfoodexp).
   In general, the total household expenditure divided into two group; nonfood expenditure and food expenditure. The nonfood expenditure consists of all household expenditure for nonfood purposes.
4. Energy and water expenditure (enrwtrexp).
   This is the household expenditure for electricity, water, LPG, kerosene, woods and others energy. The energy and water expenditure is classified as one of nonfood expenditure.
5. Home appliances expenditure (homeapplexp).
   The home appliances expenditure consists of home appliances, electronic devices, communication devices, sports equipment, jewelry and others home equipment purchase. This expenditure is belong to nonfood expenditure.
   After the community has electricity, definitely they will buy many electricity home appliances such as television, refrigerator, stereo, personal computers and so on. Barron and Torero (2014) reported that electrification increases the ownership of TV, fridge, stereo, blender, DVD player, personal computer, washer and fan.
6. Health expenditure (healthexp)
   Health expenditure covers all expenditure related with health including for the medicine and health

supplement. This expenditure is belong to nonfood expenditure.

7. Education expenditure (educexp)
   The education expenditure is the all spending for children educational purposes, including school registration and tuition fees, courses fees, books purchases and others expenses.
8. Communication expenditure (commexp)
   The communication expenditure accounts for all expenses for communication purposes, like home telephone and mobile phone bills, payphone expenses, postal cost and etc.
9. Body care expenditure (bodycareexp)
   This expenditure includes all expenses related with body care, such as soap, cosmetics, shampoo, face care, tissue and etc.
10. Transportation expenditure (transportexp)
    The transportation expenditure is the total expenditure for commuting and travelling expenses including the fuel cost.

While for controlling the household variation, this research uses four household characteristics as covariates in the model:

1. Family size
   The household family size influences the outcome variables (household expenditure). Larger family size tend to have higher expenditure
2. Age of head household
   The age of head household might affect the behavior of household expenditure.
3. Sex of head household
   Man and woman have a different attributes and personalities which may causes different decision making on household expenditure.
4. Years of education of head household
   Education may give a big influence on the way of thinking on their expenditures.

4. Methodology

This research conducts three experiments in evaluating the impact of island electrification in the South Seribu Islands district on the household expenditures. Firstly, we adjust the nominal value of household expenditures into the real value in order to control the impact of inflation. And then we convert the outcome variables (expenditures) into natural logarithm in order to simplify the interpretation. There are the three experiments in this research :

1. Basic DID method with two periods, before-after electrification
   In this experiment, we assign SUSENAS data 2007 as baseline/pre-treatment period, and compare with the condition after electrification (2008, 2009, 2010 and 2011) one by one. So, we can understand the fluctuation of the impacts of electrification on ten types of household expenditures in four years after electrification.

   The model of two period DID is shown below:

$$ln\_outcome_{it} = \beta_0 + \beta_1.period_t + \beta_2.group_i + \beta_3.(period_t.group_i$$

   where $ln\_outcome_{it}$ is the natural logarithm of outcome variable for the *i*th household in the *t* period; $period_t$ is the dummy period (0 for pre-treatment and 1 for post-treatment period); $group_i$ is the dummy group (0 for control group and 1 for treatment group); X_{it} is the *i*th household characteristics in the *t* period; and the β_3 is the DID coefficient which is the effect of electrification.
2. Multi period DID using data 2007 – 2011
   In this experiment, we apply five periods of SUSENAS data (2007-2011) in one DID linear regression and control the year fix effect and also time trend effect. In this multi period DID, we assign 2007 data as baseline, and then evaluate the impact of small islands electrification in 2008, 2009, 2010 and 2011. So we can check the robustness of the first experiment result. The multi period DID model can be seen as follow:

$$ln\_outcome_{it} = \beta_0 + \beta_{12}.group_i.d_t^2 + \beta_{13}.group_i.d_t^3 + \beta_{14}.group_i. + \beta_3.f_t + \beta_4.timetrend_t + \beta_5 X_i + \varepsilon_{it}$$

