

The Short-term Effect of Tariff Increases on Household Electricity Consumption: Evidence from a Country in Transition

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Abstract

Estimating the effect of a rise in electricity rates on household demand is challenging because of the endogeneity of tariff increases. In this study, we use a difference-in-differences method to estimate the short-term effect of an increase in residential electricity rates on monthly kWh consumption and household expenditure for electricity in Vietnam. We find that the tariff increase for electricity does not significantly change household demand in the short term, suggesting that electricity is a necessary good with low price elasticity of demand.

Keywords: Electricity, tariff increase, price elasticity, difference-in-differences, household survey, Vietnam.

JEL: Q41, Q48, C31.

1. Introduction

It has been widely documented that electrical energy and economic growth have a two-way relationship (e.g., Ferguson et al., 2010; Wolde-Rufael, 2006; Niu et al., 2013; Yoo et al., 2016). For households, access to

electricity is a basic need. Providing access to residential electricity for all is an important issue, especially for low- and middle-income countries. In addition to providing access to the electrical grid, the price of electricity should be affordable for households.

Researchers as well as policymakers pay great attention to the way firms and households respond to electricity prices. Higher prices can lower demand and the consumption of electrical energy, thereby reducing economic growth as well as household welfare. On the other hand, rising electricity consumption can cause an energy shortage crisis and have harmful effects on the environment. In this study, we examine the extent to which an increase in residential electricity rates affects household consumption in the short term (2 months after a tariff increase). We find that an increase in electricity tariffs does not reduce household consumption, suggesting that electricity is a necessary good with a low price elasticity of demand. Since consumption remains unchanged despite tariff increases, households have to pay more for electricity. This implies that households must reduce expenditure on other goods or their savings, at least in the short term. Moreover, we find

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that poor households are more likely to be affected by tariff increases.

Our study is expected to make two contributions to the related literature. Firstly, although economic theory predicts negative own-price elasticity in the demand for electricity, the extent of elasticity differs across empirical studies (e.g., see the review by Fan and Hyndman, 2011; Espey and Espey, 2004; Labandeira et al., 2017; Zhu et al., 2018). On average, short-term price elasticity is estimated at -0.35 in Espey and Espey (2004), and -0.2 in Labandeira et al., (2017). Deryugina et al. (2019) have estimated short-term price elasticity at only -0.09. However, Hung and Huang (2015) and Zhang et al. (2017) find no significant effect of price changes on household electricity demand. Recently, Zhu et al. (2018) and Pellini (2021) find that residential electricity demand is nearly inelastic in the short run.

Price elasticity in the long term is higher than in the short term, since firms and households can adjust their behavior and find substitutes to electricity in the long term. According to Labandeira et al., (2017), the average price elasticity of electricity demand in the long term is around -0.51. A recent approach is to estimate the response of households to the price using experiments, and the magnitude of the effect also differs for different settings and interventions (see the review by Faruqui and Sergici, 2010). Hence, existing studies show a wide diversity in the scale of the effects, a situation which calls for more empirical studies to better understand the consequences of electricity price increases. Our study shows that although households do not adjust their demand in response to a small tariff increase, their payments for electricity increase. Poor households can be affected if the tariff increases by a larger amount.

The second contribution of this study is to use a difference-in-differences estimator to gauge the causal effect of a tariff increase on household demand for electricity in the short term. There are two key challenges in estimating the effect of electricity price changes as well as the price elasticity of demand. The first is the endogeneity of prices. Prices are not exogenous but are determined by supply and demand. Prices may increase as a result of an increase in demand, and this issue raises the problem of reverse causality and can underestimate price elasticity. There may also be omitted variables, such as the price of other energy sources (substitutes for electricity) that lead to biased estimates of price elasticity in electricity demand.

The second difficulty in estimating the price elasticity of demand for electricity is the requirement of data for the price variation across time, sectors or areas. Most studies use price variation across time, sectors or areas to estimate price elasticity (e.g., Fan and Hyndman, 2011; Okajima and Okajima, 2013; Bigerna and Bollino, 2014; Campbell, 2018; Burke and Abayasekara, 2018). In some countries, however, such as Vietnam in this study, the price of electricity is determined nationwide and does not vary across areas. In this study, we address the two difficulties cited above by using a difference-in-differences estimator to estimate the short-term response of household demand to an increase in the residential electricity tariff, taking into account the seasonal effect of electricity consumption.

Vietnam is an interesting case to examine because it is in transition from a low- to middle-income country. Vietnam has achieved high economic growth with an annual rate of around 6% during recent decades. With economic growth, the demand for energy also increases. According to Toan et al.

(2011), electricity generation grew annually by 13.8% for the 2001–2008 period. Kozel and Nguyen (2010) found that the annual growth rate of residential demand for electricity was around 6% for the same period. In order to deal with the trend for increasing electricity consumption, since February 2011 the government has allowed the cost of electricity to adjust according to market mechanisms. Since then, residential electricity rates have increased twice in 2011 and twice in 2012. Access to the national grid has enabled rural households to increase their income, expenditure and education (Khandker et al., 2009). Thus, there is a concern whether rate increases will reduce household electricity consumption, especially for poor households. Nguyen et al. (2023) find very low electricity consumption in impoverished areas. Furthermore, there is significant inequality in electricity consumption within poor areas. Findings from this study are expected to provide useful information for policies on energy prices in Vietnam.

This paper consists of six sections. In the next section, we describe the datasets and in Section 3 we present a descriptive analysis of electricity consumption and tariffs in Vietnam. We discuss the estimation method and provide the empirical results, respectively, in Sections 4 and 5. We conclude in Section 6.

2. Datasets

This analysis relies on the Vietnam Household Living Standard Surveys in 2010 and 2012. The VHLSS have been conducted by the GSO with technical support from the World Bank every 2 years since 2002. In the 2010 VHLSS and the 2012 VHLSS, 9,402 and 9,399 households, respectively, were sampled. The VHLSS are representative for rural/urban areas and six geographic regions.

It should be noted that the 2010 VHLSS was conducted in June, September and December in 2010, with one-third of households randomly selected for the survey during each period. The 2012 VHLSS was conducted in March, June, September and December in 2012, with one-fourth of households randomly selected for the survey each time. In this study, we rely on this feature to estimate the effect of tariff increases.

The VHLSS dataset contains very detailed information on individuals, households and communes, including data on total expenditures of households, money spent on electricity and the number of kWh consumed by households in the last month. Unlike the VHLSS prior to 2010, the 2010 and 2012 VHLSS contain data on the monthly kWh that a household consumed in the month before the interview. This information allows us to analyse the effect of tariff increases on kWh consumption. Thus, this study relies on data from the VHLSS in 2010 and 2012.

3. Electricity consumption and tariffs in Vietnam

3.1. Household electricity consumption

Electricity coverage in Vietnam is high compared with other countries at similar levels of development. According to the 2012 VHLSS, nearly 97% of the population had access to electricity in 2012. While this means only 3% of the population lacked access, the proportion of households without electricity varies significantly across regions. Figure 1 shows the proportion of the population without electricity at the provincial and district levels. We used the 2009 Population and Housing Census instead of the VHLSS for this graph, since the 2009 census is representative at the district level. Consistent with Nguyen et al. (2023), we find a geographic variation in

access to electricity. Only around 90% of households in the Midlands and Northern Mountains had access to electricity. In some districts in these regions, the proportion of the population without the access was nearly 20%.

