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WHAT DRIVES HOUSEHOLD ELECTRICITY-SAVING INTENSITY? EVIDENCE FROM A DEVELOPING-COUNTRY

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Abstract

This research fundamental inquiry pertains to the factors that motivate households to conserve electricity in household sector. Electricity saving intensity is considered important for the formulation of an effective energy policy. In this study, quantitative methods were used. Data were collected from 515 households through systematic random sampling; 497 valid responses were collected. Data were analysed using IBM SPSS 25, and Stata 18 applying ordered probit analysis. The key findings are that demographic variables (age, gender, education, family size, income, and number of income earners) are significant predictors of the intensity of savings behavior. The other contribution of this study is to empirically measure the intensity of electricity-saving behavior (ESI) of households in Quetta by using an ordered probit model. The analysis reveals that demographic and socio-economic characteristics such as age, gender, education, household size, income, and number of income earners significantly determine the likelihood of consistent electricity-saving behavior. For example, higher education and older age enhance the saving intensity, while large household size and high income reduce saving behavior. These findings contribute to the behavioral economics literature by showing that electricity saving is not only a response to price changes, but is also influenced by social and demographic factors. This awareness is an important component for designing targeted behavioral interventions and public awareness campaigns for specific population groups in Quetta and other urban localities.

1. Introduction

The key construct of this study is the "intensity of electricity-saving behavior", which is defined as the degree, frequency, and commitment with which a household engages in actions to reduce electricity consumption. In this study, intensity is operationalized as a measurable variable, based on the self-reported frequency of undertaking a range of pre-identified saving behavior. In contrast, some studies show young people are more likely to adopt energy conservation practices. They are more likely to cut down on their energy usage, motivated by environmental concerns, to mitigate climate change and safeguard local ecosystems (Sperling, 2017). Furthermore, gender is an important determinant influencing attitudes toward energy saving. The correlation is affected by different

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views. Others argue that women are more inclined to save energy as they are more conscious and sensitive (Du & Pan, 2022; Rainisio et al., 2022). In contrast, another point of view states that men are more aware of environmental issues than women because they are more socially connected generally (Nakano et al., 2018). Education is an important factor in the formation of attitudes and behaviors in relation to saving energy. The education level of individuals is one of the important factors affecting participation in conservation practices and willingness to buy eco-friendly products for energy saving in various developed countries (Du & Pan, 2022; Long et al., 2023; Nakano et al., 2018). Higher educational levels are generally correlated with more environmental awareness and sustainable behaviors; however, some studies show that the relationship is not always simple (Jaffar et al., 2024; Jaffar & Latiff, 2024; Jia et al., 2018). The findings demonstrate the complexity of the relationship between education and behavioral change regarding energy saving.

Education may be a strong predictor of energy saving, but the mechanisms driving this association are complex. The effect of education on energy saving is suggested to be indirect; that is, more targeted information is needed to influence preferences for sustainable habits effectively (Jia et al., 2018). Other perspectives, however, propose that education is essential for increasing awareness of energy-efficient choices and the associated benefits in everyday life (Chen & Gou, 2022; Du & Pan, 2022). The duality in the research implies a complex role of education in energy saving. The need for targeted information and awareness-raising potential both play an important role in shaping energy-saving behaviors.

Household size is the most important demographic factor in household energy saving (Ivanova & Büchs, 2020; Lévay et al., 2021). This is consistent with research that finds that, controlling for other variables, larger household size is associated with lower per capita energy use and emissions, reflecting the reduced per capita energy use and emissions resulting from the efficient sharing of resources within the household. This sharing dynamic is not only limited to energy but also materials, living space, and opportunities for conservation (Lévay et al., 2021). Identifying social trends, such as the continuing shrinkage of household size, is critical to developing effective policies to combat global warming. On average, larger households use less energy per person due to shared living space and shared resources (Ivanova & Büchs, 2020). However, there is a clear gap in our knowledge, namely that no longitudinal studies have been conducted to investigate the question of whether the global decline in household size may increase carbon footprints and require further mitigation efforts in the future. Other research is looking at whether the global trend toward smaller household sizes is resulting in larger carbon footprints, adding to the pressure on future mitigation efforts. It seems that the size of the household is an important factor affecting energy saving in the household sector, as reported in studies such as that of Alrahili (2017), Kolog et al., 2023, and Lévay et al., (2021).