   Where d_t^2 is 2008 dummy year; d_t^3 is 2009 dummy year; d_t^4 is 2010 dummy year; d_t^5 is 2011 dummy year; f_t is year fix effect; $timetrend_t$ is the time trend effect (*group*$_i$*x year*). So, β_{12} is the impact of electrification in 2008; β_{13} is the impact of electrification in 2009; β_{14} is the impact of electrification in 2010; and β_{15} is the impact of electrification in 2011.
3. Quantile regression of multi period DID 2007 – 2011
   The quantile regression is introduced by Koenker and Bassett (1978) to check the robustness by eliminate the impact of outlier data. In this experiment, we utilize the quantile regression method in the multi period DID in order to examine the effect of small islands electrification at different points of household expenditures conditional distribution.
   As described in Koenker and Bassett (1978), the θth quantile regression, $0 < \theta < 1$, is defined as any solution by minimizing equation below:

$$\min_{\beta \in R^k} \left\{ \sum_{t \in \{t: y_t \geq x_t \beta\}} \theta |y_t - x_t \beta| + \sum_{t \in \{t: y_t < x_t \beta\}} (1-\theta) |y_t - x_t \beta| \right\}$$

   where $y_t$is the outcome variable; x_t is the vector of exogenous variables; β is the vector of coefficient. The coefficient of vector β will differ depending on the particular quantile being

estimated. In this regression, we use five quantiles, which is.15th,.25th, .50th, .75th , and .85th quantiles.

As described before, the basic assumption of DID method is Parallel Trend Assumption. Under this assumption, DID method is a powerful and unbiased estimator to evaluate the impact of such kind of intervention or policy. In this research, we assume that Parallel Trend Assumption exists in our model.

5. Result and Discussion

5.1. Descriptive Statistics Analysis

The basic assumption of DID method is the Parallel Trend Assumption. However, as described before, there is no way to perfectly prove that the assumption will hold. One way to indicate the parallel trend assumption is by comparing the initial characteristics between treatment and control group in the pre-treatment period. If the characteristics of treatment and control group is similar, we assume that they will have the same trend in absence of new treatment.

In order to support the parallel trend assumption in our data, we analyze the household initial characteristics of South Seribu Islands district (the treatment group) and North Seribu Islands district (the control group). Table 3. shows the initial characteristics descriptive statistics of both group in the pre-treatment period, which is 2007.

From Table 3, we can see that two household characteristics are statistically different. The family size and years education of head household is statistically different at 5% and 10%. While for the head of household's gender and age, we have no evidence about a difference. Even though we found evidence for the differences of some initial characteristics, the DID method is still the best method to evaluate the impacts of electrification in South Seribu Islands district. It can reduce the bias although it can not perfectly remove the bias. As the solution, we include those household characteristics in the model as the covariates to reduce the bias.

Table 4 shows the percentage of several types of household expenditures compare to total expenditure. The total household expenditure consists of two expenditures, that is food and nonfood expenditure. From Table 4, clearly the food expenditure dominates the household expenditure by around 53% to 62%. This research uses seven sub-nonfood expenditures that are suspected to have some impact resulting from electrification. However, it is very difficult to make a conclusion just using those descriptive statistics.

Table 3. Descriptive Statistics of Initial Characteristics

Variable	Control Group			Treatment Group			Mean Difference	
	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Diff	P-value
fam_size	4.0432	1.3841	208	4.3839	1.5260	112	-0.3406**	0.0437
sex	0.8990	0.3020	208	0.875	0.3322	112	0.0240	0.5126
age	42.7403	12.7964	208	43.9375	12.3757	112	-1.1971	0.4201
educ	7.2307	3.4897	208	6.5089	3.1821	112	0.7218*	0.0698

Note :*, **, *** indicate the level of significance at 10%, 5% and 1%.

Table 4. Share of Several Types of Household Expenditure

No	Household expenditure	Control Group					Treatment Group				
		2007	2008	2009	2010	2011	2007	2008	2009	2010	2011
1	Food exp	59.92	58.78	60.38	58.16	56.60	55.54	53.66	53.18	61.97	55.60
2	Nonfood exp	40.07	41.21	39.61	41.83	43.39	44.45	46.33	46.81	38.02	44.39
	a. Energy and water exp	7.69	2.95	5.71	5.00	5.78	7.64	3.12	7.44	5.09	6.13
	b. Home appliances exp	1.76	1.90	0.85	1.47	3.02	1.32	2.45	2.81	2.40	4.93
	c. Health exp	1.34	1.10	1.15	1.66	2.62	1.21	0.93	0.76	1.00	5.77
	d. Education exp	2.37	2.19	3.85	5.05	4.64	1.82	1.79	5.00	2.85	4.94
	e. Communication exp	1.58	0.65	2.24	1.74	2.06	2.28	1.00	2.92	2.21	3.10
	f. Body care exp	6.80	3.78	2.91	3.20	4.06	6.79	3.66	2.85	3.40	4.67
	g. Transportation exp	2.26	1.09	3.85	7.21	4.50	3.20	1.00	1.72	2.71	5.46

5.2. Basic DID Analysis With Two Periods: before-after electrification

In this section, we conduct a basic DID model using 2007 as the baseline/pre-treatment period with ten household expenditures as outcome variables. We use four years data after electrification (2008 – 2011) as the follow-up period and then compare it with 2007 as the baseline period. Summary of the impact of small islands electrification from two periods of DID can be seen in the Table 5.