Table 1 shows that per capita electricity consumption increased by around 7%, from 31 kWh in 2010 to 33 kWh in 2012.¹ By regions, the average monthly consumption of kWh

of households in the Midlands and Northern Mountains and Central Highlands was lowest, around 22 and 24 kWh in 2012, respectively. Households in the Southeast had the highest monthly kWh consumption, followed by households in the Red River Delta. Poor households and ethnic minorities consumed significantly less electricity compared to non-poor and Kinh/Hoa households, respectively.²

Panel A. Provinces

Panel B. Districts

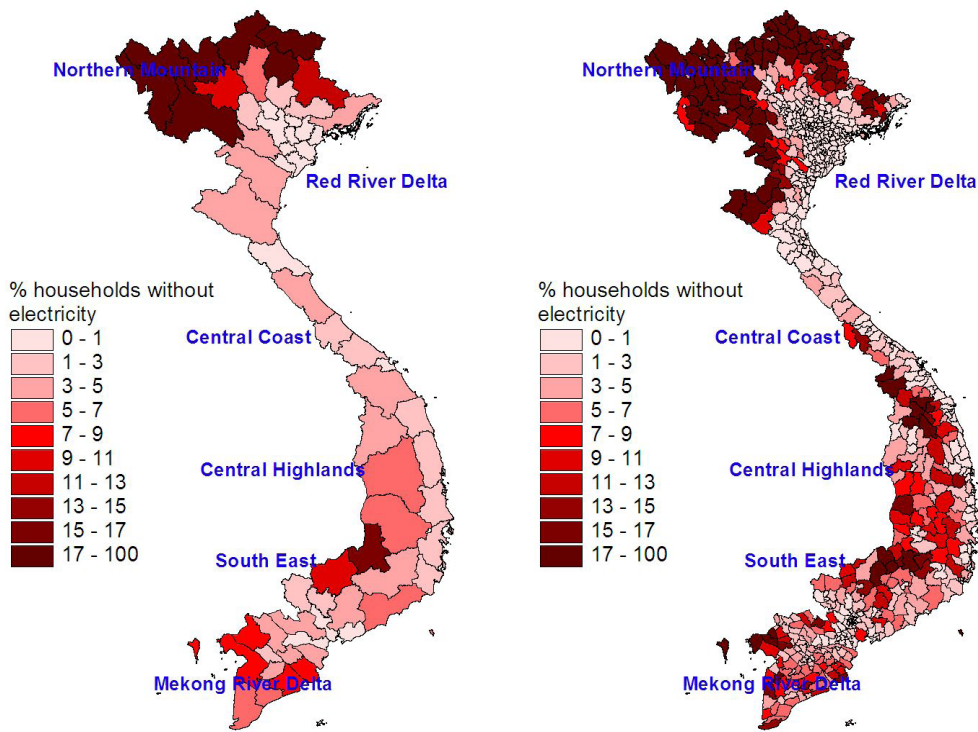


Figure 1. Percentage of population living in houses without electricity

Note: This figure shows a mainland map of electricity access across districts (estimated using data from the Vietnam Population and Housing Census 2009).

¹ Figure A.1 in the Appendix presents the distribution of kWh in 2010 and 2012.

² A household is defined as poor if its per capita consumption is below the poverty line set by the World Bank and the Government Statistics Office (GSO). It is equivalent to the cost of a food basket allowing for a daily intake of 2,230 calories per person per day, plus related non-food consumption. The WB/GSO poverty index is equal to 7,836 and 10,479 thousand VND/person/year for 2010 and 2012, respectively.

Households in Vietnam, both poor and better-off, allocate a relatively small but increasing portion of their expenditure to electricity, rising from 1.8% in 2010 to 2.1% in 2012. Urban households spend a higher proportion than rural households and poorer households spend slightly less (as a share of total spending) than the better off. Wealthier regions, such as the Southeast, spend more on electricity than poorer regions, though the proportion remains below 3%. Power is not

only widely available in Vietnam, but is also affordable.

3.2. Tariff increases during 2010-2012

In February 2011, the Prime Minister issued Decision No. 24/2011/QĐ-TTg “On the adjustment of the electricity sale price according to market mechanisms,” which allowed for the adjustment of electricity sale prices according to market mechanisms, with rate increases not exceeding 5%. Since then,

Table 1. Electricity expenditure as a percent of total cash expenditure

<i>Groups</i>	VHLS 2010			VHLS 2012		
	Per capita monthly kWh	Per capita spending on electricity (thousand VND/year)	Proportion of electricity spending in total expenditure	Per capita monthly kWh	Per capita spending on electricity (thousand VND/year)	Proportion of electricity spending in total expenditure
<i>Rural/urban</i>						
Rural	22.5	22.9	1.6	24.8	29.1	1.9
Urban	50.0	59.5	2.2	52.3	62.4	2.4
<i>Region</i>						
Red River Delta	37.5	43.1	1.9	41.4	51.1	2.2
Northern Mountains	19.3	17.7	1.4	22.1	23.1	1.7
Coastal Central	22.9	24.0	1.5	25.4	29.6	1.8
Central Highlands	21.7	22.1	1.6	23.9	27.4	1.8
South East	47.9	59.8	2.5	50.0	61.5	2.6
Mekong Delta	26.7	27.8	1.7	26.2	31.5	1.9
<i>Ethnicity</i>						
Kinh/Hoa	33.6	38.0	1.9	36.1	43.4	2.2
Ethnic minorities	12.2	10.7	1.2	12.4	13.0	1.3
<i>Poverty</i>						
Non-poor	35.5	40.1	1.9	37.1	44.7	2.1
Poor	9.8	9.3	1.5	10.2	11.3	1.8
Total	30.9	33.9	1.8	33.0	38.9	2.1

Note: Spending on electricity is adjusted to that of January 2012.
For comparison, 1 USD is equivalent to approximately 22,000 VND.

Source: Author's estimation using VHLS 2010 and 2012.

Table 2. Residential monthly retail tariff (VND/kWh)

Blocks	Date of tariff adjustment			
	1/3/2011	20/12/2011	1/7/2012	21/12/2012
0-100 kWh	1242	1242	1284	1350
101-150 kWh	1304	1369	1457	1545
151-200 kWh	1651	1734	1843	1947
201-300 kWh	1788	1877	1997	2105
301-400 kWh	1912	2008	2137	2249
401 + kWh	1962	2060	2192	2307

Source: Author's table using published information on retail tariffs.

retail electricity rates for consumption have increased by around 5% each time. In both 2011 and 2012, there were two adjustments to the retail electricity tariff. In this study, we focus on the effect of the tariff increase in July 2012. This particular increase is selected due to the availability of VHLSS data and the use of the difference-in-differences estimator, which will be discussed in more detail in the next section. The electricity tariff was increased for all tariff blocks starting July 1, 2012 (Ministry of Industry and Trade of Vietnam, 2012). Table 2 presents the detailed electricity prices for different blocks before and after the increase.

