

# Income and electricity poverty in Vietnam 2012-16

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# Outline

- Motivation
- Concept model for electricity poverty
- Data and methodology
- Visualization of results
- Estimated results
- Conclusion

# Motivation

- Electricity has a vital role in improving household welfare
- The kWh for *basic needs* is the *electricity poverty threshold*
- The threshold is the key reference for designing subsidy policies.
  - Poor households get cash transfer equivalent to 30kWh
  - Price of 1<sup>st</sup> block is about 95% of average selling price

# Motivation

- Direct measurement
  - By electricity services such as “Lighting, one electric bulb (5h/day, 40W)”
  - *Intuitive, appropriate for case by case (no consensus on “basic needs”)*
- Indirect measurements
  - The average kWh that poor households consume. *Income-poor households is not identical to energy poor households.*
  - A percentage of household expenditure/ income. *Neglect the role of other factors such as energy efficiency or price changes. The ratio is quite arbitrary*

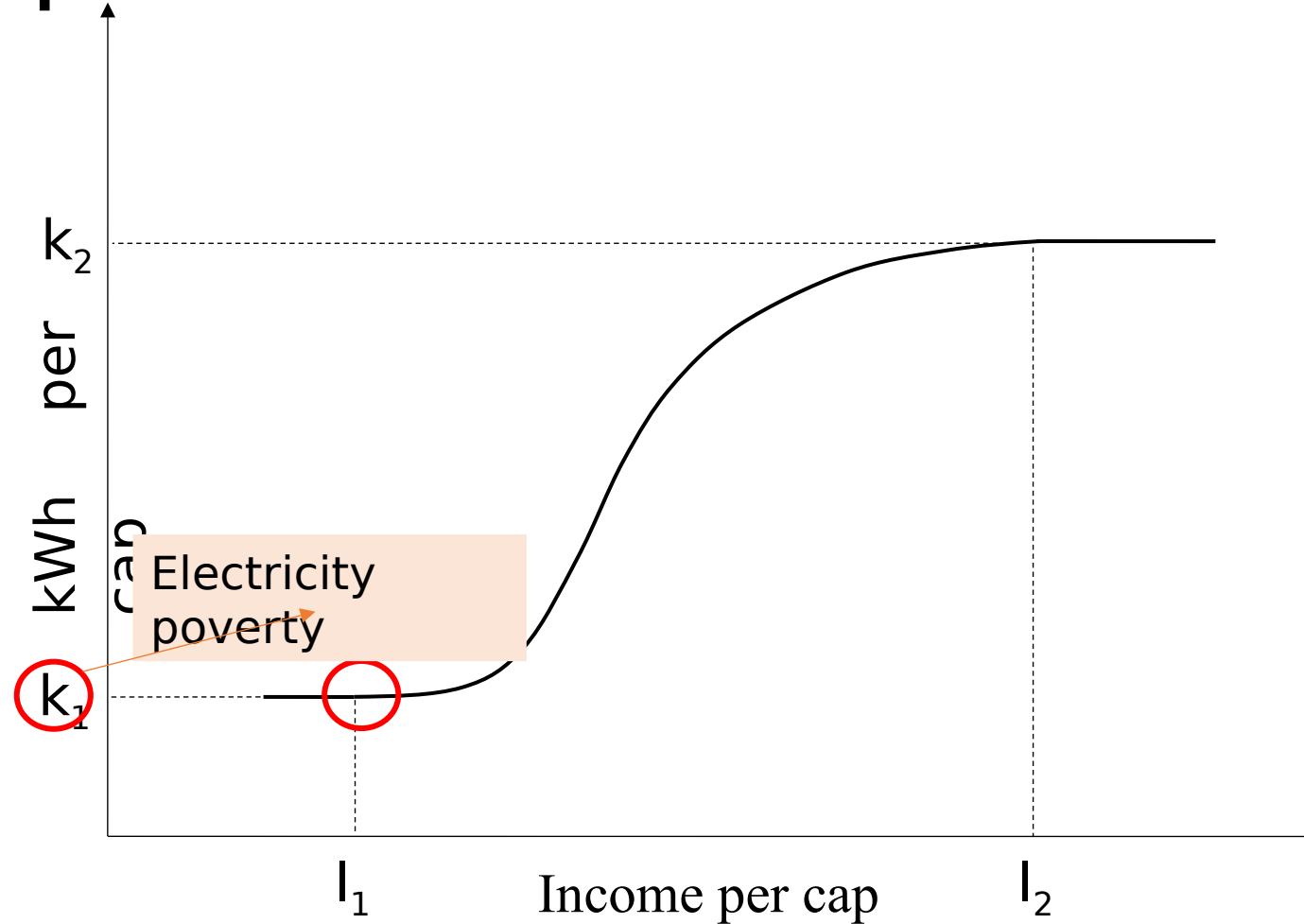
# Motivation

- Recently, Barnes *et al.* (2011, p.895)
  - “Energy poverty line is the threshold point at which energy consumption begins to rise with increases in household income”
- No assumption on household basic needs
- Non-linear relationship between income and kWh consumption

# Aims of the research

1. To test the hypothesis that there is an income threshold where kWh consumption starts to increase with income increase.
  2. If the threshold exists, whether the thresholds differs between urban and rural areas.
