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Infrastructure and Objective Well-being in Cameroon

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ABSTRACT: This study assesses the impact of infrastructure on the objective well-being of households in Cameroon. Using data from the ECAM (2014) survey on a sample of 10,303 households, multicollinearity and heteroscedasticity tests were conducted, allowing for the application of Ordinary Least Squares (OLS) regression. The results show that infrastructure—such as road conditions, access to water, electricity, and public transportation—has a significant impact on household well-being. Income is also a key factor in explaining consumption expenditure. Education plays a positive role, while age and marital status have more moderate impacts, with negative effects observed for both older individuals and those who are married. As such, governments and policymakers should further strengthen investment in basic infrastructure and promote equal access to these services. Additionally, implementing long-term maintenance programs would be highly beneficial.

KEY WORDS: Infrastructure, Objective Well-being, ECAM (2014), Ordinary Least Squares
JEL CODE: O18, I31, H54

1. BACKGROUND AND RATIONALE OF THE STUDY

Cameroon, located in Central Africa, is a developing country with a population of approximately 27 million people. It is characterized by significant geographical diversity, with relatively developed urban areas and less accessible rural regions. The country faces numerous infrastructure challenges, particularly in the sectors of transportation, drinking water, electricity, and public transit. These infrastructures play a key role in the quality of life of citizens, especially in terms of economic and social well-being, which is often measured through household consumption expenditure.

Household consumption expenditures in Cameroon—similar to other developing countries—are a crucial indicator of material well-being. These expenditures reflect the quantity of goods and services consumed by households and are heavily influenced by factors such as income, access to infrastructure, cost of living, and public policies. According to the 2014 Cameroon Household Survey (ECAM), approximately 40–50% of total household spending was allocated to food, with higher proportions in rural areas compared to urban ones. Meanwhile, spending on housing, water, electricity, and transportation represented about 20–30% of total household expenses, with marked differences across regions. Households with higher incomes tended to spend more on categories such as leisure, education, and health, whereas lower-income households devoted a larger share of their resources to food and basic needs.

In terms of transportation infrastructure (road quality and public transport), Cameroon's road network is vital for regional integration, particularly for rural areas, which are often poorly served. According to the World Bank, around 50% of the country's roads are classified as being in poor condition. This has a negative impact on the mobility of goods and people, which can limit access to markets, social services, and economic opportunities. In rural regions, poor road conditions lead to higher transportation costs, directly affecting household purchasing power and, therefore, consumption expenditure.

Public transportation, on the other hand, is insufficient in many parts of the country, especially in peripheral and rural areas. Travel can be costly and time-consuming, reducing both the time and resources available for productive activities and ultimately impacting household consumption.

Access to clean drinking water is another critical issue in Cameroon. According to data from the World Health Organization (WHO), nearly 30% of the rural population lacks access to improved drinking water. This situation results in additional expenses for households, which are often forced to purchase bottled water or dedicate a significant portion of their time and resources to water collection. These constraints limit their ability to consume other essential goods.

In urban areas, although access to water is generally better, persistent distribution problems can also create inequalities in access to safe drinking water. Households without regular access to potable water are often forced to incur additional costs or rely on less safe sources, which can negatively impact their overall well-being.

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Access to electricity in Cameroon is unevenly distributed. About 55% of the rural population lacks access to electricity, posing a major barrier to household modernization and economic activity. In urban areas, electricity is more widely available, but frequent outages and supply issues can disrupt household productivity and comfort. The lack of access to electricity limits opportunities for education, healthcare, and economic engagement, which in turn restricts consumption spending, as many households must allocate part of their resources to alternatives such as kerosene lamps or generators.

Electricity is essential for cooking, lighting, entrepreneurship, and education, and its absence directly affects the material well-being of households.

Beyond the direct links between infrastructure and well-being (through consumption expenditure), it is important to note that household well-being in Cameroon is strongly influenced by access to and the quality of infrastructure. Household consumption is an indirect measure of material well-being and is often determined by the household's ability to access essential goods and services. This relationship, however, is subject to much debate. Studies by Anderson et al. (2004), Fink et al. (2002), Canning (1998), and Donaldson (2018) show that better road networks enhance market integration, reduce transportation costs, and facilitate access to consumer goods. As a result, households are able to devote a larger share of their income to the consumption of goods and services, thereby improving their level of well-being.