4. Estimation method

Estimating the impact of an increase in electricity rates on household demand is challenging for several reasons. Firstly, electricity tariff increases are not random. Electric power companies can increase their tariffs because of increased inflation or increased production costs. An increase in living standards and higher demand for electricity can also lead to an increase in

electricity rates. Unobserved variables may affect both rates and household demand for electricity. As a result, the estimate of the electricity tariff increase may be biased. Secondly, tariff increases are often applied nationwide, and there are no control groups for evaluating the effect.

In this study, we overcome these two difficulties in measuring the short-term effect of an increase in electricity rates on household electricity demand by using a variant of the difference-in-differences method.³ We assess the effect of the July 1, 2012 rate increase on monthly electricity consumption in households for the months of September and December. Below, we present the estimation strategy used to analyze the impact of the tariff increase on electricity consumption in September. The effect of the tariff increase on electricity consumption in December is estimated using the same approach.

As discussed in the data section, an important feature of the VHLSS is that these surveys are conducted several times a year (in March, June, September and December) to take into account seasonal effects. The

³ The difference-in-differences estimator is one of the most widely-used methods in impact evaluation. For detailed discussions of this method, see e.g., Heckman et al. (2010), Wooldridge (2010).

observed difference in household electricity consumption between June and September can be expressed as the effect of the electricity tariff and the effect of time, as follows:

$$\Delta Y = E(Y_{Sep}^{2012}) - E(Y_{Jun}^{2012}) = \Delta Y_{Rise}^{2012} + \Delta Y_{Time}^{2012} \quad (1)$$

where Y_{Sep}^{2012} and Y_{Jun}^{2012} indicate the monthly kWh consumption of households in June and September, respectively. ΔY_{Rise}^{2012} and ΔY_{Time}^{2012} are the tariff increase effect and time effect, respectively. It is a problem that we cannot observe these two effects separately. However, if we assume that the time effect in 2012 is similar to that in 2010, we can use the time effect in 2010 to reflect that in 2012. It should be noted that there was no tariff increase between June and September in 2010. As a result, the difference in monthly kWh household consumption between June and September 2010 captures the time effect. Equation (1) is expressed as follows:

$$\Delta Y = E(Y_{Sep}^{2012}) - E(Y_{Jun}^{2012}) = \Delta Y_{Rise}^{2012} + [E(Y_{Sep}^{2010}) - E(Y_{Jun}^{2010})], \quad (2)$$

hence:

$$\Delta Y_{Rise}^{2012} = [E(Y_{Sep}^{2012}) - E(Y_{Jun}^{2012})] - [E(Y_{Sep}^{2010}) - E(Y_{Jun}^{2010})]. \quad (3)$$

Equation (3) is similar to the difference-in-differences estimator, in which households surveyed in September and June are considered to be the treatment and control groups, respectively, and the 2010 and 2012 surveys are considered the baseline and end-line surveys, respectively.

It should be noted that the average monthly CPI between June and September in

2010 is equal to 100.29, which is very close to the average monthly CPI between June and September in 2012 (at 100.26). The CPI during the first 6 months of 2010 and that of 2012 are also similar. Thus, the effect of the overall CPI on electricity consumption between June and September is assumed to be the same for 2010 and 2012.

For simplicity, we will estimate the effect indicated by (3) by the following difference-in-differences regression:

$$Y = \beta_0 + \beta_1 T + \beta_2 D + \beta_3 (D.T) + X' \beta_4 + \varepsilon \quad (4)$$

where Y is per capita kWh consumption in the last month, T is the dummy year which equals 1 for 2012 and 0 for 2010. D is the month dummy, which is 1 for September and 0 for June. We expect that households in September 2012 were affected by the tariff increase in July 2012. The estimate of the impact of the tariff increase is given by β_3 . We use only households sampled in June and September for the regression of (4).

One important issue is whether households really were randomly selected for survey in June and September. To test this, we pool households surveyed in June and September, and run regressions of “being surveyed in September” on several variables of household characteristics. Summary statistics for these variables are reported in Table A.1 in the Appendix. Table A.2 in the Appendix presents the regression results and shows that none of the explanatory variables are statistically significant and are of very small magnitude. The R-2 values are also extremely small. This suggests that households surveyed in September are similar to those surveyed in June. Similarly, Table A.3 in the Appendix shows that households surveyed in December are also comparable to those surveyed in June.

Since the sample of households surveyed in June or September (also December) is random, we do not need to control for additional variables. However, in Model 4 we can control for several exogenous variables X to increase the efficiency of the regressions. In this study, the control variables include household size, ethnic minority status, the proportions of children and elderly in households, the education level of household heads, per capita living area, and an urban dummy variable. These control variables should not be affected by the tariff change (Angrist and Pischke, 2009). We also conduct robustness checks in which we include additional control variables including per capita income and electric appliances of households.

An important issue is whether the tariff increase disproportionately affects low-income households. We address this issue by including interactions between the treatment variable and variables indicating poverty status, ethnic minority status, and rural residency. Specifically, we interact the treatment variable (D.T) with these variables to investigate the heterogeneous effects of tariff increases across households with different characteristics.

Standard errors of the difference-in-differences estimator can be underestimated because of autocorrelation (Bertrand et al., 2004). This is not a problem in our study, since we use only two-period data and do not use panel data. In this study, we cluster the standard errors within villages, which is the primary sampling unit in the VHLSS (Abadie et al., 2023).

5. Empirical results

5.1. Impact of the electricity tariff increase

Tables 3 and 4 present the estimation of the effect of the tariff increase on household

electricity consumption in September and December, respectively. We measure electricity consumption in terms of kWh per capita and the expenditure on electricity for the previous month. One issue with the measure of electricity consumption is that it contains a zero value for some households. In the VHLSS, around 4% of households have no electricity consumption. Thus, for each dependent variable, we estimate three models. In Model 1, we run an OLS regression of monthly kWh per capita and electricity expenditure, which receive zero for households without electricity consumption. When there is a small proportion of zero values in the dependent variable, we can also use the Tobit model. Thus Model 2 reports the Tobit regression of these dependent variables. In Model 3, we apply a logarithmic transformation to the dependent variables and replace missing values with zero. We estimate the regression using these three approaches to assess the sensitivity of the estimates.

In Table 3, the effect of the tariff increase is measured by the coefficient of the interaction between “surveyed in September” and “dummy year 2012.” It shows that the effect of a tariff increase on electricity consumption (measured by the number of kWh during the last month) is not significant. For all models, the estimates are positive but not statistically significant at conventional levels. Thus, in the short term, households do not reduce their demand in response to electricity price increases. This may be due to the modest size of the tariff increase (5%) and the fact that households can still afford their electricity consumption, particularly in a period of high economic growth. Electricity spending accounts for around 2% of total household expenditure.

Although the tariff increase has no effect on electricity consumption (measured in kWh), it may have a positive effect on household electricity payments. Columns 4 to 6 of Table

3 present positive estimates of the tariff's impact on household electricity expenditure. However, these estimates are not statistically significant at conventional levels.

