

**Effect of Price Changes on Electricity Conservation:
An Empirical Study**

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Keywords: *Price Elasticity; Electricity Conservation; Electricity Price*

Introduction

Electricity generation in Sri Lanka mainly depends on coal with 12 %, hydro power with 57 % and oil with 27 % (CEB, 2013) contributions. Accordingly 39 % of Sri Lanka's electricity is generated using imported resources such as coal and oil. This dependence on imported resources to generate electricity is likely to go up in the future with the increasing use of coal in power generation. Thus electricity conservation is so vital to Sri Lanka to reduce this dependence as well as to save foreign exchange that will be spent on importing those resources. At the global scale electricity conservation is a part of broader energy conservation. Given the declining trends in non-renewable fossil fuel resources such as coal and oil, energy conservation has drawn attention of many countries.

Energy conservation is considered as a reduction in the energy consumption from the existing level. However, every year what we observe is an increase in the overall energy consumption and electricity is no exception. The governments can use various policy tools for energy conservation such as, implementation of awareness programs, raising prices...etc. In this study we examine whether the price can be effectively used to achieve electricity conservation objectives. Electricity prices in Sri Lanka are determined by the Public Utilities Commission of Sri Lanka (PUCSL). The Sri Lankan government has

reduced electricity prices in 2014 by 25 %. However, this price reduction in electricity that is considered in this study has done with the aim of easing the burden on consumers and not for conservation. We empirically investigate the response of the consumers to this price change using primary as well as secondary data.

Objective

The main objective of this study is to examine the consumer response to the price change in electricity. We also examine whether similar change will help in achieving energy conservation objectives.

Methodology

This research uses primary data collected covering 100 households. Households were selected representing all provinces in Sri Lanka. Within each provincial cluster we used convenient sampling strategy. Number of households sampled from each province is proportional to the provincial population. The data were gathered using a questionnaire and also we collected electricity bills of two months (before and after the last electricity price change that occurred on 19th of September 2014).

Two multiple regression models were estimated using OLS method. Both models were estimated with the objective of investigating the effect of price change on electricity conservation (a reduction in electricity consumption). Thus the first model examines the difference in the electricity consumption after the price change. The second model considers the provincial variation in energy consumption. Both models consider log of monthly electricity consumption (number of units). Independent variables are household average price (monthly bill amount divided by the monthly number of electricity units consumed), number of people employed in the household as a fraction of number of family members in the household, monthly household income, location of household (urban or rural, dummy variable), dummy variable to

identify the two periods (before and after the price change) and 9 provincial dummies to identify provincial variation.

Model 1:

$$\log Q_i = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \alpha D_1 + \alpha D_2 + \alpha D_3 + \alpha D_4 + \alpha D_5 + U_i$$

where, $\log Q_i$ = log value of monthly number of electricity units consumed
 $\log X_1$ = log value of average household price
 $\log X_2$ = log of number of people employed as a fraction of total number of family members in the household.

$D_1 \rightarrow D_4$ are four dummy variables that identifies household income groups

$D_1 = 1$ if monthly income less than Rs.5000, Otherwise 0

$D_2 = 1$ if monthly income is between Rs.5000-10000, Otherwise 0

$D_3 = 1$ if monthly income is between Rs.10000-30000, Otherwise 0

$D_4 = 1$ if household belong to rural area, Otherwise 0

$D_5 = 1$ Before price change, Otherwise 0

u_i = Random error term

Model 2:

$$\log Q_i = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \alpha_1 D_1 + \alpha_2 D_2 + \alpha_3 D_3 + \alpha_4 D_4 + \alpha_5 D_5 + \gamma_1 P_1 + \gamma_2 P_2 + \gamma_3 P_3 + \gamma_4 P_4 + \gamma_5 P_5 + \gamma_6 P_6 + \gamma_7 P_7 + \gamma_8 P_8 + U_i$$

where, $P_1 - P_8$ are eight provincial dummies were added to Model 1 to identify provincial variation in electricity consumption. The other province is used as the base province.

Results and Discussion

Table 1 presents the OLS output of model 1 which was estimated to examine whether the price change has a significant effect on the electricity consumption. The key variable is the dummy variable that identifies the time period after the price change.