2. Literature Review

Household Electricity-Saving got core interest in the united nation developmental goal (UN, 2021). The "intensity of electricity-saving behavior" is an important construct in this study and it refers to the extent to which, frequency and effort a household engages in actions specifically targeted to reducing its electricity consumption. In this research, intensity is operationalized as a measurable variable based on the self-reported frequency of engagement in a range of pre-identified saving behavior and

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provides a nuanced classification of households from low to high electricity savings. However, the intensity of saving behavior, although very important, still has a big gap in the literature of developing countries contexts (Jan et al., 2023; Jiao et al., 2022; Nguyen et al., 2025). Prior research has examined adoption of specific technologies or intentions to save rather than a continuum of behavioral engagement (Chen & Gou, 2022; Fu et al., 2021; Wang et al., 2021). This research fills this void by explicitly considering the measurement and explanation of electricity saving intensity as a major objective. This study addresses a major shortcoming of previous, narrower approaches, by studying the role of economic and behavioral factors not only in the presence of saving behavior but also in the magnitude of saving behavior.

Household electricity saving behavior is focused with socio-economic and demographic variables in the latest literature. Complex relationships between energy-efficiency measures and age of households have been investigated. Repeated cross-national research has found an interesting trend: older people tend to save more energy than younger people (Corbos et al., 2023). An interesting exception to this pattern, however, can be found in a study of Japanese households by Yagita and Iwafune (2021). They contradict the popular view that older Japanese are less likely to save energy. The Japanese study is thought to have this difference because of a number of factors, including spending more time at home and having more electronic devices. In contrast, some studies suggest that the youth show greater willingness to adopt energy-saving behavior. They are more motivated by environmental concerns to avoid energy use as a precaution against climate change and the preservation of local ecosystems (Sperling, 2017). In contrast, literature indicates that the age-saving relationship may vary across settings, and it may reflect different savings motivations. Among many others, gender is an important factor in energy saving. The relationship between gender and energy saving is viewed differently. Another view is that women are more sensitive and tend to save energy, as pointed out in studies like Du and Pan (2022) and Rainisio et al. (2022). In contrast, Nakano et al. (2018) have suggested that men are more socially connected and, therefore, more environmentally aware. These divergent views illustrate the need to consider gender in the specific social and economic context of the households being studied.

Household size is a key demographic factor in household energy saving (e.g., Ivanova & Büchs, 2020; Lévay et al., 2021). Studies show that larger household size is associated with lower per capita energy use and emissions, controlling for other variables, because of efficient sharing of resources within the household. This sharing dynamic is not only about energy but also about materials, living space, and conservation opportunities (Lévay et al., 2021). Understanding social trends, including the trend toward smaller households, is important to developing effective policies to address global warming. The bigger the household, the lower the energy use per capita, as the living space and the resources are shared (Ivanova & Büchs, 2020). However, there is a distinct gap in our knowledge, as there are no longitudinal studies examining the question of whether the global trend of decreasing household sizes may increase carbon footprints and require further mitigation efforts in the future. Work also explores whether the global trend toward smaller household sizes is leading to larger carbon footprints and therefore putting pressure on future mitigation efforts. Studies such as Alrahili (2017) indicate that household size is a significant factor affecting energy saving in the household sector. This in-depth examination of household dynamics underscores the intricate link between

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household size and energy saving and calls for a more integrated approach to policy development and international efforts to tackle climate change.

Economic research suggests that income is an important factor in influencing people's energy-saving decisions (Naeem et al., 2022). The relationship between income and energy-related behavior is complex, especially when considering lower-income households. This demographic is generally conservative and resides in the poor stratum of society (Lenzen et al., 2006). There are some studies that examine the complex relationship between income or socioeconomic status and energy-saving behavior. The wealthy also tend to adopt the newest energy-efficient technologies, demonstrating a proclivity for environmentally friendly approaches (Brick et al., 2023; Kumar et al., 2022). However, this wealth may reduce their vulnerability to price incentives to change their daily energy-saving habits. For example, measures like a carbon tax may result in lower price sensitivity of rich people to electricity tariffs (Kumar et al., 2022). Besides, the composition of household income earners also seems to be another important factor for electricity saving. The explanatory variables are demographic and economic factors that are assumed to impact the intensity of electricity saving. Variables include respondent age, respondent gender, level of education, household size, household income level, and total number of household members contributing to household income.

