Influence of social indicators in the consumption of domestic electricity for urban marginal areas of Guayaquil.

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Abstract– The current study examines the influence of social indicators on the consumption of electricity for eight urban marginal areas of the city if Guayaquil, by means of ordinary least square regression. For this purpose, domestic and electric indicators were obtained from the literature and after correlated with the natural log of average monthly electricity consumption. Results show that labor gives a negative coefficient, meaning that people work outside the home and that households with more women and elderly people consume more electricity.

Keywords—social indicators, urban marginal, ordinary least square regression.

I. INTRODUCTION

In Ecuador, almost 56% of the population live in urban-marginal (19.3%) and rural areas (37%), according to the census of population and housing carried out in 2010 by the National Institute of Statistics and Censuses (INEC). Urban marginal areas of the country are defined as those who were once settlements on the outskirts of the city in precarious conditions, but now, count with access to services in environmentally vulnerable areas. Studying electricity demand for these urban marginal sectors of the city of Guayaquil is structurally and circumstantially important for planning and managing electricity production in Ecuador, as these sectors continue improving their social status and in consequence, increasing their electricity needs. Therefore, they constitute and important target group for research, since households are responsible of a great share of electricity demand for a country and represent a considerable amount of greenhouse emissions. In this context, getting better understanding of the underlying social indicators and finding the link between them and consumption patterns, will permit to draw more reliable implications for future considerations and the design and implementation of effective reducing policies [1].

For this purpose, in previous studies, the determinants of electricity demand for a small portion of population from one urban marginal area of the city were obtained [2]. Factors such as household size, income per capita, utility per capita, ratio of educated people per household and working people per household were correlated with electricity demand, using Tobit regression. After, a much bigger sample of 1,184 houses was obtained from eight different urban marginal areas and later, correlations of sociodemographic variables, household characteristics and behavioral patterns showed a combined explanation of variability of 10% [3].

In this paper we use the same principle of correlation with regressions, but with bigger sample from the eight areas of the city. Another difference for this study, is the development of individual models for each area, contrary to the previous one [3] were just one general model was developed combining the data of all eight. To be able to run different models was possible after augmenting the sample survey results for each area. This time, validated data from 1,903 households was available (increment of 37.78%). The objectives of this research are to determine the following:

Assessing the social stratification of the eight areas,

Calculating the average amount of electricity consumed in each area.

Finding out the correlation of the electricity consumption and social indicators.

Results from this study will provide inputs to the ministry of electricity and renewable energy in their decision making towards effective and sustainable domestic consumption of electricity

This paper is divided in (2) literature review, where we present all state-of-the-art information on social indicators, (3) methodology shows the study area and general information of each area and finally, the regression model for the social indicators, and finally (4) results section, where we present the calculations and results.

II. LITERATURE REVIEW

Usually macroeconomic variables, such as gross domestic product (GDP) and population growth are used to project the electricity consumption for a country [4] [5] [6]. However, macroeconomic analysis may be too wide to explain consumption behavior [7] given that socioeconomic conditions in such areas differ greatly in urban marginal areas.

Several studies have been conducted on correlating certain social indicators with electricity consumption. Some of them focus on micro-level energy consumption using domestic survey data. Differences in household size, income level, labor access, education, number of children and elderly, number of female, electrical appliances own by the family and how many of them are high and medium power demand and finally the

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amount of 110 and 220 volts power plugs availability are likely to affect domestic decisions on electricity consumption.