Table 3. Effect of the Tariff Increase on Electricity Consumption in September

Explanatory variables	Dependent variable is "per capita monthly kWh"			Dependent variable is "per capita monthly spending on electricity"		
	Model 1: OLS	Model 2: Tobit	Model 3: OLS (Log)	Model 1: OLS	Model 2: Tobit	Model 3: OLS (Log)
	(1)	(2)	(3)	(4)	(5)	(6)
Surveyed in September * dummy year 2012	2.64 (2.30)	2.31 (2.05)	0.0563 (0.0609)	5.71 (4.00)	4.86 (3.43)	0.0846 (0.0714)
Surveyed in September (1 for September, 0 for June)	1.34 (1.89)	1.17 (1.65)	0.0365 (0.0535)	-0.48 (3.41)	-0.42 (2.89)	0.0043 (0.0647)
Dummy year 2012 (1 for 2012, 0 for 2010)	1.73 (1.88)	1.58 (1.65)	0.1034* (0.0541)	11.44*** (3.48)	9.68*** (2.91)	0.4652*** (0.0642)
Ethnic minorities (ethnic minorities=1, Kinh=0)	-9.10*** (0.77)	-7.86*** (0.67)	-0.6565*** (0.0374)	-11.66*** (0.96)	-9.77*** (0.81)	-0.7006*** (0.0351)
Household size	-1.04*** (0.32)	-0.88*** (0.28)	-0.0368*** (0.0069)	-0.99** (0.49)	-0.80* (0.41)	-0.0300*** (0.0076)
Number of children below 15 years	-0.09 (1.91)	-0.06 (1.67)	-0.1307*** (0.0473)	-0.83 (2.74)	-0.68 (2.31)	-0.1987*** (0.0497)
Number of members over 60 years	-4.75** (1.85)	-4.26*** (1.62)	-0.1593*** (0.0362)	-10.41*** (2.58)	-8.95*** (2.13)	-0.2474*** (0.0386)
Completed school grades of household head	1.37*** (0.12)	1.20*** (0.10)	0.0433*** (0.0028)	1.75*** (0.17)	1.50*** (0.14)	0.0474*** (0.0031)
Log of per capita living area	16.78*** (1.31)	14.74*** (1.01)	0.4143*** (0.0197)	22.42*** (1.81)	18.99*** (1.40)	0.4376*** (0.0211)
Urban areas (urban=1, rural=0)	22.34*** (1.40)	20.06*** (1.31)	0.5593*** (0.0273)	34.76*** (2.20)	30.37*** (1.88)	0.6947*** (0.0320)
Constant	-28.18*** (4.97)		1.6429*** (0.0878)	-47.74*** (7.17)		1.4160*** (0.0991)
Observations	7,674	7,674	7,674	7,674	7,674	7,674
R-squared	0.295		0.422	0.312		0.485

Note: The marginal effect is reported for the Tobit model.

The price is adjusted to that of January 2012.

Robust standard errors in parentheses. Standard errors are corrected for sampling weight and cluster correlation.

*** p<0.01, ** p<0.05, * p<0.1

Source: Estimation from VHLSS 2010 and 2012.

In Table 4, we analyze the effect of the tariff increase on households' electricity consumption in December. Consistent with the findings in Table 3, the results indicate no significant impact of the tariff increase

on electricity consumption during this period. These findings suggest that, in the short term, households do not adjust their electricity demand in response to higher prices. Thus, consistent with recent studies such as Zhu

Table 4. Effect of the Tariff Increase on Electricity Consumption in December

Explanatory variables	Dependent variable is "per capita monthly kWh"			Dependent variable is "per capita monthly spending on electricity"		
	Model 1: OLS	Model 2: Tobit	Model 3: OLS (Log)	Model 1: OLS	Model 2: Tobit	Model 3: OLS (Log)
	(1)	(2)	(3)	(4)	(5)	(6)
Surveyed in December * dummy year 2012	0.03 (2.21)	0.04 (1.94)	0.0098 (0.0605)	2.57 (3.93)	2.03 (3.09)	0.0565 (0.0704)
Surveyed in December (1 for December, 0 for June)	1.12 (1.86)	0.98 (1.63)	0.0207 (0.0539)	-1.88 (3.46)	-1.45 (2.72)	-0.0414 (0.0648)
Dummy year 2012 (1 for 2012, 0 for 2010)	1.96 (1.86)	1.77 (1.64)	0.1039* (0.0543)	11.75*** (3.44)	9.06*** (2.70)	0.4672*** (0.0642)
Ethnic minorities (ethnic minorities=1, Kinh=0)	-6.91*** (0.87)	-5.95*** (0.73)	-0.5641*** (0.0335)	-6.11* (3.13)	-4.76* (2.61)	-0.6283*** (0.0349)
Household size	-1.66*** (0.30)	-1.42*** (0.26)	-0.0444*** (0.0079)	-1.63*** (0.51)	-1.18*** (0.44)	-0.0419*** (0.0081)
Number of children below 15 years	0.28 (2.12)	0.26 (1.86)	-0.1485*** (0.0499)	-3.96 (2.85)	-3.05 (2.15)	-0.2219*** (0.0537)
Number of members over 60 years	-3.72** (1.71)	-3.29** (1.51)	-0.1563*** (0.0380)	-7.61*** (2.33)	-6.02*** (1.92)	-0.2223*** (0.0393)
Completed school grades of household head	1.29*** (0.10)	1.13*** (0.09)	0.0429*** (0.0029)	1.67*** (0.18)	1.29*** (0.20)	0.0462*** (0.0031)
Log of per capita living area	15.27*** (1.13)	13.40*** (0.95)	0.4009*** (0.0203)	18.36*** (1.62)	14.18*** (1.58)	0.3951*** (0.0214)
Urban areas (urban=1, rural=0)	20.23*** (1.29)	18.13*** (1.16)	0.5300*** (0.0278)	31.28*** (2.03)	24.93*** (2.49)	0.6715*** (0.0318)
Constant	-20.94*** (4.39)		1.7146*** (0.0946)	-32.66*** (6.64)		1.5909*** (0.1025)
Observations	7,758	7,758	7,758	7,758	7,758	7,758
R-squared	0.270		0.390	0.167		0.458

Note: The marginal effect is reported for the Tobit model.

The price is adjusted to that of January 2012.

Robust standard errors in parentheses. Standard errors are corrected for sampling weight and cluster correlation.

*** p<0.01, ** p<0.05, * p<0.1

Source: Estimation from VHLSS 2010 and 2012.

et al. (2018) and Pellini (2021), our study indicates that residential electricity demand is nearly inelastic in the short run.

Tables 3 and 4 also reveal several important determinants of electricity consumption in Vietnam. Ethnic minorities, who are poorer and located mainly in the mountains and highlands, consume less electricity than do the Kinh majority people.⁴ Urban households consume more electricity than do rural ones. Larger households and those with more children use less electricity compared to smaller households and those with fewer children. Households led by individuals with higher education levels consume more electricity than those led by less educated individuals.