Reliable and regular access to safe drinking water allows households to allocate fewer resources to purchasing water or alternative solutions. Moreover, a steady water supply reduces the risk of waterborne diseases, thereby improving health and lowering healthcare expenditures—further freeing up resources for other forms of consumption (Ashraf et al., 2010; Hutton et al., 2004; Galiani et al., 2005).

Access to electricity has a direct impact on household productivity. It facilitates income-generating activities (e.g., craftsmanship, small businesses) and reduces spending on alternatives (e.g., candles, kerosene lamps), freeing up resources for other types of consumption and enhancing overall household well-being (Dinkelman, 2011; Gertler & Schargrodsky, 2005; Khandker & Samad, 2014).

Research by Lucas (2012), Cervero and Golub (2007), Beevers and Britton (2007), and others has shown that access to public transportation—especially in urban areas—plays a crucial role in allowing households to reach jobs, schools, hospitals, and markets more easily. This increased mobility lowers geographic and economic barriers and supports greater social and economic inclusion, which can substantially improve household well-being.

In light of the above, it is important to recognize that infrastructure is essential for economic growth and poverty reduction. The Cameroonian government has implemented various policies and infrastructure projects to address these challenges, such as the National Development Plan (PND), which includes initiatives aimed at improving access to essential infrastructure like roads, drinking water, electricity, and public transportation. However, despite these efforts, significant inequalities remain between urban and rural areas in terms of infrastructure access.

Improvements in these sectors have a direct impact on household well-being—not only by reducing the costs of transportation, water, and energy, but also by facilitating access to new markets and economic opportunities. Infrastructure development is therefore crucial for boosting household consumption and enhancing quality of life.

The main objective of this study is to estimate the impact of infrastructure (road quality, access to potable water, electricity, and public transportation) on the objective well-being of households in Cameroon. Following the introduction, Section 2 presents the literature review, Section 4 outlines the methodology, Section 5 discusses the results and interpretations, and finally, the conclusion wraps up the study.

2. LITERATURE REVIEW

The relationship between infrastructure and objective well-being has been widely explored in both economic and sociological literature. Infrastructure refers to the range of facilities, services, and systems that support the functioning of an economy and society, such as roads, electricity, potable water, transportation systems, hospitals, schools, and more. Objective well-being refers to the assessment of individuals' quality of life based on tangible and measurable criteria such as access to healthcare, education, security, employment, and environmental quality.

There are several theoretical frameworks that establish links between infrastructure and objective well-being, notably: human capital theory, externalities theory, and sustainable development theory.

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First, human capital theory, developed by scholars such as Lucas (1980), Easterlin (1970), Schultz (1960), Sen (1985), and Becker (1970), argues that infrastructure plays a vital role in enhancing human capital. For instance, access to quality education, supported by well-equipped schools, enables individuals to acquire skills that increase their productivity and economic well-being. Likewise, modern healthcare infrastructure promotes better health, thereby improving workers' quality of life. In relation to objective well-being, these scholars argue that investment in infrastructure enhances human capital and, consequently, individuals' ability to fully participate in society—leading to improvements in their objective well-being.

Second, externalities theory, developed by Pigou (1912), Coase (1960), Arrow (1960), and Ostrom (1990, 1999), highlights how infrastructure can generate positive externalities—benefits that extend beyond the individuals directly involved in the investment. For example, investment in efficient transportation infrastructure can reduce traffic congestion, lower environmental costs associated with greenhouse gas emissions, and improve the quality of life for urban residents. Regarding objective well-being, such externalities help improve living conditions even for individuals who are not direct beneficiaries of the infrastructure.

Third, sustainable development theory, promoted by thinkers such as Rawls (1971), Ostrom (1990, 1999), and Sen (1985), emphasizes the role of infrastructure in sustainable development—a model of progress that seeks to meet current needs without compromising the ability of future generations to meet theirs. Sustainable infrastructure, such as renewable energy systems, eco-friendly public transport, or sustainable agriculture, helps protect the environment while promoting both economic and social well-being. In terms of objective well-being, the development of sustainable infrastructure ensures a healthy environment for future generations, thereby enhancing long-term well-being.