3. Methodology

3.1 Research Design and Population

The population of the study site consists of all households in A and B areas of the district of Quetta, Pakistan. In this study, A is the city centre, and B is the surrounding area of the city centre. The present study is an attempt to collect data from households in Quetta, Pakistan. The study is conducted in the A and B areas of the district, with a total of 218662 houses. The present study was restricted to the households of Quetta district, Pakistan. Due to the large size of the study target population, the assessments required representative sample surveys, as noted by Malhotra et al. (2017), Ong et al. (2023), and Sekaran and Bougie (2016). The data for this study were collected using the technique of systematic random sampling, which is a credible probability sampling method in research methodology (Azeem et al., 2023). In this study, the systematic sampling technique was adopted to get an even and fair representation of the whole population of households in District Quetta. This method was selected because it is efficient, minimizes selection bias, and is widely recognized as a reliable method for large population-based studies in social sciences (Sekaran & Bougie, 2016; Malhotra et al., 2017). The sample frame consisted of all the 218,662 households of District Quetta (A areas: city centre locations and B areas: surrounding suburban and rural localities). These households formed the total target population and were selected to provide a mix of neighbourhood types and socio-economic backgrounds. The minimum sample size was determined by applying the Cochran (1977) formula and it was 385 households, which is the minimum number required to ensure statistical representativeness. However, the target was 515 households in an effort to improve reliability and to allow for non-responses. The data collection yielded 497 valid responses, which equals 96.5% of the target sample and is adequate population coverage. To ensure representative distribution of the sample, the sampling interval (k) was calculated by dividing the total population by the desired sample size. The interval was something like 425. The target was 515 households, and there were 218,662 of them. A sample of every 425th household was therefore taken from a list of

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218662 households. The first step was to get a random starting point from a random number table, so as to eliminate the initial selection bias. The first number was 238, the first household selected was 238, then 663, then 1088, then 1513 and so on until the sample was complete.

3.2 Measurement of electricity saving intensity

Electricity saving intensity was measure using Likert scale survey data on how often respondents engaged in activities to save electricity. The dependent variable Y_i, which is the electricity saving intensity of each household was estimated using survey data responses of five levels from least saving to most saving i.e., category 1 Seldom (infrequent in saving electricity), category 2 Occasionally (saves electricity only in certain situations), category 3 Sometimes (moderate in saving electricity), category 4 Often (frequent in saving electricity) and category 5 Always (consistent and active in saving electricity). This sequence is a logical range of conservation effort. Never always means a little effort Always means a strong and steady effort to conserve electricity. The ordering of this scale is important because it allows the model to see how the demographic and socioeconomic characteristics influence the likelihood of households having higher conservation behavior.

The explanatory variables (X_i) are demographic and economic variables that are assumed to affect the intensity of electricity saving. Variables: Age, Sex, Educational level, Family size, Family income level, Number of income earners. Age is a continuous variable indicating the age of the respondent in years. Gender is categorical (1 = Male, 0 = Female). Education level is ordinal and has categories from no formal education to tertiary education. Household size is a continuous variable and is the total number of persons in the household. Household income level is ordinal. It is classified from low to high income level. Number of income earners: Number of income earners is a continuous variable representing the total number of household members that earn income.

3.3 Ordered Probit Estimation

The empirical model used in this analysis is an ordered response model. Based on model dependent variable nature study apply an ordered probit estimation technique. The dependent variable and independent variable of the estimation are provided in equation 1 below.