- The research is framed in Vietnam context from 2012-16

# Concept model



**Figure 1. The non-relationship between income and kWh consumption**  
Source. Author illustrated

# Methodology

- Barnes *et al.* (2011) approach
  - Divide income per cap to  $n$ -quantiles, take the poorest quantile as the base
  - Estimate the equation
    - $\ln y_i$  = ln of kWh per cap of household  $i$
    - $j$  = quantile index, the higher  $j$ , the higher quantile
    - $D_j$  = 1 if the income per cap of household falls in  $j^{\text{th}}$ -quantile, =0 otherwise
    - $Z$  = other variables such as price, temperature, household demographic
    - $A_k$  = vector of appliances
    - $D_{kj}$  = dummy vars = 1 if the household owns the appliance  $j$ , = 0 otherwise



# Methodology

- Employ  $l$  to denote the value of  $l$ . The estimated coefficients of  $l$  are expected to have the pattern.

$l_1, l_2, \dots, l_{l-1}, l_l, \dots$

$k_1 = \text{mean(kWh per cap)} \text{ of the group } k.$

- Choosing number of quantiles
  - The number of quantiles is chosen to ensure that there is at least  $l$ .
  - Trial and error with increasing number of quantiles until satisfying the rule

# Methodology

- Endogeneity caused by increasing block tariffs (IBTs)
- Apply McFadden, Puig and Kirschner (1977)'s approach: use predicted price as IVs for actual price.

<i>Block</i>	<i>Lower bound</i>	<i>Upper bound</i>	<i>Mar 2019 – present</i>
1	1	50	1,678
2	51	100	1,734
3	101	200	2,014
<b>4</b>	<b>201</b>	<b>300</b>	<b>2,536</b>
5	301	400	2,834
6	401		2,927
ASP			1,864.44

Note. Unit '000 VND per kWh; ASP: average selling price

VAT excluded.