These theoretical frameworks have been empirically tested in both developing and developed countries, though results often vary depending on context. A significant number of studies underscore both linear and nonlinear effects of infrastructure. While debates continue, Sen (1999) focused on demonstrating how infrastructure influences opportunities and social well-being. He linked the concept of infrastructure to human development. His capabilities approach used both qualitative and quantitative methods to assess how infrastructure affects individuals' abilities to live the lives they value. This included surveys and case studies measuring impacts on quality of life, employing a holistic approach that integrates economic, social, and political dimensions to provide a comprehensive understanding of well-being.

These two approaches (quantitative and qualitative) help to show that, within the capabilities framework, individuals can make meaningful use of the resources available to them. Infrastructure—whether physical (roads, schools) or social (healthcare systems, security)—directly affects these capabilities. Adequate infrastructure increases individuals' ability to lead lives they consider worthwhile. Sen also highlighted how infrastructure can either exacerbate or reduce inequality. For instance, limited access to education or healthcare for certain populations can hinder their personal and social development.

Porter (1990), in his theory of value chains and clusters, emphasizes the importance of infrastructure for economic development and community well-being. Porter analyzed case studies to examine how various nations and regions develop their infrastructure and how it impacts competitiveness and well-being. He used a variety of indicators to measure economic performance—including productivity, service access, and living standards—offering an integrated assessment of infrastructure and its effects through a systemic approach. This approach considers not only the infrastructure itself but also its interaction with other factors such as policy, education, and innovation. Porter concludes that a nation's competitiveness depends on its ability to create favorable conditions for businesses, and that robust infrastructure (transportation, telecommunications, energy) is essential to support this competitiveness. In his diamond model, he identifies four key determinants of competitiveness: factor conditions (including infrastructure), demand conditions, related industries, and firm strategy/structure. Efficient infrastructure enhances productivity and thereby improves economic well-being. Additionally, strong infrastructure contributes to improved quality of life by facilitating access to markets, education, and healthcare, which can lead to increased income and reduced poverty.

Acemoglu et al. (2012) discuss the impact of institutions, including infrastructure, on economic development and well-being. Their comparative analysis examined how institutional differences across nations and regions affect infrastructure and well-being. Using economic modeling, they showed that inclusive institutions promote infrastructure investment and lead to sustainable economic growth. Their historical evaluation provided a long-term perspective on how institutions evolve and shape economic and social development. The authors argue that the quality of institutions—both political and economic—is a key determinant of development disparities across countries. Inclusive institutions foster innovation and growth and enable effective infrastructure development, whether physical (roads, schools, utilities) or institutional (legal frameworks, property rights). Effective infrastructure improves

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access to markets, education, and healthcare, thereby enhancing living standards. These authors stress that without inclusive institutions, infrastructure investments may be inadequate or misallocated, ultimately hindering development. Their work has significant implications for public policy and long-term development planning.

Sachs (2005) studied how essential infrastructure such as water and electricity affects economic development and well-being in developing countries. He adopted a multidisciplinary approach, combining economics, public health, and environmental studies to analyze the impact of infrastructure on well-being. His data analysis incorporated statistical indicators to assess the relationship between infrastructure and economic growth. Sachs concluded that infrastructure is foundational to economic development. Adequate access to basic infrastructure (roads, water, electricity) is critical for improving quality of life and promoting growth. He showed that infrastructure development benefits not only the economy but also sectors such as health and education, which directly affect population well-being. Case studies highlighted significant gains in well-being from infrastructure investments—such as potable water projects that reduced disease and boosted productivity.

Florida (2002), in his research on the "creative class," argues that high-quality infrastructure attracts talent and contributes to urban well-being. His quantitative analysis examined correlations between infrastructure, economic growth, and well-being across cities, using indicators such as diversity, service access, and quality of life. He also conducted case studies of specific cities to illustrate how infrastructure investment improved both well-being and economic appeal. Additionally, surveys and interviews were used to gather residents' perceptions of quality of life and how infrastructure affects their daily lives. Florida concluded that cities attracting members of the creative class (artists, scientists, entrepreneurs) tend to offer rich cultural and social infrastructure—including arts centers, attractive public spaces, and efficient transport systems. He argues that quality infrastructure improves residents' quality of life, stimulates innovation and productivity, and enhances urban economic competitiveness. Well-developed infrastructure attracts businesses and talent, driving growth and, consequently, improving well-being.