Equation 1 Ordered probit regression

$$Y_i^* = x_i'\beta + e_i$$

$$Y_i^* = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon_i$$

$e_i \sim (0,1)$, $i = 1,2,\ldots\ldots, N$

Where $E(e_i/x_i) = 0$ and $Var(e_i/x_i) = 1$. The observable variable, Y_i, is treated as an ordinal variable with J number of response categories and as a representation of the theoretical random variable, $Y_i^* = J$, and $\mu = \mu{-}1\ \mu_0\ \mu_1 \ldots \mu_J$ defined as a vector of unobservable threshold parameters, with the relation between the observable and the latent variable expressed as; $Y_i = J$ if $\mu_J - 1 < Y_i^* \leq \mu_J, J = 0, 1, 2, \ldots .., J$ Where $\mu{-}1 = -\infty$, $\mu 0 = 0$, $\mu J = \infty$ and $\mu{-}1 < \mu 0 < \mu 1 < \cdots\cdots\cdots < \mu_J$. The probability can be written as: $Prob[Y_i = J] = Prob[\mu j{-}1 < Y_i^* \leq \mu_J] = Prob[\mu_J{-}1 - x_i'\beta < e_i \leq \mu_J - x_i'\beta]$ which can be written as $\Phi(\mu_J - x_i'\beta) - \Phi(\mu_{J-1} - x_i'\beta)$. Where J is the categories of responses to electricity saving and $\Phi(\bullet)$ is the standard normal cumulative distribution function = $\frac{\partial Prob[Conservation\ J]}{\partial x_i}$ $[\varphi(\mu_{J-1} - x_i'\beta) - \varphi(\mu_J - x_i'\beta)]\ x\beta$, Where $\varphi(\bullet)$ is the standard normal density function.

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3.4 Goodness of Fit

To assess the model's fitness, the Pseudo R-Square, the standard fitness, the Pearson and deviance-based goodness of fit, and the test of parallel lines were used. The model fit report shows a Pseudo R-Square value of 0.2630. Model Information indicates a chi-square statistic from fitting a model of 430.591 with 9 degrees of freedom and a significance of 0.000. The Pearson Goodness-of-Fit statistic was 818.561 with 827 degrees of freedom ($p = 0.576$). Deviance = 703.094, df = 827.999. The Test of Parallel Lines gave a Chi-Square of 22.442 with 27 degrees of freedom and a significance of 0.715.

4. Results

The results are reported as marginal effects and predicted probabilities. The dependent variable "Electricity saving intensity" has five ordered scales, from seldom to always dependent on the independent variables. The variables are the respondent's age, the respondent's gender, the respondent's education level, the size of the respondent's household, the respondent's income level, and the number of income earners in the household. The ordered structure captures the change in electricity saving intensity from lower to higher, and it allows analysis of how demographic and socio-economic characteristics modify the probability of households belonging to each saving category.

To give an important summary of the demographic, socio-economic and behavioral characteristics of the surveyed households in Quetta, descriptive statistics of continuous and categorical variables are reported. The baseline context of the sample is presented in the tables above. It provides information on the age of respondents, size of household, number of income earners, gender distribution, educational attainment, income groups, and reported electricity saving intensity. Such information is valuable, as it speaks to the diversity of the sample, but also highlights structural and behavioral differences across households likely to influence electricity consumption and conservation practices. These descriptive patterns are provided by the analysis and set the basis for understanding the interaction between economic and demographic characteristics and electricity use and saving behavior. This is further investigated through econometric modelling in the subsequent sections of this study.

The mean age of respondents was 40.74 years, ranging widely (SD = 14.49) from 21 to 72 years. This diversity ensures that the study captures perspectives from both younger and older household members, which is important, especially for understanding differences between generations in the intensity of saving electricity. Average household size is 5.81 members, which indicates large family structures. This is common in Quetta, where extended families often live together. They vary in size from 2 to 13 members and show nuclear and extended household arrangements. Larger households are likely to have a higher demand for electricity, but may also find it hard to establish consistent energy-saving behaviors. The average number of income earners per household is 2.07, with a maximum of 5 and a minimum of 1. This means most households have two earners contributing to household income. This indicates a moderate level of economic participation. Having more than one earner in a household may also mean having higher disposable income, so they are less likely to save electricity than a single-earner household, which may be more sensitive to energy costs and thus more likely to save.