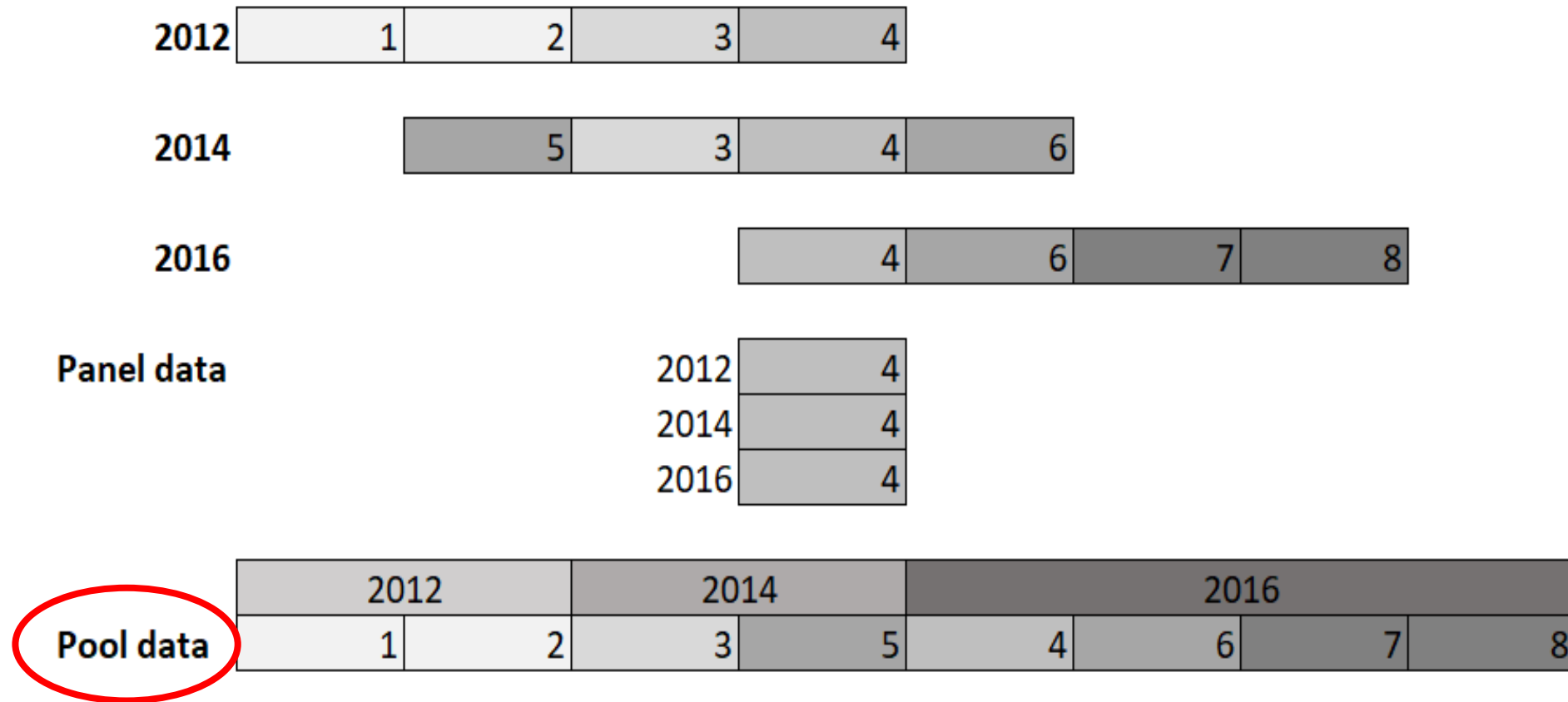
**Table 1. The most recent retail electricity prices for residential**

Source. Author compiled

# Data

- Vietnam Household Living Standard Surveys (VHLSS) 2012, 2014 and 2016
  - Rotated surveys
  - Has data on electricity bills and kWh consumption of “last month”
- Electricity prices from various legal documents
- Temperature from US National Oceanic and Atmospheric Administration (NOAA)
  - 14 stations across Vietnam

# Data



**Figure 2. The data construction**  
Source. Author illustrated

# Data

- Data for prices
  - The retail price schedule applied to roughly 85 per cent of households who can buy electricity directly from EVN.
  - The wholesale prices applied to remote rural areas. The retail price for the group is unknown.
- The study applies the retail price schedules for the whole sample
  - the wholesale price is applied to a small fraction of the population
  - The wholesale price is also in IBTs form thus, there is no decreasing block tariffs in the retail price for the second group

# Data

- Data for kWh
  - There is a significant difference between original kWh and derived kWh from electricity bills.
  - Choose the kWh derived from electricity bills because people normally remember their last month's bill rather than remember how many kWh they consumed
- Data on temperature: geographic proximity procedure
  - Identify the nearest station for each household
  - Assign the temperature of the station for the household
- All money term variables are adjusted to 2012 by CPI index

# Data

<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
<i>Demographic</i>					
Household size	19,297	3.77	1.57	1.00	15.00
Sex ratio	19,296	0.48	0.21	0.00	1.00
Elder ratio	19,296	0.17	0.30	0.00	1.00
Children ratio	19,296	0.21	0.21	0.00	1.00
<i>Economics</i>					
Monthly income per cap	19,291	2,838.26	2,853.47	102.00	110,143.00
<i>Housing condition</i>					
Area in square meter	19,278	80.97	53.70	5.00	750.00