Firstly, the total expenditure shows a positive impact of islands electrification in all periods

observed and is statistically significant. So we have strong evidence that electrification increases the total household expenditure since it is significant in all periods. We use the real value of household expenditure. Since the total expenditure increases, it means that the household consumes more goods and services after electrification. Then we may conclude that electrification can increase the community welfare, because the total expenditure increases significantly.

In the Indonesian data, it is common to use the household expenditure as a representation of household income because of the data availability. This finding means that electrification can boost the economic development in the small islands community.

The food expenditure displays a strong impact caused by electrification in all periods. It rises around 20% in all periods and statistically significant at 1%. Barron and Torero (2015) found that the ownership of some food-related electrical appliances at home increased dramatically after the introduction of electricity in their research in El Salvador. They found that the ownership of refrigerators and blenders increased by 54.4% and 24.6%. Then we may suspect that the ownership of refrigerators and blenders also increased dramatically in the South Seribu Islands district after electrification. The refrigerator and blender ownership encourages households to spend more money for food, because they can store their food in the refrigerator and also use the blender to help them prepare food. We think that electrification can promote the food security of island communities, whether through the increase in the quantity, quality or the expansion of the food style consumption. So we conclude that electrification increases household food expenditures, and then we suspect this can improve the islands community health indirectly.

The education expenditure and communication expenditure generate identical results. Both of them have a positive and significant impact of electrification in the first and second year. The household may be become enthusiastic after they were connected to electricity grid and then spend more money in the short term after electrification. So they spend more money in the first two years after electrification and then back to their consumption pattern in the following years.

Next, from Table 5, we can see that the impact of electrification on nonfood expenditures increases and is statistically significant in the first two years by around 20% compared to 2007 as baseline period. But for the third year, it decreases 12% while for the fourth year becomes statistically insignificant. The increasing nonfood expenditure in the first and second year may be dominated by the portion of electricity appliances purchases. Since the electricity appliances is a durable goods which have a long lifecycle, the household can use it around five years and do not need to spend money to buy the same type of electricity appliances. As a result, the nonfood expenditure in the third year reduces by 12% and is statistically significant. While for the last year's observation, we have no such evidence about the impact of electrification on nonfood expenditure.

The home appliances expenditure shows a positive and significant effect in the first two years after electrification. It increases more than 60% in the first and second year. However, we have no evidence in the third and fourth year after electrification. Barron and Torero (2015) studied the impact of electrification in northern El Salvador found that electrification increased the ownership of televisions by 57.8%, refrigerators by 54.4%, stereos by 43.7%, blenders by 24.6% and some other electronics devices also. From this evidence, we believe that the household tend to buy electricity appliances once they are connected to electricity in order to get the benefits of electricity. This is the reason why the home appliance expenditure increases significantly in the first and second year after electrification. Since home appliances are durable goods, they do not need to make second purchases for the same home appliances. This can explain why the result for the third and fourth are statistically insignificant. Then we may conclude that the increases of home appliances expenditure is dominated by the spending for electricity home appliances.

Energy and water expenditures also go up in the first, second, and fourth years after electrification by 31%, 41%, and 26%. This expenditure increases because of the purchasing of many home electrical appliances. After they have more electrical appliances, they consume more electricity. However, in the third year after electrification, there is no strong evidence about the impact of electrification but the sign is still positive. But in general, we can conclude that after the households connect to electricity grid, their energy and water expenditure increases, because they consume more energy and water.

Next, we have no evidence about the impact of electrification on health expenditure since it is statistically insignificant. This means that the health expenditure is not so different between before electrification and after electrification. However, the

health expenditure cannot indicate the health condition of islands community. But at least we did not get a positive and significant impact of electrification on health expenditure since it indicates a lower condition of community health.

