

# КОМП'ЮТЕРНЕ МОДЕЛЮВАННЯ В ХІМІЇ ТА ТЕХНОЛОГІЯХ І СИСТЕМАХ СТАЛОГО РОЗВИТКУ

## ECONOMETRIC MODELING FOR EVALUATION OF RELATION BETWEEN ACCESS TO ELECTRICITY AND QUALITY OF LIFE IN COLOMBIA

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**Abstract:** *This paper analyzes the effect of energization on income, education, health and agricultural productivity in the dispersed rural areas of Colombia. For this, the results of the 3rd National Agriculture Census 2014 conducted by the National Administrative Department of Statistics (DANE, for its acronym in Spanish) were used. The sample size of the cross section of the CNA is 1122 municipalities, which includes the Archipelago of San Andrés and Providencia and 20 non-municipalized areas.*

**Keywords:** *Dispersed Rural Areas, Squares Least in three stages (3SLS), Energization, Quality of life*

### Introduction

The task of providing education, access to information, sanitation, medical care, food, shelter and minimum incomes become more difficult without more economic, abundant and reliable energy. A society that has access to electricity creates conditions to alleviate poverty, increase social protection and raise its standard of living. Recently there has been an interest in the field of electrification and its effect on the quality of life. Empirical evidence has demonstrated the relationship of effect and causality between energizing and improving quality of life. Recent research on the subject exposes the risks to health, the damages in the education and the challenges of the productivity of those societies that suffer energy poverty.

### Formulation of the problem

In Colombia, there are two types of zones: Interconnected Zones and NonInterconnected Zones. According to the Colombian Electric Information System, the latter comprise around 52% of the national territory include 17 departments, 5 departmental capitals, 54 municipal head offices and 1,262 localities. The highest percentage of electrification of the NIZ is found in the departmental and municipal headwaters, which generally have diesel generators and, in some cases, with small hydroelectric plants. Some studies have been carried out to measure the effect generated by the energization in the national territory. However, most of these have been focused on technical and economic assessment, but they do not evaluate the subsequent changes generated when the projects

start-up, and do not take into account quantitative methods to analyze social, economic and environmental variables.

### Research analysis

This work analyzed the effect of electrification on income, education, health, and employment productivity in the dispersed rural areas of Colombia. The cross-sectional data for the test were obtained from the Colombian National Agriculture Census, which were conducted by the National Administrative Department of Statistics and the Energy Mining Planning Unit of Colombia. Furthermore, an econometric model was used to represent the endogenous behavior of the problem, i.e. a simultaneous equations model of three stages with least squares (3SLS).

To solve the problem, a simultaneous system of regression equations was obtained:

$$\text{Income} = \beta_0 + \beta_1 \text{electricity} + \beta_2 \text{education} + \beta_3 \text{agricultural productivity} \\ + \beta_4 \text{health} + \bar{Y}_1 \bar{X}_1 + \varepsilon_1$$

$$\text{Health} = \delta_0 + \delta_1 \text{electricity} + \bar{Y}_2 \bar{X}_2 + \varepsilon_2$$

$$\text{Agricultural productivity} = \phi_0 + \phi_1 \text{electricity} + \bar{Y}_3 \bar{X}_3 + \varepsilon_3$$

$$\text{Education} = \mu_0 + \mu_1 \text{electricity} + \bar{Y}_4 \bar{X}_4 + \varepsilon_4$$

$$\text{Electricity} = \rho_0 + \rho_1 \text{income} + \bar{Y}_5 \bar{X}_5 + \varepsilon_5$$

The regression results showed the access to electricity like a positive impact in the case of study. This effect was observed directly through the intermediate effects of the levels of education, health and agricultural productivity. The highly significant magnitude of the effect of electricity on the quality of life of the population is an important and powerful argument for including energy policies in national development plans.

### Conclusions

The intuitive explanation of the impact generated by the energization is the improvement in the levels of health, education, productivity and income. It is understandable that an increase in education will lead to an increase in income, but it is also true that a greater amount of income allows a household to seek better educational conditions. Due to these bidirectional causalities, the estimation of the relationships required an econometric model that takes into account the problems of endogeneity: model of simultaneous equations of three stages with least squares (3SLS).

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Table 1. 3SLS Simultaneous estimation of the effect of electricity on households

	<b>Municipal Added Value (log)</b>	<b>People without health affiliation</b>	<b>Harvested area</b>	<b>Students absenteeism (5-16 years old)</b>	<b>Electricity coverage Index</b>
<b>Electricity Coverage Index</b>	0.019 (0.100) <sup>1</sup>	-0.094 (0.003) <sup>3</sup>	0.582 (0.000) <sup>3</sup>	-0.094 (0.000) <sup>3</sup>	
<b>Students absenteeism between 5-16 years old</b>	-0.329 (0.000) <sup>3</sup>				
<b>Harvested area</b>	0.012 (0.082) <sup>1</sup>				
<b>People without health affiliation</b>	0.455 (0.000) <sup>3</sup>				
<b>Municipal Added Value (log)</b>					3.716 (0.001) <sup>3</sup>
<b>Illiterate people</b>		0.158 (0.000) <sup>3</sup>	-0.060 (0.472)	0.167 (0.000) <sup>3</sup>	-0.532 (0.000) <sup>3</sup>
<b>Own productive units</b>	0.007 (0.144)	-0.005(0.320)	0.072 (0.008) <sup>3</sup>	0.021 (0.048)	0.033 (0.372)
<b>Houses with sewer service</b>		0.017 (0.066) <sup>1</sup>			
<b>Housing with aqueduct service</b>		0.009 (0.286)			
<b>People affiliated to the subsidized health system</b>		-0.070 (0.000) <sup>3</sup>			
<b>Agricultural productive units with presence of livestock</b>			-0.236 (0.000) <sup>3</sup>		
<b>_cons</b>	7.59 (0.000)	15.025 (0.000)	-28.057 (0.000)	24.728 (0.000)	72.948 (0.000)
<b>No. of Obs.</b>	1122	1122	1122	1122	1122
<b>P-value</b>	0.000	0.000	0.000	0.000	0.000

<sup>1</sup> P < 0.10

<sup>2</sup> P < 0.05

<sup>3</sup> P > 0.01

P value parenthesis

The research found that a household connected to electricity has a significant and significant effect on health, education and agricultural productivity. Likewise, a positive and significant effect of electricity on income was determined. The highly significant magnitude of the effect of electricity on the quality of life of the population is then an important and powerful argument for including energy policies in the development talks.