According to Shulte [8], household size and composition shows that there are considerable economies of scale in residential energy use. Larger households tend to use energy services more effectively compared to smaller ones, and households with low income or low expenditure budget will further increase the likelihood of energy related deprivation. Sukarno [9], pointed out that households' lifestyles and energy consumption are closely related and, that lifestyle is influenced by income level, family patterns and other factors. Ery [10], showed that in Bandung, family size, time spent at home, education level, home appliances and lighting had a significant, positive effect on the monthly electricity bill. Niu [11] used household income, price of electricity, all kinds of electrical appliances, purchase price of main appliances, and other variables to fully reflect behavior, preferences and living patterns of sample households in electricity use and provided the basis for analyzing the relationship between household electricity consumption and the quality of life. Anggun [12] and Xie [13] showed that family members' size is positive and give significant effect to household demand electricity consumption in Malang, Indonesia and Sichuan province, China respectively. Bedir [14], conducted a descriptive analysis on the variables related to ownership of appliances, their use, presence, and household and dwelling characteristics, and electricity consumption. Hasanov [15], investigated the impacts of the population age groups and affluence on the residential electricity consumption in Azerbaijan, and Jones [16], provided an analysis of the appliance ownership and use factors contributing to high electrical energy demand in UK homes.

III. METHODOLOGY

3.1 The study area

Guayaquil is the largest and most populated city in Ecuador with about 2.70 million people in the metropolitan area. Guayaquil is located on the western bank of the Guayas River and is the capital of the Ecuadorian province of Guayas.; the city is the nation's principal commercial and manufacturing centre and can be representative for the province of Guayas. Domestic access to electricity is high with a 97% coverage, according to the World Bank. Ecuador has invested heavily in hydroelectric power over the past decade, building on substantial potential due its high rainfall and mountainous geography, also petroleum production play an important role in the country [17].

3.2 Sample survey

The data examined for this paper was collected from 8 different urban marginal areas of the city of Guayaquil. An interview survey designed by the authors, asked householders about details of their domestic electricity consumption practices. Social indicators were broadly categorized into domestic indicators and electric indicators. The variables were chosen based on previous research (see Section 2) and limited by what was available in the data set. The sample size was N = 1,903 households distributed for the eight areas as shown in figure 1.

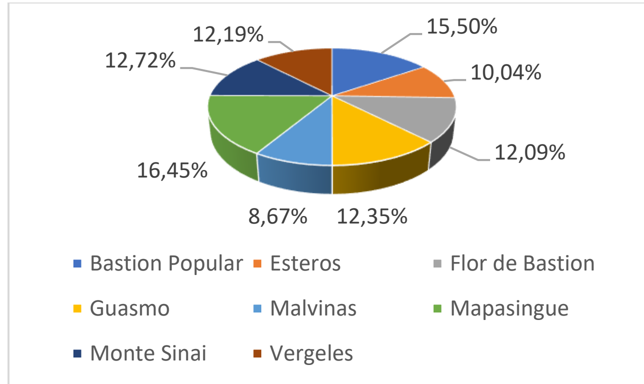

Fig. 1 Survey Distribution

Figure 2 summarizes the percentages distribution of social stratification among all eight urban marginal areas. As it can be seen, distribution is similar and first and second places shift between middle high socioeconomic group and middle socioeconomic group. The households in study area were stratified into five different socioeconomic groups based on a stratification questionnaire about income, owned electronic devices, types of jobs and others. This questionnaire measures the socioeconomic group on a scale from 0 to 1000.

- Low socio-economic group: threshold < 316 (LSEG)
- Middle low socioeconomic group: threshold between 316.1 - 535 (MLSEG)
- Middle socioeconomic group: threshold between 535.1 - 696 (MSEG)
- Upper middle socioeconomic group: threshold between 696.1 - 845 (MHSEG)
- High socioeconomic group: threshold between 845.1 – 1000 (HSEG)