**Table 2. Data statistics for some main variables**  
Source. Author illustrated

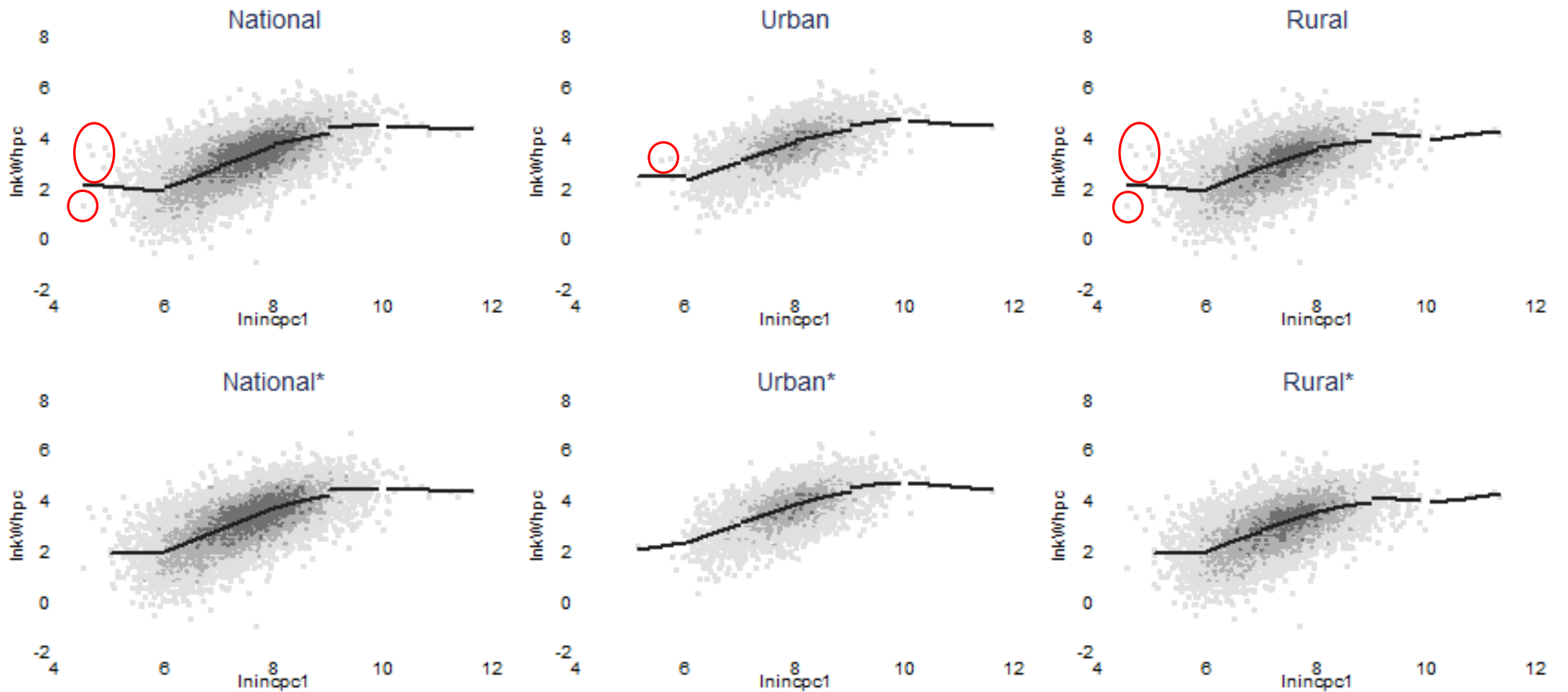
# Data

<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
<i>Assets</i>					
Air conditioner	19,229	0.15	0.36	0.00	1.00
Fan	19,229	0.91	0.29	0.00	1.00
Fridge	19,229	0.63	0.48	0.00	1.00
Washing	19,229	0.31	0.46	0.00	1.00
Oven	19,229	0.08	0.27	0.00	1.00
Computer	19,229	0.22	0.41	0.00	1.00
Television	19,229	0.94	0.24	0.00	1.00
Water heater	19,229	0.24	0.43	0.00	1.00
Generator	19,229	0.02	0.13	0.00	1.00
<i>Energy</i>					
Liquid Petroleum Gas	19,294	107.63	114.26	0.00	4,500.00
<i>Electricity</i>					
Electricity bill last month	19,297	241.61	254.67	2.00	7,320.00
kWh consumed last month	19,297	134.20	111.71	1.23	2,661.54