Next, the impact of electrification on body care expenditures represents a convincing result since the results are positive and significant for all periods. So, the household spend more money on body treatment expenditures then we can suspect it can improve the personal health condition.

The regression result shows that the transportation expenditure goes down significantly in the first year until third year. While for the last year of our observation indicates insignificant impact. The transportation expenditure seems to have a negative impact as a result of electrification. From the previous result, we found that electrification increases the ownership of electrical appliances such as TV, refrigerator, stereo, DVD player and so on. So, the household member can enjoy entertainment and news though TV, stereo, and DVD player. The refrigerator allows the household to preserve food for a longer time. So they go to the market less frequently than before electrification. As a result, the transportation expenditure falls down significantly.

5.3. Multi Period DID Analysis Using Data from 2007 to 2011

In this second experiment, we conduct a multi-period DID regression from 2007 to 2011 in order to check the robustness of the result from the first experiment. Same as the first experiment, in this experiment we use 2007 as the baseline and the following years as the post-treatment period. So we can assess the impact of electrification each year after electrification.

As we can see in Table 6, the result is not so different from the first experiment. The only difference is about the impact of electrification on the total expenditures in 2010. However, for others results are similar. It shows a similar sign with a small variation in number. After this process, we are confident that we found a robust result regarding the impacts of small islands electrification on household expenditures.

5.4. Quantile Regression Analysis of Multi-Period DID 2007-2011

Table 7 shows the quantile regression results for all periods on the distribution of all household expenditures. The impact of small islands electrification on the household total expenditure clearly shows a positive and significant impact for almost all quantile group in the first and second year after electrification. While for the third and fourth year after electrification, the impact is not conclusive.

While for food expenditure, electrification indicates a positive and significant impact for almost all quantile. This finding strengthens the previous finding that electrification can increase the household food expenditure. By this finding, we can conclude that an electrification program can generate food security improvements in islands community by increasing the household food expenditures.

Similar with the previous experiment, the impact of electrification on household energy and water expenditures shows a positive and significant impact for the first two years after electrification. One thing to note, that the lower quantile group increased more than the upper quantile. For example, in 2008, the energy and water expenditure of 15^{th} percentile group increases by 57%, compared to 23% for the 85^{th} percentile group.

For the household home appliance expenditure, the upper quantiles increase their spending more than the lower quantiles. We can see clearly that the upper median quantile (75^{th} and 85^{th} quantile group) shows an increase of home appliance expenditure and is statistically significant. We think that the upper quantiles have more income rather than the lower quantile, so they can increase their spending on home electricity appliances expenditures. The home appliance expenditures of the 75^{th} and 85^{th}quantiles increase significantly by more than 100% in average in all periods after electrification.

The education expenditure shows a positive impact and is statistically significant for all quantile in the first and second year. The lower quantile seems to have bigger electrification impact rather than the upper quantile. While the third and fourth year indicate no evidence regarding impact of electrification.

For the communication expenditure, we can see clearly that the median quantile increased sharply and is significant at 1% in all periods. Then, we have no strong evidence about the impact of electrification for other quantiles. The impact of electrification on body care expenditure shows a positive impact and statistically significant. The distribution spreads smoothly for all quantiles except for the.15^{th} quantile.

Table 5. Summary of the Impacts of Electrification From Two Period DID 2007 as Baseline Period

Impacts on the outcome variables		ln_totalexp	ln_foodexp	ln_nonfoodexp	ln_enrwtrexp	ln_homeapplexp	ln_healthexp	ln_educexp	ln_commexp	ln_bodycareexp	ln_transportexp	Household Characteristics	Obs
Period before-after	2007vs2008	0.2352*** (0.0560)	0.2427*** (0.0595)	0.2023*** (0.0716)	0.3125*** (0.0813)	0.6030*** (0.1942)	0.1322 (0.1446)	0.3382** (0.1398)	0.8058*** (0.2896)	0.2051** (0.0896)	-0.3996** (0.1890)	included	639
	2007vs2009	0.1558*** (0.041)	0.1327*** (0.0482)	0.2038*** (0.0536)	0.4187*** (0.0786)	0.6401*** (0.216)	-0.1920 (0.1368)	0.8755*** (0.2064)	0.6170*** (0.2346)	0.1475* (0.0872)	-0.7410*** (0.2841)	included	640
	2007vs2010	0.0760* (0.0441)	0.2312*** (0.0478)	-0.1268** (0.0632)	0.0990 (0.0764)	0.2675 (0.2675)	0.2521 (0.1625)	-0.0448 (0.1753)	0.1891 (0.2365)	0.1759** (0.0847)	-0.4764*** (0.1715)	included	637
	2007vs2011	0.1572** (0.0781)	0.2163*** (0.0808)	0.0603 (0.0948)	0.2603** (0.1154)	0.4471 (0.4249)	0.1366 (0.2810)	0.2889 (0.2175)	0.4407 (0.2687)	0.3219*** (0.0953)	0.1594 (0.1465)	included	553