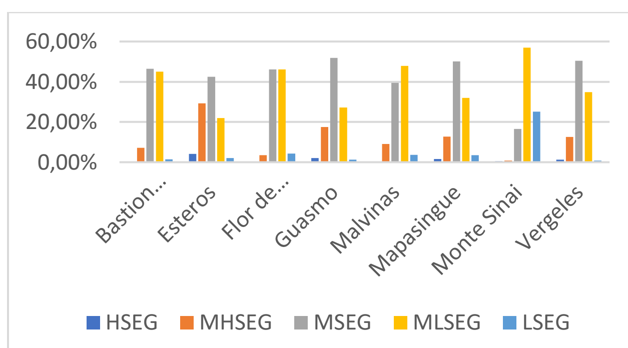

Fig. 2 Social stratification among urban marginal areas

3.3. Domestic indicators

Tables 1 to 8 summarize the domestic indicators and their frequencies used in subsequent analysis for all the eight urban marginal areas. Household size represent the number of inhabitants per each house, social status is the measure from 0 to 1,000 as shown in section 4.1, number of children and elderly represents how many people under eighteen and above sixty five years old live in each house, the ratio of mid-education stands for the total member of a household with at least high school level divided by household size and income per capita is the total income that the family as a group receive divided by the household size.

TABLE I
DOMESTIC INDICATORS – BASTION POPULAR

Variable (code)	Categories (N)
Household size (house_size)	n/a (continuous: M = 4.17, SD = 1.67)
Social status (soc_status)	n/a (continuous: M = 535.48, SD = 113.35)
Number of children (nbr_child)	n/a (continuous: M = 1.05, SD = 1.12)
Number of elderly (nbr_elderly)	n/a (continuous: M = 0.17, SD = 0.47)
Number of female (nbr_female)	n/a (continuous: M = 2.18, SD = 1.21)
Ratio of Mid Education (ratio_mid_ed)	n/a (continuous: M = 0.62, SD = 0.30)
Ratio of working people (ratio_labor)	n/a (continuous: M = 0.48, SD = 0.26)
Income per capita (ratio_income)	n/a (continuous: M = 142.20, SD = 113.63)

TABLE II
DOMESTIC INDICATORS – ESTEROS

Variable (code)	Categories (N)
Household size (house_size)	n/a (continuous: M = 3.59, SD = 1.54)
Social status (soc_status)	n/a (continuous: M = 631.97, SD = 138.39)
Number of children (nbr_child)	n/a (continuous: M = 0.92, SD = 1.13)
Number of elderly (nbr_elderly)	n/a (continuous: M = 0.34, SD = 0.68)
Number of female (nbr_female)	n/a (continuous: M = 1.79, SD = 1.06)
Ratio of Mid Education (ratio_mid_ed)	n/a (continuous: M = 0.79, SD = 0.25)
Ratio of working people (ratio_labor)	n/a (continuous: M = 0.49, SD = 0.28)
Income per capita (ratio_income)	n/a (continuous: M = 214.88, SD = 153.00)

TABLE III
DOMESTIC INDICATORS – FLOR DE BASTION

Variable (code)	Categories (N)
Household size (house_size)	n/a (continuous: M = 3.98, SD = 1.54)
Social status (soc_status)	n/a (continuous: M = 516.22, SD = 111.24)
Number of children (nbr_child)	n/a (continuous: M = 1.15, SD = 1.13)
Number of elderly (nbr_elderly)	n/a (continuous: M = 0.11, SD = 0.37)
Number of female (nbr_female)	n/a (continuous: M = 1.79, SD = 0.97).
Ratio of Mid Education (ratio_mid_ed)	n/a (continuous: M = 0.56, SD = 0.29)
Ratio of working people (ratio_labor)	n/a (continuous: M = 0.47, SD = 0.26)
Income per capita (ratio_income)	n/a (continuous: M = 148.33, SD = 113.95)