5.2. Robustness check

We conduct several robustness checks to assess the estimated effects of the tariff increase on electricity consumption. First, we test whether the estimates are sensitive to different sets of control variables. Tables A.5 and A.6 in the Appendix present DID regression results without control variables, while Tables A.7 and A.8 include an extended set of controls, such as regional dummies, household per capita income, and appliance ownership indicators. The results remain consistent with those in Tables 3 and 4. Additionally, we run regressions without sampling weights and explore alternative clustering methods for standard errors (district-level clustering and heteroskedasticity-consistent standard errors). The results are very similar to those in Table 3 and 4. Across all models, we find

no significant effect of the tariff increase on household electricity consumption.

5.3. Heterogeneous effects

In Table 5, we include interactions between the tariff increase and several explanatory variables. For simplicity, the dependent variables are the log of electricity consumption and the log of spending. The triple interaction between an explanatory variable, 'surveyed in September,' and the '2012 dummy year' captures the heterogeneous effect of the tariff increase based on the explanatory variable's value. The results indicate that the effect of the tariff increase does not differ between urban and rural households, ethnic minorities and the Kinh majority, or households with varying living areas.

However, the effect of the tariff increase varies between poor and non-poor households.⁵ The effect of the tariff increase on electricity consumption among non-poor households is positive but not statistically significant. However, the difference in the effect between poor and non-poor households is negative and statistically significant at the 5% level, suggesting that tariff increases have a stronger (negative) impact on poor households. For the poor, the effect on the log of kWh is estimated at -10.3 (calculated as 0.0307 plus -0.1333), though this estimate is not statistically significant. A separate regression using only poor households (Table A.8 in the Appendix) also finds a negative but insignificant effect of the tariff increase on the electricity consumption of the poor households.

⁴ Vietnam has 54 ethnic groups, of which the Kinh majority accounts for 85% of the total population of Vietnam. The Kinh earn more income than other ethnic minorities and are more likely to live in Delta areas.

⁵ A household is defined as poor if per capita expenditure is below the poverty line, which is set by the World Bank (WB) and the General Statistics Office (GSO) of Vietnam. The poverty line is equivalent to an expenditure level for food that allows for 2,230 calories per day per person and some essential non-food expenditure, such as clothing and housing.

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In Table 6, we analyze the heterogeneous effects of the tariff increase on electricity consumption in December. The results show that none of the interaction terms are statistically significant, suggesting that the tariff increase does not have a heterogeneous impact on electricity consumption across different household groups in December.

6. Conclusion

Electrical energy is an important dimension of living standards, especially for

households in a country in transition, such as Vietnam. Electricity tariffs as well as the level of electricity consumption have been both increased over time. In this study, we estimate the short-term effect of a tariff increase on electricity consumption by households in Vietnam, and we do not find any significant effect from tariff increases. This indicates that electricity is a necessity with low price elasticity of demand. Vietnam has experienced significant economic growth in recent decades. Therefore, a moderate

Table 5. Heterogeneous Effects of the Tariff Increase on Electricity Consumption in September

Explanatory variables	Dependent variable is “log of per capita monthly kWh”				Dependent variable is “log of per capita monthly spending on electricity”			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Surveyed in September * dummy year 2012	0.0408 (0.0615)	0.0583 (0.0617)	-0.0274 (0.1149)	0.0594 (0.0584)	0.0975 (0.0719)	0.0801 (0.0721)	0.0624 (0.1281)	0.0838 (0.0686)
(Surveyed in September * dummy year 2012) * urban	0.0459 (0.0505)				-0.0381 (0.0552)			
(Surveyed in September * dummy year 2012) * ethnic minorities		-0.0169 (0.0645)				0.0382 (0.0683)		
(Surveyed in September * dummy year 2012) * Log of per capita living area			0.0287 (0.0327)				0.0076 (0.0357)	
(Surveyed in September * dummy year 2012) * poverty status of households				-0.1181** (0.0516)				-0.1008* (0.0550)
Surveyed in September (1 for September, 0 for June)	0.0378 (0.0535)	0.0364 (0.0535)	0.0364 (0.0535)	0.0398 (0.0508)	0.0032 (0.0646)	0.0046 (0.0647)	0.0043 (0.0647)	0.0082 (0.0619)
Dummy year 2012 (1 for 2012, 0 for 2010)	0.1047* (0.0541)	0.1033* (0.0542)	0.1041* (0.0541)	0.1036** (0.0515)	0.4641*** (0.0641)	0.4655*** (0.0642)	0.4654*** (0.0642)	0.4653*** (0.0614)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.6470*** (0.0881)	1.6426*** (0.0878)	1.6653*** (0.0929)	1.8812*** (0.0853)	1.4126*** (0.0993)	1.4169*** (0.0991)	1.4220*** (0.1045)	1.6847*** (0.0963)
Observations	7,674	7,674	7,674	7,674	7,674	7,674	7,674	7,674
R-squared	0.422	0.422	0.422	0.453	0.485	0.485	0.485	0.516

Note: Control variables include ethnic minorities, household size, number of children below 15 years, number of members over 60 years, completed school grades of household head, urban dummy, and the poverty status. The price is adjusted to that of January 2012.

The poverty status of households is equal to 1 for poor households, and 0 for non-poor households. Robust standard errors in parentheses. Standard errors are corrected for sampling weight and cluster correlation. *** p<0.01, ** p<0.05, * p<0.1

Source: Estimation from VHLSS 2010 and 2012.

increase in tariffs is likely to be affordable for most households. However, we find that poor households may be more adversely affected by tariff increases than non-poor households. If electricity tariffs rise significantly, poor households may be forced to reduce their consumption. This also suggests that tariff hikes should be avoided during economic slowdowns, as they could negatively impact household living standards and production. To mitigate the impact on poor households, tariff increases for lower consumption blocks

should be smaller than those for higher blocks. Additionally, providing electricity subsidies to poor households could help alleviate the financial burden.

Finally, it is important to acknowledge the limitations of our study in estimating the causal effect of the tariff increase. The DID estimator may be biased if the timing of the tariff increase is not exogenous. For example, if the government raises tariffs during periods of high electricity demand, the effect may be underestimated. Additionally, due to data

Table 6. Heterogeneous Effects of the Tariff Increase on Electricity Consumption in December