Note : 1. *, **, *** indicate the level of significance at 10%, 5% and 1%.
2. Household characteristics : sex, age and years education of head household, and family size.
3. Robust standard error in parenthesis

Table 6. Result of Multi Period DID 2007 - 2011

Variable	ln_totalexp	ln_foodexp	ln_nonfoodexp	ln_enrwtrexp	ln_homeapplexp	ln_healthexp	ln_educexp	ln_commexp	ln_bodycareexp	ln_transportexp
DID_coef_2008	0.2155***	0.2080***	0.20055***	0.3331***	0.6287***	0.1033	0.4553***	0.8043***	0.2024**	-0.3707**
DID_coef_2009	0.1443***	0.1117**	0.2072***	0.4061***	0.6352***	-0.2016	0.8820***	0.6206***	0.149*	-0.737***
DID_coef_2010	0.0723	0.2232***	-0.1235*	0.1019	0.2753	0.2547	-0.0548	0.1918	0.1858**	-0.4843***
DID_coef_2011	0.1703**	0.2289***	0.0718	0.2584**	0.5137	0.1145	0.2926	0.4617*	0.3487***	0.1805
fam_size	0.1334***	0.1457***	0.1263***	0.0709***	0.1000***	0.0818***	0.1858***	0.0776***	0.1126***	0.1235***
sex	0.1392***	0.1794***	0.1016**	0.0132	0.2621**	0.0705	0.003	0.2084	0.0647	0.0767
age	0.0025***	0.000015	0.0057***	0.0053***	-0.0016	0.0065	0.0083**	0.0159***	-0.0003	0.0065**
educ	0.0293***	0.0176***	0.0430***	0.0238***	0.0720***	0.0345***	0.0122	0.1095***	0.0183***	0.041***
timetrend	-0.000039***	-0.00008***	0.000016	-0.00004	-0.000032	-0.00006	-0.0001***	-0.00007	-0.00005**	0.0001***
year_2008	0.1371***	0.1082***	0.1559***	-0.9595***	0.0760	-0.2690***	-0.1065	-0.7879***	-0.4605***	-0.27***
year_2009	-0.0694***	-0.0584**	-0.0926***	-0.3681***	-0.4696***	-0.4572***	0.0468	0.249*	-0.9383***	0.4085***
year_2010	0.1036***	0.0707**	0.1171***	-0.3684***	-0.2861**	-0.6278***	0.4263***	0.2699*	-0.7047***	0.6235***
year_2011	0.06037**	0.0096	0.1279***	-0.2689***	0.3551**	-0.1658	0.5344***	0.3757**	-0.442***	0.8445***
_cons	13.5240***	13.1078***	12.4176***	11.1714***	8.8871***	9.0868	9.7457***	8.2132***	11.1321***	9.4068***
observation	1509	1509	1509	1505	1251	1478	1116	1176	1508	1285

Note :*, **, *** indicate the level of significance at 10%, 5% and 1%.