4.1 Marginal Effects of Demographic and Socioeconomic Factors

The marginal effects of the ordered probit model provide a more complex picture of the effect of

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the demographic and socioeconomic variables on the Electricity Saving Intensity (ESI) in the five ordered categories: Seldom, Occasionally, Sometimes, Often, and Always. The results provide a measure of the change in the probability of a household falling into each ESI category for each explanatory variable, holding other variables constant, and permit a more precise interpretation of effect sizes.

The marginal effects provided in table 1 below.

Table 1 Marginal effects

	Electricity Saving Intensity (ESI) Seldom	Electricity Saving Intensity (ESI) Occasionally	Electricity Saving Intensity (ESI) Sometimes	Electricity Saving Intensity (ESI) Often	Electricity Saving Intensity (ESI) Always
Age	-.0009**	-.0005**	-.0013**	.0000	.0027**
Gender					
Male	-.0255***	-.0157***	-.0366**	.0031	.0746***
Education					
Primary	-.1824***	-.1746***	.0803**	.1659***	.1108***
Secondary	-.2191***	-.2763***	-.0375	.2321***	.3009***
Tertiary	-.2244***	-.2980***	-.0901**	.2279***	.3847***
Household size	.0078**	.0048**	.0110**	-.0007	-.0229**
Household Income					
Average Income	-.0312***	-.0187***	-.0412***	.0007	.0904***
High Income	.0968 ***	.0692***	.0605***	-.0687**	-.1578***
Income Earners in Family	.0583 ***	.0364***	.0820***	-.0059	-.1708***

Note: *Significant at 10%, ** Significant at 5%, ***Significant at 1%

The results apprehended from marginal effect analysis provide key findings. Electricity-saving behavior is positively and significantly associated with age. An increase in age of one year increases the probability of being in the highest ESI category (Always) by 0.27 percentage points and decreases the probability of being in the lower categories of ESI (Seldom, Occasionally and Sometimes). This shows that older people tend to continue saving electricity, and young people tend to save irregularly or less. This corresponds to an increase of about 2.7 percentage points in the probability of regular savings of electricity for 10 years. This suggests altogether a small but significant age effect on household electricity saving behavior. ESI is also very much about gender. Males are 7.46 percentage points more likely than females to report that they "Always" save electricity, and their probabilities of being in the lower categories are significantly lower, especially Seldom and Occasionally, by 2.55 and 1.57 percentage points, respectively. The results indicate that men in the sample are more likely to engage in regular electricity-saving behaviors than women.

Among all predictors, education has one of the strongest effects. Compared with the household with no formal education, electricity-saving intensity has a dramatic shift with the electrification status and education attainment. For example, households with tertiary education are 38.5 percentage points more likely to be in

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the "Always" group, and 22.4 percentage points less likely to be in the "Seldom" group. The results from the data up to October 2023 indicate that higher levels of education are associated with a greater likelihood of consistent saving behavior and a lesser likelihood of seldom saving at the primary and secondary levels. The clear monotonic relationship shows the contribution of education to the awareness, understanding, and continuous application of energy-saving practices.

The intensity of saving electricity is negatively correlated with household size. The probability of being in the highest ESI category decreases by 2.29 percentage points with the addition of a household member. But it does increase the chances of being in lower and mid-level categories such as Seldom, Occasionally, and Sometimes. The trend indicates that large households have difficulty coordinating to save electricity on a consistent basis, or have high consumption patterns by default, which makes saving more difficult. The household income results imply a more complex relationship. Average-income households are 9.04 percentage points more likely to say "Always" save electricity and less likely to be in the lower categories than the low-income households, indicating stronger conservation behavior. But for high-income households, the pattern is reversed, with a 15.78 percentage point lower probability of "Always" saving and higher probabilities of being in the lower intensity categories, especially Seldom. Perhaps it's a sign of higher overall electricity use and a lower need or incentive to conserve among richer households.

The number of income earners in the household is also found to have a significant negative effect on ESI. A unit increase in the number of income earners reduces the probability of "Always" saving electricity by 17.08 percentage points and increases the probability of the Seldom, Occasionally, and Sometimes categories. Therefore, the more people in a household and the more disposable income there is, the less constrained energy use is. The marginal effects generally indicate a specific and significant effect of demographic and socioeconomic factors on electricity-saving behavior. A higher level of electricity-saving intensity is more strongly associated with older age, male, higher level of education, and average income group. Conversely, a higher household size, number of income earners, and household income decrease the probability of electricity-saving intensity.