TABLE IV
DOMESTIC INDICATORS – GUASMO

Variable (code)	Categories (N)
Household size (house_size)	n/a (continuous: M = 3.94, SD = 1.77)
Social status (soc_status)	n/a (continuous: M = 591.23, SD = 120.67)
Number of children (nbr_child)	n/a (continuous: M = 1.15, SD = 1.19)
Number of elderly (nbr_elderly)	n/a (continuous: M = 0.15, SD = 0.42)
Number of female (nbr_female)	n/a (continuous: M = 2.07, SD = 1.12)
Ratio of Mid Education (ratio_mid_ed)	n/a (continuous: M = 0.73, SD = 0.29)
Ratio of working people (ratio_labor)	n/a (continuous: M = 0.46, SD = 0.27)
Income per capita (ratio_income)	n/a (continuous: M = 177.15, SD = 194.24)

TABLE V
DOMESTIC INDICATORS – MALVINAS

Variable (code)	Categories (N)
Household size (house_size)	n/a (continuous: M = 3.98, SD = 1.55)
Social status (soc_status)	n/a (continuous: M = 550.95, SD = 123.35)

Number of children (nbr_child)	n/a (continuous: M = 1.11, SD = 1.09)
Number of elderly (nbr_elderly)	n/a (continuous: M = 0.23, SD = 0.50)
Number of female (nbr_female)	n/a (continuous: M = 2.01, SD = 1.11)
Ratio of Mid Education (ratio_mid_ed)	n/a (continuous: M = 0.69, SD = 0.27)
Ratio of working people (ratio_labor)	n/a (continuous: M = 0.45 SD = 0.0.28)
Income per capita (ratio_income)	n/a (continuous: M = 144.57, SD = 118.36)

TABLE VI
DOMESTIC INDICATORS – MAPASINGUE

Variable (code)	Categories (N)
Household size (house_size)	n/a (continuous: M = 3.59, SD = 1.68)
Social status (soc_status)	n/a (continuous: M = 571.46, SD = 130.72)
Number of children (nbr_child)	n/a (continuous: M = 0.77, SD = 0.99)
Number of elderly (nbr_elderly)	n/a (continuous: M = 0.31, SD = 0.60)
Number of female (nbr_female)	n/a (continuous: M = 1.80, SD = 1.10)
Ratio of Mid Education (ratio_mid_ed)	n/a (continuous: M = 0.66, SD = 0.32)
Ratio of working people (ratio_labor)	n/a (continuous: M = 0.49, SD = 0.29)
Income per capita (ratio_income)	n/a (continuous: M = 191.08, SD = 148.60)

TABLE VII
DOMESTIC INDICATORS – MONTE SINAI

Variable (code)	Categories (N)
Household size (house_size)	n/a (continuous: M = 3.87, SD = 1.81)
Social status (soc_status)	n/a (continuous: M = 407.36, SD = 131.57)
Number of children (nbr_child)	n/a (continuous: M = 1.62, SD = 1.45)
Number of elderly (nbr_elderly)	n/a (continuous: M = 0.06, SD = 0.25)
Number of female (nbr_female)	n/a (continuous: M = 1.92, SD = 1.26)
Ratio of Mid Education (ratio_mid_ed)	n/a (continuous: M = 0.47, SD = 0.0.32)
Ratio of working people (ratio_labor)	n/a (continuous: M = 0.38, SD = 0.26)
Income per capita (ratio_income)	n/a (continuous: M = 100.87, SD = 84.34)

TABLE VIII
DOMESTIC INDICATORS – VERGELES

Variable (code)	Categories (N)
Household size (house_size)	n/a (continuous: M = 3.88, SD = 1.46)
Social status (soc_status)	n/a (continuous: M = 57.37, SD = 117.71)
Number of children (nbr_child)	n/a (continuous: M = 1.15, SD = 1.12)
Number of elderly (nbr_elderly)	n/a (continuous: M = 0.14, SD = 0.42)
Number of female (nbr_female)	n/a (continuous: M = 1.89, SD = 1.02)
Ratio of Mid Education (ratio_mid_ed)	n/a (continuous: M = 0.62, SD = 0.29)
Ratio of working people (ratio_labor)	n/a (continuous: M = 0.46, SD = 0.28)
Income per capita (ratio_income)	n/a (continuous: M = 143.61, SD = 117.03)