**Table 2. Data statistics for some main variables (cont.)**

Source. Author illustrated





Note. \* Samples without outliers; outliers are in circles

**Figure 3. Density scatter plots with a series of fitted lines for different income quantiles**

Source. Authors estimated

<i>Inkwh1pc</i>	<i>Original data</i>			<i>Data without outliers</i>		
	<i>National</i>	<i>Rural</i>	<i>Urban</i>	<i>National</i>	<i>Rural</i>	<i>Urban</i>
<i>Income quantiles (selected first 10 quantiles out of 100 quantiles)</i>						
<i>_Iqincpc1_2</i>	-0.0199 [0.0886]	-0.1177 [0.1034]	-0.0164 [0.0923]	0.0737 [0.0835]	0.033 [0.0938]	-0.0503 [0.0986]
<i>_Iqincpc1_3</i>	0.1047 [0.0748]	0.0218 [0.0904]	0.0878 [0.0784]	0.1589** [0.0679]	0.1259 [0.1039]	0.0664 [0.0840]
<i>_Iqincpc1_4</i>	0.1631** [0.0780]	0.0077 [0.0733]	0.1600** [0.0798]	0.2087*** [0.0806]	0.0941 [0.0846]	0.1479* [0.0758]
<i>_Iqincpc1_5</i>	0.1681** [0.0702]	0.1457* [0.0811]	0.1125 [0.0879]	0.2195*** [0.0638]	0.2552*** [0.0861]	0.128 [0.0853]
<i>_Iqincpc1_6</i>	0.1315* [0.0731]	0.108 [0.0820]	0.2153** [0.0975]	0.1639** [0.0726]	0.1927** [0.0883]	0.1978* [0.1042]
<i>_Iqincpc1_7</i>	0.2007*** [0.0731]	0.1121 [0.0816]	0.1206 [0.0846]	0.2517*** [0.0739]	0.1931** [0.0781]	0.0987 [0.0895]
<i>_Iqincpc1_8</i>	0.1615** [0.0758]	0.0746 [0.0709]	0.1605* [0.0853]	0.2188*** [0.0701]	0.1498** [0.0757]	0.1679* [0.0902]
<i>_Iqincpc1_9</i>	0.1903** [0.0774]	0.1317* [0.0776]	0.2841*** [0.0867]	0.2478*** [0.0768]	0.2244** [0.0881]	0.2724*** [0.0945]
<i>_Iqincpc1_10</i>	0.2030** [0.0804]	0.1214 [0.0822]	0.3180*** [0.0770]	0.2562*** [0.0787]	0.2271*** [0.0872]	0.3517*** [0.0863]
N	18971	13171	5800	18965	13165	5798
R-sq	0.633	0.557	0.665	0.627	0.547	0.645
adj. R-sq	0.629	0.55	0.654	0.623	0.541	0.634

Note. All income quantiles above the 10<sup>th</sup> quantiles are positive and significant at the level of 0.05.

Std. Err. in brackets; \* p<0.10, \*\* p<0.05, \*\*\* p<0.01

**Table 3. Estimates of kWh per cap on the quantiles of income per cap.**

Source. Authors estimated

# Electricity poverty thresholds

		<i>National (group 3)</i>		<i>Urban (group 9)</i>		<i>Rural (group 5)</i>	
		<i>N</i>	<i>mean</i>	<i>N</i>	<i>mean</i>	<i>N</i>	<i>mean</i>
(1)	kwh1pc	193	12.39359	58	28.72122	136	13.41762
(2)	incpc1	193	416.6301	58	1161.295	136	449.9606
(3)	hhsz	193	4.143678	58	4.12972	136	4.036105
(4)	kwh1*		51.36		118.61		54.15

Note. Unit of monthly income per cap at 2012 price (incpc1): ‘000 VND; \* (4) = (1) x (3)

**Table 4. Average kWh consumption of a households having corresponding income quantiles.**

Source. Author estimated

# Electricity poverty thresholds

<i>No.</i>	<i>Electricity Services</i>	<i>kWh Consumption</i>
1	Charge phone everyday	1
2	Boil 5 teapots everyday	2
3	Lighting, 4 lamps 4 hour per day	7
4	Fan, 8 hours per day	17
5	Rice cooker OR Television	23
	<i>Total</i>	<i>50</i>

Table 5. Electricity services a household can consume with 50 kWh.  
Source. Ha-Duong (2016)

# Conclusion

- We estimated the minimum level of electricity consumption that a household needs to meet its basic needs is about 50kWh/month > current threshold of 30 kWh/month.
- Limitation
  - A certain degree of measurement errors when apply retail price for the whole sample
  - 14 weather station data for temperature.

# Q&A

- Thank you for your attention!