4.2 Predicted probabilities

Table 2 provides a useful and clear insight into the predicted probabilities of the association of demographic and socio-economic factors and various levels of Electricity Saving Intensity (ESI), from Seldom (lowest level) to Always (highest level). These results are an extension of the ordered probit results, as we estimate the probability of the household being in each of the categories while controlling for other factors to present the impact of the change in age, gender, education, household size, household income, and number of income earners on electricity-saving.

Table 2 Predicted Probabilities

	Electricity Saving Intensity (ESI) Seldom	Electricity Saving Intensity (ESI) Occasionally	Electricity Saving Intensity (ESI) Sometimes	Electricity Saving Intensity (ESI) Often	Electricity Saving Intensity (ESI) Always

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Age_at					
1	.1151***	.1353***	.2948***	.2468***	.2077***
2	.0908***	.1178***	.2609***	.2544***	.2758***
3	.0697***	.1029***	.2267***	.2496***	.3508***
Gender_at					
1	.1191***	.1262***	.2772***	.2449***	.2323***
2	.0936***	.1105***	.2406***	.2480***	.3070***
Education_at					
1	.2322**	.3461***	.3296***	.0758***	.0160**
2	.0497***	.1714***	.4100***	.2418***	.1268***
3	.0130***	.0698***	.2921***	.3079***	.3170***
4	.0078***	.0480***	.2395***	.3037***	.4007***
Household size_at					
1	.0712***	.1101***	.2386***	.2504***	.3295***
2	.0934***	.1259***	.2714***	.2516***	.2574***
3	.1192***	.1441***	.3029***	.2409***	.1927***
Household Income_at					
1	.1144***	.1286***	.2721***	.2392***	.2454***
2	.0832***	.1099***	.2308***	.2400***	.3359***
3	.2113***	.1979***	.3326***	.1704***	.0875***
Income Earners in Family					
1	.0211**	.0759***	.2156***	.2514***	.4357***
2	.1289***	.1989***	.3646***	.2067***	.1007***
3	.3950***	.3153***	.2412***	.0420***	.0062

Note: *Significant at 10%, ** Significant at 5%, ***Significant at 1%

The results of predicted probabilities state key findings. The relationship between age and electricity-saving intensity clearly shows that the older people are, the more likely they continue saving electricity. The probability of being in the Always category is 0.208 for the youngest age group (Age_at = 1), 0.276 for the middle age (Age_at = 2) and 0.351 for the oldest group (Age_at = 3). The opposite pattern is observed for the probability of being in the Seldom category, which declines monotonically from 0.115 for the youngest to 0.070 for the oldest. The middle categories (Occasionally and Sometimes) also decline in probability with age. The probability of Often is relatively stable across age groups. The pattern suggests that the older households are more committed to the adoption of regular and sustained electricity-saving practices than the younger households, which results in a higher electricity-saving intensity.

There are also variations by sex, especially at the extreme ends of the scale of electricity saving intensity. The probability of being in the Always

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group is .232 for females (Gender_at = 1) and .307 for males (Gender_at = 2). The probabilities of being in the Seldom class are 0.119 for women and 0.094 for men. The results indicate that men are more likely to self-report the highest levels of saving electricity and less likely to self-report infrequent saving practices. The middle categories (Occasionally, Sometimes and Often) are relatively similar in probability across gender, suggesting that the gender differences are more pronounced at the extremes of the intensity scale.

Education is one of the most stable and powerful predictor gradients. Among respondents who have no formal education (Edu_at = 1), the probability of reporting Always saving electricity is only 0.016, while the probability of being in the Seldom category is as high as 0.232. With more education, these probabilities change dramatically. For primary education (Edu_at = 2), the probability of Always is raised to 0.127, and for secondary education (Edu_at = 3), it is raised to 0.317. For the education level of tertiary (Edu_at = 4), the probability of always saving electricity is 0.401. In contrast, for the tertiary group, the probability of being in the Seldom category is reduced significantly to 0.008.