3.4. Electric indicators

Tables 9 to 16 summarize the electrical indicators variables and their frequencies used in subsequent analysis. The electrical appliances were divided into three groups:

- High demand appliances considered for the study were: fridge, induction kitchen, electric kitchen, electric oven, washing machine, air conditioner, water pump.
- Medium demand appliances considered for the study were: vacuum cleaner, electric grill, electric shower, hot water tank, iron, computer, DVD player, stereo, sewing machine, blender, microwave oven.
- Low demand appliances considered for the study were: portable audio & video devices, colour TV, video camera, fans, rice cooker.

TABLE IX
ELECTRIC INDICATORS – BASTION POPULAR

Variable (code)	Categories (N)
Number of electrical appliances (nbr_elec_appliances)	n/a (continuous: M = 9.20, SD = 3.77)
Number of high power appliances (nbr_highpower_appliances)	n/a (continuous: M = 2.09, SD = 1.10)
Number of medium power appliances (nbr_medpower_appliances)	n/a (continuous: M = 5.17, SD = 2.17)
Number of 110 Volts plugs (nbr_110_pl)	n/a (continuous: M = 5.89, SD = 3.31)

Number of 220 Volts plugs (nbr_220_pl)	n/a (continuous: M = 0.37, SD = 0.75)

For purpose of this study, only high and medium power number of electrical appliances are considered, as well as the total number. Also, number of 110 and 220 Volts are being considered for the regression analysis, since they represent the potential for use of electricity per household.

TABLE X
ELECTRIC INDICATORS – ESTEROS

Variable (code)	Categories (N)
Number of electrical appliances (nbr_elec_appliances)	n/a (continuous: M = 12.28, SD = 5.37)
Number of high power appliances (nbr_highpower_appliances)	n/a (continuous: M = 3.41, SD = 1.70)
Number of medium power appliances (nbr_medpower_appliances)	n/a (continuous: M = 7.11, SD = 3.59)
Number of 110 Volts plugs (nbr_110_pl)	n/a (continuous: M = 6.56, SD = 4.03)
Number of 220 Volts plugs (nbr_220_pl)	n/a (continuous: M = 0.83, SD = 1.33)

TABLE XI
ELECTRIC INDICATORS – FLOR DE BASTION

Variable (code)	Categories (N)
Number of electrical appliances (nbr_elec_appliances)	n/a (continuous: M = 9.25, SD = 3.87)
Number of high power appliances (nbr_highpower_appliances)	n/a (continuous: M = 2.80, SD = 1.26)
Number of medium power appliances (nbr_medpower_appliances)	n/a (continuous: M = 5.23, SD = 2.43)
Number of 110 Volts plugs (nbr_110_pl)	n/a (continuous: M = 4.80, SD = 2.50)
Number of 220 Volts plugs (nbr_220_pl)	n/a (continuous: M = 0.20, SD = 0.79)

TABLE XII
ELECTRIC INDICATORS – GUASMO

Variable (code)	Categories (N)
Number of electrical appliances (nbr_elec_appliances)	n/a (continuous: M = 10.81, SD = 4.26)
Number of high power appliances (nbr_highpower_appliances)	n/a (continuous: M = 3.01, SD = 1.55)
Number of medium power appliances (nbr_medpower_appliances)	n/a (continuous: M = 6.22, SD = 2.60)
Number of 110 Volts plugs (nbr_110_pl)	n/a (continuous: M = 5.75, SD = 3.99)
Number of 220 Volts plugs (nbr_220_pl)	n/a (continuous: M = 0.93, SD = 1.47)