Explanatory variables	Dependent variable is “log of per capita monthly kWh”				Dependent variable is “log of per capita monthly spending on electricity”			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Surveyed in December * dummy year 2012	0.0028 (0.0619)	0.0102 (0.0612)	0.0791 (0.1144)	-0.0010 (0.0582)	0.0845 (0.0718)	0.0524 (0.0708)	0.1575 (0.1228)	0.0406 (0.0677)
(Surveyed in December * dummy year 2012) * urban	0.0207 (0.0515)				-0.0832 (0.0547)			
(Surveyed in December * dummy year 2012) * ethnic minorities		-0.0039 (0.0667)				0.0351 (0.0701)		
(Surveyed in December * dummy year 2012) * Log of per capita living area			-0.0241 (0.0322)				-0.0351 (0.0334)	
(Surveyed in December * dummy year 2012) * poverty status of households				-0.0482 (0.0523)				-0.0262 (0.0503)
Surveyed in December (1 for December, 0 for June)	0.0214 (0.0539)	0.0207 (0.0539)	0.0208 (0.0539)	0.0339 (0.0509)	-0.0440 (0.0647)	-0.0414 (0.0648)	-0.0413 (0.0649)	-0.0267 (0.0616)
Dummy year 2012 (1 for 2012, 0 for 2010)	0.1044* (0.0543)	0.1038* (0.0543)	0.1033* (0.0543)	0.1059** (0.0513)	0.4650*** (0.0641)	0.4675*** (0.0642)	0.4664*** (0.0643)	0.4693*** (0.0612)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.7151*** (0.0947)	1.7146*** (0.0946)	1.6945*** (0.0989)	1.9929*** (0.0942)	1.5893*** (0.1026)	1.5917*** (0.1025)	1.5616*** (0.1063)	1.8987*** (0.1011)
Observations	7,758	7,758	7,758	7,758	7,758	7,758	7,758	7,758
R-squared	0.390	0.390	0.390	0.428	0.459	0.458	0.458	0.496

Note: Control variables include ethnic minorities, household size, number of children below 15 years, number of members over 60 years, completed school grades of household head, urban dummy, and the poverty status. The price is adjusted to that of January 2012.

The poverty status of households is equal to 1 for poor households, and 0 for non-poor households. Robust standard errors in parentheses. Standard errors are corrected for sampling weight and cluster correlation. *** p<0.01, ** p<0.05, * p<0.1

Source: Estimation from VHLSS 2010 and 2012.

limitations, we are unable to estimate the long-term effects of the tariff increase. While addressing these limitations is beyond the scope of this study, it is an important direction for future research.

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Appendix

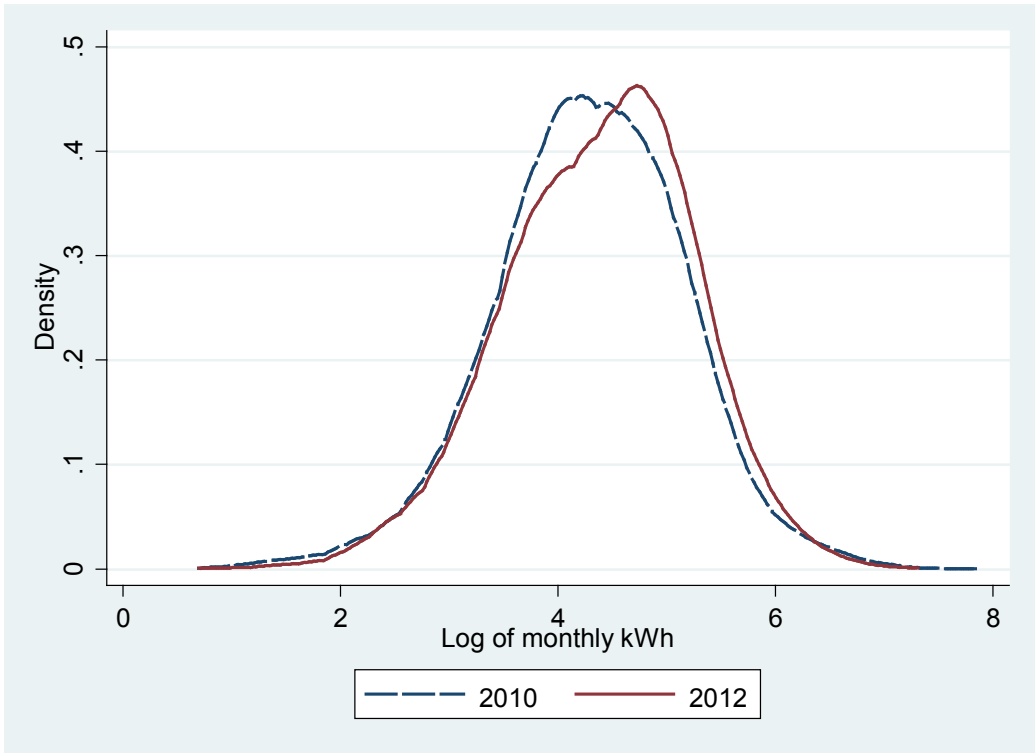


Figure A.1. Kernel density of log of monthly kWh
Source: Author's estimation using VHLSS 2010 and 2012

Table A.1. Summary statistics of variables

Variables	2010		2012	
	Mean	Std. Dev.	Mean	Std. Dev.
Per capita monthly consumption of electricity in kWh	30.91	35.82	33.02	34.05
Per capita monthly spending on electricity (thousand VND)	33.90	43.80	38.90	51.71
Per capita income (thousand VND)	19248.0	56069.8	26693.4	25229.8
Per capita living area (m ²)	20.75	16.29	22.66	17.62
Ethnic minorities (ethnic minorities=1, Kinh=0)	0.112	0.315	0.117	0.321
Household size	3.886	1.556	3.831	1.567
Number of children below 15 years	0.202	0.207	0.196	0.206
Number of those over 60 years	0.123	0.261	0.147	0.285
Completed school grades of household head	7.478	3.596	7.412	3.693
Urban areas (urban=1, rural=0)	0.305	0.461	0.308	0.462
Poverty status (poor=1, non-poor=0)	0.160	0.367	0.139	0.346
Observations	3205		4469	

Note: Price adjusted to that of January 2012.

Source: Estimation from VHLSS 2010 and 2012.

Table A.2. Probit regression of dependent variable “households surveyed in September”

Explanatory variables	Sampe of the 2010 VHLSS	Sampe of the 2012 VHLSS	Sampe of the 2010 and 2012 VHLSSs
Ethnic minorities (ethnic minorities=1, Kinh=0)	0.201	-0.098	-0.054
	(0.149)	(0.096)	(0.072)
Household size	0.025	0.016	0.006
	(0.026)	(0.019)	(0.014)
Number of children below 15 years	-0.291*	-0.078	-0.144*
	(0.172)	(0.116)	(0.087)
Number of those over 60 years	0.225	0.074	0.030
	(0.139)	(0.090)	(0.072)
Completed school grades of household head	0.018*	0.000	0.005
	(0.010)	(0.007)	(0.006)
Log of per capita living area	-0.045	0.035	-0.063*
	(0.067)	(0.050)	(0.036)
Urban areas (urban=1, rural=0)	0.248**	-0.015	0.032
	(0.119)	(0.081)	(0.061)
Constant	1.117***	-0.157	0.550***
	(0.271)	(0.204)	(0.149)
Observations	3,205	4,469	7,674
Pseudo R ²	0.0129	0.0011	0.0012

Robust standard errors in parentheses. Standard errors are corrected for sampling weight and cluster correlation.

*** p<0.01, ** p<0.05, * p<0.1

Source: Estimation from VHLSS 2010 and 2012.