The intensity of electricity saving is negatively associated with the size of the household. For small households of three members (HHsize_at = 1), the probability of being in the Always category is 0.330; for medium households (HHsize_at = 2), the probability of being in the Always category is 0.257; and for large households of nine members (HHsize_at = 3), the probability of being in the Always category is 0.193. Seldom category increases from 0.071 to 0.119 when moving from small to large households. Thus, larger household size also means a higher probability of being in the Sometimes category, while the Often category remains relatively stable. These results suggest that larger households are less likely to save electricity.

The predicted probabilities for household income show a more complex pattern. The households with an average income (Inc_at = 2) are more likely to have a consistent saving behavior, with a probability of 0.336 for the Always category and 0.083 for the Seldom category. For low-income households (Inc_at = 1), the pattern is more moderate (Always = 0.245 and Seldom = 0.114). However, households with high income (Inc_at = 3) are quite different. The probability of Always is only 0.088, while the probability of Seldom is much higher at 0.211. These households are also more likely to be in the Sometimes category (0.333) and less likely to be in the Often category (0.170). Average-income households are more active in regular electricity-saving activities. High-income households are less active in electricity-saving, perhaps because they have less economic necessity to do so or because they are more accustomed to a higher consumption lifestyle.

The number of people in a household who earn income is significantly and inversely related to the intensity of electricity saving. The probability of being in the Always category is very high (0.436) for single-earner households (IE_at=1), while the Seldom probability is only 0.021. With three earners (IE_at = 2), the probability of Always falls dramatically to 0.101; Seldom increases to 0.129. The probability of Always is close to zero (0.006) for households with five earners (IE_at=3), while Seldom rises dramatically to 0.395. The results indicate that with the increase in economic activities of the households with multiple earners, there is a significant decline in consistent electricity-saving practices. This can be attributed to the increase in disposable income, which results in increased energy use and less emphasis on electricity-saving.

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5. Discussion

This research has investigated household electricity saving intensity with socio-economic and demographic variables. The estimation results state that there were gender differences in electricity saving intensities, with male respondents indicating a higher probability of saving intensity. This finding is in agreement with Nakano et al. (2018), but not with Du and Pan (2022) and Rainisio et al. (2022), who claim that women are more energy-saving-minded in general because of their environmental consciousness. Increase in education level was found to have a positive impact on saving intensity, which is in line with Du & Pan (2022), Long et al. (2023), and Nakano et al. (2018), who highlighted the significance of education in increasing environmental awareness and pro-environmental behaviors. This finding highlights the role of educational institutions in nurturing electricity-saving values and sustainable behaviors. The marginal effects from the ordered probit model provide a better understanding of the effects of demographic and socio-economic factors on the Electricity Saving Intensity (ESI) in the five ordered categories of Seldom, Occasionally, Sometimes, Often, and Always. The results present estimates of the change in probability of a household falling into each ESI category for a change in each explanatory variable, holding constant all other factors, and allow for a more precise interpretation of effect sizes.

Age and electricity-saving behavior are consistently and statistically significantly associated. An increase in age by one year increases the probability of being in the highest ESI category (Always) by 0.27 percentage points and decreases the probability of being in the lower categories of ESI (Seldom, Occasionally, and Sometimes). Hence, the older the individual, the more likely he or she is to perform regular electricity-saving behavior, and the younger the individual, the more likely he or she is to perform irregular or infrequent saving. This is about 2.7 percentage points higher in the probability of saving electricity regularly. There is a 10-year difference, and this is a gradual but significant effect of age on household electricity-saving behavior. Gender is also an important factor in ESI. Males are 7.46 percentage points more likely to report "Always" saving electricity than females. Their probabilities of falling into the lower categories, especially Seldom and Occasionally, are significantly lower by 2.55 and 1.57 percentage points respectively. The results of this study suggest that the males in the sample were more homogenous than females in implementing electricity saving practices.