TABLE XIII
ELECTRIC INDICATORS – MALVINAS

Variable (code)	Categories (N)
Number of electrical appliances (nbr_elec_appliances)	n/a (continuous: M = 8.36, SD = 3.64)
Number of high power appliances (nbr_highpower_appliances)	n/a (continuous: M = 1.72, SD = 1.26)
Number of medium power appliances (nbr_medpower_appliances)	n/a (continuous: M = 5.35, SD = 2.29)
Number of 110 Volts plugs (nbr_110_pl)	n/a (continuous: M = 6.76, SD = 3.21)
Number of 220 Volts plugs (nbr_220_pl)	n/a (continuous: M = 0.33, SD = 0.71)

TABLE XIV
ELECTRIC INDICATORS – MAPASINGUE

Variable (code)	Categories (N)
Number of electrical appliances (nbr_elec_appliances)	n/a (continuous: M = 10.30, SD = 4.57)
Number of high power appliances (nbr_highpower_appliances)	n/a (continuous: M = 2.92, SD = 1.22)
Number of medium power appliances (nbr_medpower_appliances)	n/a (continuous: M = 5.92, SD = 3.04)
Number of 110 Volts plugs (nbr_110_pl)	n/a (continuous: M = 6.26, SD = 3.53)
Number of 220 Volts plugs (nbr_220_pl)	n/a (continuous: M = 0.57, SD = 01.20)

TABLE XV
ELECTRIC INDICATORS – MONTE SINAI

Variable (code)	Categories (N)
Number of electrical appliances (nbr_elec_appliances)	n/a (continuous: M = 7.41, SD = 3.54)
Number of high power appliances (nbr_highpower_appliances)	n/a (continuous: M = 2.56, SD = 1.38)
Number of medium power appliances (nbr_medpower_appliances)	n/a (continuous: M = 3.88, SD = 2.12)
Number of 110 Volts plugs (nbr_110_pl)	n/a (continuous: M = 3.71, SD = 2.14)
Number of 220 Volts plugs (nbr_220_pl)	n/a (continuous: M = 0.40, SD = 1.23)

3.5 Dependent variable: Natural Average Monthly Electric Consumption.

The dependent variable used was the natural logarithm of the average monthly electric consumption taken in kWh. This value reflected the average kWh from 6 to 24 months of each households. Electric bills are available online on the website of the ministry of electricity and renewable energies (MEER) for the last 24 months. Some households recorded the entire period, others less because they were recently connected to the grill.

TABLE XVI
ELECTRIC INDICATORS – VERGELES

Variable (code)	Categories (N)
Number of electrical appliances (nbr_elec_appliances)	n/a (continuous: M = 9.47, SD = 3.60)
Number of high power appliances (nbr_highpower_appliances)	n/a (continuous: M = 2.76, SD = 1.21)
Number of medium power appliances (nbr_medpower_appliances)	n/a (continuous: M = 5.24, SD = 2.26)
Number of 110 Volts plugs (nbr_110_pl)	n/a (continuous: M = 5.49, SD = 2.45)
Number of 220 Volts plugs (nbr_220_pl)	n/a (continuous: M = 0.64, SD = 1.26)

The dependent variable was log-transformed (natural log) to achieve greater symmetry of the distribution of the residuals in the regression analysis. Table 17 shows the mean and standard variations values of the eight neighbourhoods. In regression models where the dependent variable has been log-transformed and the predictors have not, the format for interpretation is that dependent variable changes by 100 ⁄ (coefficient) percent on average for a one unit increase in the independent variable while all other variables in the model are held constant.

TABLE XVII
AVERAGE MONTHLY ELECTRICITY CONSUMPTION

Neighbourhood	Value (kWh)
BASTION POPULAR	M = 221.09, SD = 141.56
ESTEROS	M = 271.12, SD = 201.79
FLOR DE BASTION	M = 229.54, SD = 264.18
GUASMO	M = 237.57, SD = 151.48
MALVINAS	M = 191.40, SD = 134.67
MAPASINGUE	M = 221.78, SD = 167.22
MONTE SINAI	M = 154.92, SD = 109.87
VERGELES	M = 213.47, SD = 137.11

Total average monthly electricity consumption of all eight urban marginal areas is 217.61 kWh.