Table A.3. Probit regression of dependent variable “households surveyed in December”

Explanatory variables	Sampe of the 2010 VHLSS	Sampe of the 2012 VHLSS	Sampe of the 2010 and 2012 VHLSSs
Ethnic minorities (ethnic minorities=1, Kinh=0)	0.132 (0.152)	-0.089 (0.095)	-0.098 (0.074)
Household size	0.006 (0.027)	0.004 (0.019)	-0.010 (0.015)
Number of children below 15 years	-0.214 (0.173)	-0.076 (0.112)	-0.086 (0.087)
Number of those over 60 years	0.250* (0.140)	0.114 (0.090)	0.048 (0.072)
Completed school grades of household head	0.016 (0.010)	0.007 (0.007)	0.007 (0.006)
Log of per capita living area	-0.069 (0.068)	-0.066 (0.048)	-0.117*** (0.037)
Urban areas (urban=1, rural=0)	0.264** (0.119)	-0.029 (0.082)	0.032 (0.063)
Constant	1.263*** (0.272)	0.131 (0.198)	0.747*** (0.153)
Observations	3,287	4,471	7,758
R-squared	0.0121	0.0015	0.0026

Robust standard errors in parentheses. Standard errors are corrected for sampling weight and cluster correlation.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Source: Estimation from VHLSS 2010 and 2012.

Table A.4. Effect of the Tariff Increase on June Electricity Consumption: Regressions Without Control Variables

Explanatory variables	Dependent variable is “per capita monthly kWh”			Dependent variable is “per capita monthly spending on electricity”		
	Model 1: OLS	Model 2: Tobit	Model 3: OLS (Log)	Model 1: OLS	Model 2: Tobit	Model 3: OLS (Log)
	(1)	(2)	(3)	(4)	(5)	(6)
Surveyed in September * dummy year 2012	0.80 (2.80)	0.66 (2.35)	0.0209 (0.0818)	2.78 (4.56)	2.24 (3.70)	0.0357 (0.0957)
Surveyed in September (1 for September, 0 for June)	3.74* (2.22)	3.11* (1.84)	0.0939 (0.0707)	3.15 (3.70)	2.51 (2.96)	0.0761 (0.0853)
Dummy year 2012 (1 for 2012, 0 for 2010)	5.11** (2.19)	4.31** (1.83)	0.1789** (0.0697)	16.27*** (3.77)	13.00*** (2.96)	0.5532*** (0.0824)
Constant	28.27*** (1.98)		2.9899*** (0.0659)	29.20*** (3.44)		2.8844*** (0.0793)
Observations	7,674	7,674	7,674	7,674	7,674	7,674
R-squared	0.006		0.010	0.029		0.075

Note: The marginal effect is reported for the Tobit model.

The price is adjusted to that of January 2012.

Robust standard errors in parentheses. Standard errors are corrected for sampling weight and cluster correlation.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Source: Estimation from VHLSS 2010 and 2012.

Table A.5. Effect of the Tariff Increase on December Electricity Consumption: Regressions Without Control Variables

Explanatory variables	Dependent variable is “per capita monthly kWh”			Dependent variable is “per capita monthly spending on electricity”		
	Model 1: OLS	Model 2: Tobit	Model 3: OLS (Log)	Model 1: OLS	Model 2: Tobit	Model 3: OLS (Log)
	(1)	(2)	(3)	(4)	(5)	(6)
Surveyed in September * dummy year 2012	-2.62 (2.64)	-2.16 (2.19)	-0.0566 (0.0794)	-1.47 (4.41)	-1.04 (3.29)	-0.0252 (0.0929)
Surveyed in September (1 for September, 0 for June)	3.53 (2.19)	2.94 (1.82)	0.0872 (0.0702)	1.81 (3.77)	1.34 (2.81)	0.0409 (0.0847)
Dummy year 2012 (1 for 2012, 0 for 2010)	5.11** (2.19)	4.32** (1.83)	0.1789** (0.0697)	16.27*** (3.77)	12.15*** (2.86)	0.5532*** (0.0824)
Constant	28.27*** (1.98)		2.9899*** (0.0659)	29.20*** (3.44)		2.8844*** (0.0793)
Observations	7,758	7,758	7,758	7,758	7,758	7,758
R-squared	0.002		0.005	0.015		0.072

Note: The marginal effect is reported for the Tobit model.

The price is adjusted to that of January 2012.

Robust standard errors in parentheses. Standard errors are corrected for sampling weight and cluster correlation.

*** p<0.01, ** p<0.05, * p<0.1

Source: Estimation from VHLSS 2010 and 2012.

Table A.6. Effect of the Tariff Increase on June Electricity Consumption: Regressions With Additional Control Variables

Explanatory variables	Dependent variable is “per capita monthly kWh”			Dependent variable is “per capita monthly spending on electricity”		
	Model 1: OLS	Model 2: Tobit	Model 3: OLS (Log)	Model 1: OLS	Model 2: Tobit	Model 3: OLS (Log)
	(1)	(2)	(3)	(4)	(5)	(6)
Surveyed in September * dummy year 2012	1.14 (1.83)	1.02 (1.69)	0.0354 (0.0474)	3.08 (3.07)	2.73 (2.75)	0.0520 (0.0494)
Surveyed in September (1 for September, 0 for June)	1.66 (1.50)	1.51 (1.36)	0.0263 (0.0422)	0.48 (2.61)	0.42 (2.32)	0.0015 (0.0442)
Dummy year 2012 (1 for 2012, 0 for 2010)	-4.18*** (1.56)	-3.75*** (1.41)	-0.0376 (0.0428)	2.87 (2.79)	2.61 (2.49)	0.3153*** (0.0443)
Ethnic minorities (ethnic minorities=1, Kinh=0)	2.03** (0.97)	1.78** (0.88)	-0.2371*** (0.0325)	3.74*** (1.22)	3.20*** (1.07)	-0.2258*** (0.0291)
Household size	-3.13*** (0.36)	-2.83*** (0.35)	-0.1068*** (0.0059)	-3.62*** (0.51)	-3.19*** (0.45)	-0.1046*** (0.0059)
Number of children below 15 years	3.26* (1.79)	2.97* (1.61)	-0.0178 (0.0398)	4.38* (2.40)	3.89* (2.11)	-0.0547 (0.0394)
Number of members over 60 years	2.26 (1.59)	1.99 (1.45)	0.0448 (0.0304)	0.53 (2.04)	0.39 (1.82)	0.0143 (0.0308)
Completed school grades of household head	0.09 (0.09)	0.09 (0.08)	0.0074*** (0.0024)	0.02 (0.14)	0.03 (0.12)	0.0088*** (0.0025)
Log of per capita living area	6.72*** (1.05)	6.11*** (0.90)	0.1383*** (0.0175)	8.38*** (1.40)	7.42*** (1.21)	0.1241*** (0.0176)
Per capita income	9.01*** (1.91)	8.17*** (1.60)	0.1934*** (0.0151)	13.65*** (2.30)	12.08*** (1.85)	0.2477*** (0.0150)
Urban areas (urban=1, rural=0)	7.97*** (1.11)	7.31*** (1.07)	0.2175*** (0.0207)	12.27*** (1.46)	11.02*** (1.32)	0.2720*** (0.0218)
Electric appliance variables	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-74.52*** (19.88)		0.5082*** (0.1512)	-121.98*** (23.22)		-0.1715 (0.1476)
Observations	7,674	7,674	7,674	7,674	7,674	7,674
R-squared	0.467		0.617	0.509		0.692

Note: Electric appliance variables include dummy variables indicating the ownership of fridge, washing machine, electric fan, water heater, electric cooker, air conditioner, television, stereo player, computer, water pump.