Table 7. Quantile Regression Result

Impacts of Electrification Quantile Regression	Mean	q15	q25	q50	q75	q85
Impact on ln_totalexp						
DID_coef_2008	0.2155***	0.221	0.251***	0.232***	0.204***	0.190***
DID_coef_2009	0.1443***	0.188**	0.088*	0.112**	0.138***	0.131***
DID_coef_2010	0.0723	0.130*	0.0889	0.079	0.049	0.036
DID_coef_2011	0.1703**	0.136	0.0508	0.24**	0.242	0.331***
Impact on ln_foodexp						
DID_coef_2008	0.2080***	0.1606*	0.32**	0.339***	0.229***	0.1404**
DID_coef_2009	0.1117**	0.1602**	0.142**	0.116**	0.121*	0.0874
DID_coef_2010	0.2232***	0.2245***	0.241***	0.302***	0.235***	0.1386*
DID_coef_2011	0.2289***	0.1760725	0.227**	0.217***	0.253*	0.2039
Impact on ln_nonfoodexp						
DID_coef_2008	0.20055***	0.1643**	0.156**	0.257***	0.197*	0.145
DID_coef_2009	0.2072***	0.246***	0.265***	0.196***	0.0925	0.149**
DID_coef_2010	-0.1235*	-0.1275	-0.136*	-0.093	-0.12*	-0.179**
DID_coef_2011	0.0718	-0.054	-0.043	0.119	0.089	0.139
Impact on ln_enrwtrexp						
DID_coef_2008	0.3331***	0.574***	0.383***	0.332***	0.251***	0.231**
DID_coef_2009	0.4061***	0.645***	0.542***	0.399***	0.326***	0.242***
DID_coef_2010	0.1019	0.209	0.134	0.086	0.054	0.0348
DID_coef_2011	0.2584**	0.126	0.347	0.339***	0.282*	0.334**
Impact on ln_homeapplexp						
DID_coef_2008	0.6287***	0.0926	0.864***	0.875***	1.103***	0.742***
DID_coef_2009	0.6352***	-0.3788	-0.162	0.478*	1.471***	1.747***
DID_coef_2010	0.2753	-0.615**	-0.113	0.299	1.004**	1.340***
DID_coef_2011	0.5137	-0.377**	-0.0512	0.77**	1.216	1.575**
Impact on ln_healthexp						
DID_coef_2008	0.1033	-0.147	0.0047	0.1186	0.2931*	0.2913**
DID_coef_2009	-0.2016	-0.433*	-0.395***	-0.1753*	-0.1183	-0.012
DID_coef_2010	0.2547	0.6605	0.4098*	0.3342**	0.1155	0.2427
DID_coef_2011	0.1145	-0.1668	-0.2417	0.0723	0.0834	0.5282
Impact on ln_educexp						
DID_coef_2008	0.4553***	0.682***	0.553***	0.511***	0.339**	0.266**
DID_coef_2009	0.8820***	1.965***	1.424***	0.794***	0.626***	0.485***
DID_coef_2010	-0.0548	-0.4592	0.0394	0.2107	0.0129	-0.098
DID_coef_2011	0.2926	0.472	0.2851	0.1809	0.393**	0.2116
Impact on ln_commexp						
DID_coef_2008	0.8043***	0.2211	1.251**	1.953***	0.421*	0.1865
DID_coef_2009	0.6206***	0.1097	0.3069	1.405***	0.1732	0.0243
DID_coef_2010	0.1918	-0.5251	0.1436	1.380***	0.1991	-0.052
DID_coef_2011	0.4617*	-0.1526	0.0289	1.491***	0.4032	0.1486
Impact on ln_bodycareexp						
DID_coef_2008	0.2024**	0.0436	0.3128**	0.2402**	0.4168***	0.231***
DID_coef_2009	0.149*	0.316**	0.6149***	0.25***	-0.1123	-0.1245*
DID_coef_2010	0.1858**	0.0734	0.2475**	0.2937**	0.189**	0.1414**
DID_coef_2011	0.3487***	0.2801	0.5013***	0.308***	0.423**	0.431***
Impact on ln_transportexp						
DID_coef_2008	-0.3707**	-0.5612	-0.647***	-0.1905	0.0185	0.0529
DID_coef_2009	-0.737***	-1.5027**	-1.194**	-0.2662	-0.2464**	-0.4122
DID_coef_2010	-0.4843***	0.2644	-0.019	-0.448**	-1.082***	-1.345***
DID_coef_2011	0.1805	0.372	-0.2431	0.0805	0.313**	0.278***

Note :*, **, *** indicate the level of significance at 10%, 5% and 1%.

6. Conclusion

Based on the explanation in the previous chapters and the results analysis of the models, some conclusions can be presented, as follows:

a. Electrification shows a significant impact on all types of household expenditures in the first and second year after electrification, with the exception of health expenditures.
b. Total expenditure, food expenditure and body care expenditure display a positive and significant impact after electrification in all observation periods. Then, we may conclude that generally, electrification can improve the welfare and health of islands community.
c. From the quantile regression, electrification seems having impacts for all household in the community. Moreover, lower income households received a higher impact of electrification especially for energy-water and education expenditure. As a result, we can conclude that the impact of electrification is well distributed in community as even poor households demonstrate a higher impact for several consumption expenditures.

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