3.6 Regression Analysis

To analyze the effect of selected social indicators to the natural log of average kWh consumption of electricity, this study follows a multiple regression model. The Ordinary Least Square (OLS) method was used to estimate the parameters in multiple regression models as did by [18]. The model developed was:

$$Y = \beta_0 + \sum_{i=1}^{n} \beta_i$$

Where:
Y: Natural Log kWh Monthly Average;
Xi: Independent Variables;
β_0: Constant term;
β_i: Coefficient of independent variables;

As said earlier, two models will be developed following OLS regression per area: one for the domestic indicators and another for the electric indicators. The independent variables for the domestic indicators model are household size, social status, number of children, number of elderlies, number of females, ratio of mid-education, ratio of working people and income per capita. Additionally, the independent variables for the electric model are number of electrical appliances, number of high-power appliances, number of medium power appliances, number of 110 Volts plugs and number of 220 Volts plugs.

IV. RESULTS

A total of 1,903 households from eight urban marginal areas of the city of Guayaquil were selected randomly for the study: Bastion Popular (2295), Esteros (191), Flor de Bastion (230), Guasmo (235), Malvinas (165), Mapasingue (313), Vergeles (232) and Monte Sinai (242).

4.1 Domestic Indicators Model

Table 18 summarizes the domestic indicators model after OLS regression. Labour ratio coefficients are negative for 6 of the areas, meaning that with more people working less consumption of electricity. We can also assume that in six areas, people work outside the household, whilst at Esteros and Guasmo, artisan jobs occur. For the number of female and elderly in each household, out of eight areas, six have positive coefficients meaning that with higher number of female and elderly, the consumption of electricity will increase. This can be explained additionally because of the tendency of women and older people at these areas to remain at home.

As shown in previous studies, higher mid-education ratio will consume more electricity. This can tell us that for the city the education degree level doesn´t help the consumption reduction.

4.2 Domestic Indicators Model

Table 19 summarizes the electric indicators model after OLS regression. As can be seen, mostly positive coefficients are obtained for all the indicators. This means that an increment in any of them variables, will produce an increase in the consumption of electricity.

TABLE XVIII

REGRESSION MODEL – DOMESTIC INDICATORS

Variable	Bastion Popular	Esteros	Flor de Bastion	Guasmo	Malvinas	Mapasingue	Monte Sinai	Vergeles
Intercept	4.888e+00 (18.641)***	1.887e+00 (14.289)***	1.7506447 (12.416)***	2.217e+00 (20.358)***	2.230e+00 (15.516)***	1.9231687 (15.432)***	1.878e+00 (17.546)***	2.0096327 (15.741)***
house_size	1.143e-01 (2.333)*	-5.123e-03 (-0.182)	0.0202515 (0.783)	1.847e-02 (1.057)	-1.250e-02 (-0.417)	0.0003722 (0.017)	4.675e-02 (2.134)*	-0.0284142 (-1.200)
soc_status	-4.054e-05 (-0.091)	2.718e-04 (1.352)	0.0004877 (1.994)*	-1.417e-05 (-0.082)	4.450e-04 (1.750)	0.0002303 (1.240)	8.051e-05 (0.417)	0.0005635 (3.044)**
nbr_child	-1.124e-01 (-2.003)*	3.652e-02 (1.178)	-0.0187771 (-0.599)	1.801e-02 (0.811)	-2.382e-02 (-0.691)	-0.0144021 (-0.458)	-4.355e-03 (-0.174)	0.0350004 (1.249)
nbr_elderly	1.399e-01 (1.386)*	4.082e-02 (1.125)	0.0152728 (0.215)	-5.676e-02 (-1.276)	-1.459e-01 (-2.645)**	0.0188983 (0.476)	2.401e-02 (0.255)	0.0402218 (0.801)
nbr_female	2.760e-02 (0.467)	1.648e-02 (0.522)	0.0040429 (0.129)	-1.985e-02 (-0.881)	1.284e-02 (0.373)	0.0312201 (1.066)	-6.718e-03 (-0.267)	0.0425604 (1.678)
ratio_mid_ed	1.987e-01 (1.143)	1.645e-01 (1.472)	0.1401200 (1.551)	1.268e-02 (0.174)	-2.533e-01 (-2.285)*	0.1220749 (1.558)	5.267e-02 (0.709)	-0.0655298 (-0.857)
ratio_labor	-5.193e-01 (-2.541)*	1.700e-01 (1.918).	-0.0759534 (-0.704)	1.040e-01 (1.372)	-7.482e-02 (-0.683)	-0.0198171 (-0.241)	-7.647e-02 (-0.707)	-0.0048964 (-0.055)
ratio_income	-2.311e-05 (-0.049)	1.797e-05 (0.106)	0.0005878 (2.441)*	-5.900e-05 (-0.556)	-7.908e-05 (-0.286)	0.0001720 (0.969)	7.393e-05 (0.218)	-0.0004664 (-2.182)*