Table 1: Regression result: Electricity consumption

Variable	Coefficient	T-value	P value
Constant	3.4201***	22.28	0.000
lnaX ₁	.3320***	5.43	0.000
lnaX ₂	.2932 **	1.90	0.058
Less 5000	-.7590***	-5.11	0.000
5000-10000	-.3843**	3.48	0.001
10000-30000	-.1800**	-2.38	0.018
Rural	-.2400 **	-3.44	0.001
Time period dummy	.0860	1.36	0.176
R-squared	0.5890		
F-stat	16.74		

Dependent Variable: Log of monthly electricity consumption

According to results, Model 1 can be accepted in 1 % significant level (F test result) and coefficient of determination is 0.58 which explains that 58 % of the variation in electricity consumption can be explained by explanatory variables in the model. Average price and dummy variable for income less than Rs.5000 are significant at 1% significance level. The dummy variable for monthly income level between Rs.5000 -10000 and the variable that represents rural households are significant at 5% (monthly income more than Rs.30,000 was omitted from the income groups) while other variables appear to be insignificant at 10 % level significance.

The estimated coefficient for number of people work in a household as a fraction of the number of people in the household is 0.29 which means that 1% increased of the percentage employed in the household will increase the electricity consumption by 29 %. However, this relationship is not significance within the estimated model. The model uses three dummy variables for income groups. Compared to the omitted group which is monthly income is greater than Rs. 30000, all other three income groups have significantly lower electricity consumption.

The dummy variable that identifies rural and urban difference indicates that in rural areas electricity consumption is significantly lower than urban areas. The dummy variable used to identify the difference in consumption between the time periods due to price change in electricity is not significant indicating that there is no significant difference in electricity consumption between the two time periods due to price change. The price reduction made by the government by 25% can increase purchasing power of consumers which has not resulted in changing the electricity consumption. Within the consumer budget the increased real income of consumers due to reduction in electricity price may have increased their spending on other goods and services. This raises a question whether the electricity conservation targets can be achieved by price changes.

Table 2: Regression result- Model 1

Variable	Coefficient	T-value	P value
Constant	3.597***	21.26	0.000
lnaX ₁	0.292***	4.66	0.000
lnaX ₂	0.210	1.37	0.172
less5000	-0.587***	-3.86	0.000
5000-10000	-0.364**	-3.35	0.001
10000-30000	-0.171*	-2.31	0.022
Rural	-0.218**	-3.05	0.003
Reform Dummy	0.0839	1.38	0.168
North	0.224	1.29	0.197
North Central	-0.119	-0.78	0.438
North West	-0.377**	-2.97	0.003
Eastern	-0.467	-2.62	0.010
Central	-0.030	-0.25	0.804
Western	-0.023	-0.22	0.827
Uva	-0.319	-2.14	0.033
Sabaragamuwa	-0.201	-1.58	0.116
R-squared	0.6247	F-stat	10.23

***1% significant level **5% significant level *10% significant level

To analyze the impact of provincial differences in electricity consumption the above model has extended including eight dummy variables (one province was omitted) representing every province in Sri Lanka while keeping southern province as the omitted one.

The estimated slope coefficient for the extended regression model with their associated t and probability values are given in Table 02. The estimated dummy variables to represent provinces are insignificant except the dummy variables used for north west province which is significant at 10 % level of significance. Further, it appears to be insignificant the price change variable indicating that 25 % price reduction has not made a significant effect in consumption. However coefficient of determination for this model has increased to 62 % which indicates model 2 is a better fit compared to model 1.

Conclusion

This study concludes that a 25 % reduction in electricity price has not resulted a significant change in the electricity consumption in Sri Lanka. It seems that the consumers continued their consumption pattern (number of units) unchanged regardless of the price change. Additional savings derived within their budget, due to reduction in price may have spent on other goods and services. Several questions arises from this study. First, can we use price as a conservation policy tool? What will be the response of consumers if the government raises price, say by 25% with the objective of electricity conservation? It is more likely that the consumers will respond to an increase in price than a decrease with a significant reduction in consumption. However, this needs further research to confirm such an outcome. Further, this study focused only about households which are basically a consumption unit. It would be interesting to examine how industry will respond to such a price change.

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