The marginal effect is reported for the Tobit model.

The price is adjusted to that of January 2012.

Robust standard errors in parentheses. Standard errors are corrected for sampling weight and cluster correlation.

*** p<0.01, ** p<0.05, * p<0.1

Source: Estimation from VHLSS 2010 and 2012.

Table A.7. Effect of the Tariff Increase on December Electricity Consumption: Regressions With Additional Control Variables

Explanatory variables	Dependent variable is “per capita monthly kWh”			Dependent variable is “per capita monthly spending on electricity”		
	Model 1: OLS	Model 2: Tobit	Model 3: OLS (Log)	Model 1: OLS	Model 2: Tobit	Model 3: OLS (Log)
	(1)	(2)	(3)	(4)	(5)	(6)
Surveyed in September * dummy year 2012	-1.85 (1.75)	-1.65 (1.58)	-0.0203 (0.0465)	-0.21 (3.07)	-0.12 (2.42)	0.0217 (0.0479)
Surveyed in September (1 for September, 0 for June)	1.18 (1.47)	1.07 (1.33)	0.0052 (0.0421)	-1.63 (2.68)	-1.27 (2.17)	-0.0580 (0.0441)
Dummy year 2012 (1 for 2012, 0 for 2010)	-2.76* (1.44)	-2.45* (1.31)	-0.0286 (0.0426)	5.11* (2.65)	4.09* (2.14)	0.3262*** (0.0442)
Ethnic minorities (ethnic minorities=1, Kinh=0)	3.62*** (1.09)	3.32*** (1.00)	-0.1286*** (0.0303)	5.29*** (1.93)	4.24*** (1.30)	-0.1595*** (0.0287)
Household size	-3.48*** (0.29)	-3.13*** (0.25)	-0.1153*** (0.0061)	-3.65*** (0.56)	-2.83*** (0.64)	-0.1141*** (0.0061)
Number of children below 15 years	3.26* (1.88)	2.96* (1.68)	-0.0206 (0.0373)	-0.33 (2.29)	-0.28 (1.79)	-0.0713* (0.0382)
Number of members over 60 years	3.08* (1.61)	2.76* (1.45)	0.0548* (0.0316)	1.97 (1.93)	1.43 (1.52)	0.0306 (0.0307)
Completed school grades of household head	0.15* (0.09)	0.14* (0.08)	0.0048* (0.0025)	0.21 (0.16)	0.17 (0.13)	0.0055** (0.0025)
Log of per capita living area	6.77*** (0.99)	6.13*** (0.87)	0.1384*** (0.0166)	7.34*** (1.38)	5.78*** (1.13)	0.1067*** (0.0162)
Per capita income	7.97*** (0.85)	7.19*** (0.76)	0.2091*** (0.0159)	10.48*** (1.21)	8.19*** (0.87)	0.2430*** (0.0158)
Urban areas (urban=1, rural=0)	6.18*** (0.95)	5.61*** (0.88)	0.1795*** (0.0210)	9.80*** (1.22)	7.76*** (1.30)	0.2425*** (0.0216)
Electric appliance variables	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-67.72*** (8.10)		0.3109** (0.1451)	-88.15*** (9.96)		-0.0540 (0.1472)
Observations	7,758	7,758	7,758	7,758	7,758	7,758
R-squared	0.430		0.600	0.282		0.682

Note: Electric appliance variables include dummy variables indicating the ownership of fridge, washing machine, electric fan, water heater, electric cooker, air conditioner, television, stereo player, computer, water pump.

The marginal effect is reported for the Tobit model.

The price is adjusted to that of January 2012.

Robust standard errors in parentheses. Standard errors are corrected for sampling weight and cluster correlation.

*** p<0.01, ** p<0.05, * p<0.1

Source: Estimation from VHLSS 2010 and 2012.

Table A.8. Effect of the Tariff Increase on Electricity Consumption of the Poor Households in December

Explanatory variables	Dependent variable is “per capita monthly kWh”			Dependent variable is “per capita monthly spending on electricity”		
	Model 1: OLS	Model 2: Tobit	Model 3: OLS (Log)	Model 1: OLS	Model 2: Tobit	Model 3: OLS (Log)
	(1)	(2)	(3)	(4)	(5)	(6)
Surveyed in September * dummy year 2012	-1.74 (1.28)	-1.54 (1.14)	-0.1774 (0.1193)	-0.06 (1.36)	0.01 (1.24)	-0.0662 (0.1119)
Surveyed in September (1 for September, 0 for June)	1.28 (1.11)	1.12 (0.99)	0.1308 (0.1068)	-0.53 (0.94)	-0.56 (0.86)	-0.0052 (0.0958)
Dummy year 2012 (1 for 2012, 0 for 2010)	1.85* (1.11)	1.67* (1.01)	0.2284** (0.1071)	5.75*** (1.04)	5.13*** (0.94)	0.5560*** (0.0975)
Ethnic minorities (ethnic minorities=1, Kinh=0)	-4.44*** (0.50)	-4.05*** (0.44)	-0.4988*** (0.0504)	-5.42*** (0.52)	-4.90*** (0.45)	-0.5193*** (0.0405)
Household size	-0.46*** (0.15)	-0.41*** (0.14)	-0.0497*** (0.0142)	-0.51*** (0.20)	-0.46** (0.18)	-0.0494*** (0.0142)
Number of children below 15 years	-0.71 (1.21)	-0.65 (1.11)	-0.0310 (0.1333)	-1.95 (1.58)	-1.76 (1.44)	-0.1994* (0.1058)
Number of members over 60 years	0.27 (1.05)	0.17 (0.98)	-0.0655 (0.0980)	-1.07 (1.25)	-1.01 (1.16)	-0.1983** (0.0941)
Completed school grades of household head	0.23*** (0.08)	0.22*** (0.07)	0.0217*** (0.0056)	0.27*** (0.09)	0.25*** (0.08)	0.0219*** (0.0055)
Log of per capita living area	1.67*** (0.61)	1.53*** (0.55)	0.1408*** (0.0499)	0.44 (0.78)	0.37 (0.72)	0.1031** (0.0499)
Urban areas (urban=1, rural=0)	5.86*** (1.48)	5.56*** (1.35)	0.3504*** (0.0731)	7.16*** (1.48)	6.78*** (1.41)	0.4488*** (0.0708)
Constant	8.26*** (2.23)		1.9984*** (0.1994)	11.08*** (2.92)		2.0245*** (0.1964)
Observations	1,291	1,291	1,291	1,291	1,291	1,291
R-squared	0.161		0.217	0.239		0.326

Note: The marginal effect is reported for the Tobit model.

The price is adjusted to that of January 2012.

Robust standard errors in parentheses. Standard errors are corrected for sampling weight and cluster correlation.

*** p<0.01, ** p<0.05, * p<0.1

Source: Estimation from VHLSS 2010 and 2012.