t-student in parentheses.

Significance: 0 "***"; 0,001 "**"; 0,01 "*"; 0,05 "."; 0,1 " "

TABLE XIX

REGRESSION MODEL – ELECTRIC INDICATORS

Variable	Bastion Popular	Esteros	Flor de Bastion	Guasmo	Malvinas	Mapasingue	Monte Sinai	Vergeles
Intercept	5.027657 (37.301)***	2.172290 (22.664)***	2.08141 (12.392)***	2.300176 (45.915)***	1.86875 (5.385)***	2.01099 (30.261)***	1.912376 (30.178)***	2.261447 (31.886)***
nbr_elec_appliances	0.004220 (0.107)	0.022885 (1.096)	-0.03041 (-1.229)	0.00214 (0.124)	-0.01008 (-0.337)	0.02269 (1.101)	-0.006965 (-0.259)	-0.021725 (-1.056)
nbr_highpower_appliances	0.075058 (1.225)	-0.003927 (-0.143)	0.10278 (3.139)**	0.012231 (0.518)	0.03427 (0.861)	0.03109 (1.143)	0.044129 (1.422)	-0.011097 (-0.367)
nbr_medpower_appliances	-0.007549 (-0.137)	-0.021961 (-0858)	0.02305 (0.731)	-0.001776 (-0.081)	0.02579 (0.693)	-0.02925 (-1.089)	0.018257 (0.516)	0.034718 (1.330)
nbr_110_pl	0.002018 (0.134)	0.018000 (0.181)	0.40714 (2.043)*	-0.006967 (-1.383)	0.35886 (1.005)	0.00553 (0.847)	0.006751 (0.590)	0.004499 (0.488)
nbr_220_pl	-0.052857 (-0.812)	0.036020 (1.919)	0.36133 (4.642)***	-0.010854 (-0.864)	-0.02595 (-0.278)	0.02561 (1.357)	0.016856 (0.798)	0.011218 (0.653)

t-student in parentheses.

Significance: 0 "***"; 0,001 "**"; 0,01 "*"; 0,05 "."; 0,1 " "

V. CONCLUSIONS

This study aimed to analyse the influence of social indicators in the electricity consumption of eight urban marginal areas of the city of Guayaquil. Overall, this research proves that people from these areas do not have real awareness of their level of consumption and that the level of education affects negatively. Government projects should aim at providing training for the inhabitants of the sectors in energy efficiency and security. Also, policies to stimulate basic education in such urban marginal areas that are likely to reduce the consumption of electricity should be set in motion.

Future investigations could try to include time in the regression to obtain a projection of future consumption and debate different development scenarios for these areas and how that would affect the electricity demand in the near future.

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