Education is one of the best predictors. For the electrification status and education attainment, the electricity saving intensity relative to the household with no formal education has a dramatic shift. For example, households with tertiary education are 38.5 percentage points more likely to belong to the "Always" group and 22.4 percentage points less likely to belong to the "Seldom" group. Higher levels of education (primary and secondary) increase the likelihood of regular saving and decrease the likelihood of infrequent saving. The evident monotonic relationship emphasizes the importance of educational campaigns to increase awareness, understanding and sustained use of energy-saving measures. The intensity of electricity saving is negatively correlated with household size. Adding a household member decreases the probability of being in the highest category of ESI by 2.29 percentage points. But it increases the likelihood of being in the lower and middle categories like Seldom, Occasionally and Sometimes. This pattern suggests that larger households have difficulties to coordinate electricity savings or they have higher consumption patterns making it difficult to save. Results for household income show a more

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complex relationship. Low-income households are 9.04 percentage points less likely than average-income households to report "Always" saving electricity, and are less likely to be in the lower categories than average-income households. This indicates a stronger conservation behavior. Conversely, for high-income households the opposite is true: the probability of "Always" saving is 15.78 percentage points lower, and the probabilities of lower intensity categories are higher, especially in Seldom. This could indicate greater overall electricity consumption and a reduced need or incentive to conserve among wealthier households. ESI is also significantly negatively affected by the number of income earners in a household. As the number of additional income earners increases, the probability of "Always" saving electricity decreases by 17.08 percentage points and the probability of Seldom, Occasionally and Sometimes increases. This implies that households with higher income, and perhaps higher disposable income, are less constrained in their use of energy. In general, the marginal effects show that demographic and socio-economic factors have different and significant impacts on electricity-saving behavior. Older age, male, higher level of education, and average income group are found to be more strongly associated with higher level of electricity-saving intensity. But larger household size, number of income earners, and high household income tend to reduce the probability of electricity-saving intensity.

6. Limitations and Recommendations for Future Research

Secondly, the study depends on self-reported data of households, which could be subject to social desirability bias. Participants' answers about their electricity consumption and their habits to conserve electricity may be influenced by what they perceive as socially acceptable or expected. We tried to minimize bias by using structured surveys and data validation techniques, but the intrinsic limitations of self-reported data should be considered when interpreting these findings.

7. Conclusion

This study was an empirical assessment of the intensity of electricity-saving behavior (ESI) among households of Quetta using an ordered probit model. The analysis indicates that demographic and socioeconomic characteristics such as age, gender, education, household size, income, and number of income earners significantly predict the likelihood of consistent electricity-saving behavior. Higher education and older age are related to higher saving intensity, whereas larger household size and high income are related to lower saving behavior. Overall, the marginal effects indicate that demographic and socioeconomic factors have a significant and differential influence on electricity-saving behavior. Older age, male gender, higher level of education, and the average income group are more associated with a higher level of electricity-saving intensity. A higher number of income earners and high household income reduce the probability of electricity-saving intensity compared to larger household size. The predicted probabilities provide a full picture of the impact of household characteristics on electricity saving behaviors. The saving intensity for electricity (Always category) is greater for higher average income, smaller household size, higher education, men and older age. Conversely, age groups, less educated households, larger families, high income groups and households with many income earners have higher probability of lower saving intensities (i.e. Seldom or Sometimes categories).

Overall, the magnitude of the electricity-saving behavior was also correlated with household

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characteristics. The frequency of electricity conservation was always higher in smaller households than in larger households. Thus, a large household size may hamper the implementation of coordinated energy-saving practices. Income also appeared to play a role in conservation behavior, with middle income households being more consistent in saving electricity, while higher income households were relatively less likely to engage in electricity conservation behavior on a regular basis. This could imply that more financially endowed households are under less economic pressure to limit their electricity consumption. Likewise, the number of income earners in a household was negatively associated with electricity-saving behavior. Households with fewer earners were more likely to save electricity than households with more earners, who were less likely to save electricity on a regular basis. The results suggest that age, education, household size, income level and number of income earners are important in shaping household electricity saving behavior. The findings suggest that the effectiveness of energy conservation programs could be enhanced by taking into account the socioeconomic and demographic diversity of households, instead of a one-size-fits-all approach to promote electricity conservation practices.

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