Glaeser (2011) explored the role of urban infrastructure in supporting economic and social well-being in cities, expanding on Florida's work. Using quantitative methods, demographic data, urban case studies, and economic modeling, Glaeser demonstrated that cities are engines of economic growth. He emphasized the importance of urban infrastructure—transportation, housing, and public services—for fostering human interaction, innovation, and productivity. Geographic proximity enhances social and economic exchange, and well-developed infrastructure improves accessibility, thereby enhancing well-being by reducing travel times and increasing service availability. Glaeser also identified links between infrastructure quality and key well-being indicators such as health, education, and safety. Cities with strong infrastructure systems tend to exhibit higher satisfaction levels and quality of life among residents.

In light of the above, the empirical evidence on the impact of infrastructure on well-being remains mixed and context-dependent. This variability stems from differences in estimation techniques, the choice of infrastructure indicators, and definitions of well-being. Despite numerous reports and studies on infrastructure development in Cameroon and elsewhere, there is a notable lack of research specifically focusing on the direct relationship between infrastructure and objective well-being. Most existing studies tend to explore infrastructure's impact on macroeconomic growth, without delving into its direct influence on citizens' well-being—particularly in terms of access to healthcare, education, and other essential services.

This study seeks to fill this gap by providing a detailed analysis of how infrastructure affects the objective well-being of Cameroonians, using both quantitative and qualitative data.

3. METHODOLOGY

3.1. Model Specification

The use of multiple regression models to analyze the impact of infrastructure on objective well-being, as measured by household consumption expenditures, is a central topic in development economics and public policy evaluation. Scholars such as Banerjee et al. (2004), Duflo et al. (2007), Greenstone et al. (2004), Canning et al. (2004), and Straub (2008) have made significant contributions to this field by employing rigorous quantitative methods to assess the effects of infrastructure on household spending. These studies show that improvements in infrastructure often have a positive impact on household consumption, particularly in terms of access to basic services such as water, electricity, and transportation. This study draws on these models to estimate the impact of infrastructure on household consumption expenditures.

The regression model will be specified as follows:

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$$Ci=\beta0+\beta1RoadCondition_i+\beta2PotableWater_i+\beta3Electricity_i+\beta4PublicTransport_i+\beta5Income_i+\beta6Age_i+\beta7Education_i+\beta8MaritalStatus_i+\epsilon_i$$

Where:
Ci = Household consumption expenditure of household iii, measured in local currency (CFA Franc)
Infrastructure variables :
RoadCondition: Quality of the road in the household's region (e.g., good, average, poor)
PotableWater: Access to potable water (binary: 1 = regular access, 0 = no regular access)
Electricity: Access to electricity (binary: 1 = access, 0 = no access)
PublicTransport: Access to public transportation (binary: 1 = access, 0 = no access)
Socio-Economic Variables :
Income: Total income of the household
Gender: Gender of the household head (1 = male, 0 = female)
Age: Age of the household head
Education: Education level of the household head
MaritalStatus: Marital status of the household head (1 = married, 0 = other)
ϵi = Random error term

3.2. Nature and Sources of Data

The data used will come from the Cameroonian Household Survey (ECAM) 2014, which provides detailed information on the socio-economic characteristics of households, including consumption expenditures, access to infrastructure, and the demographic characteristics of household heads.

3.3. Estimation Techniques and Testing the Impact of Infrastructure

We will estimate the econometric model using a multiple linear regression method. The coefficients $\beta1,\beta2,\ldots,\beta9$ will be estimated using the Ordinary Least Squares (OLS) method. This method minimizes the sum of squared residuals (ϵi) to find the values of the coefficients that best explain the variance in consumption expenditures (Fisher, 1921).
To test the significance of the estimated coefficients, we will use the p-values associated with each coefficient (Legendre, 1805). In general, if the p-value of a coefficient is less than 0.05, this indicates that the corresponding infrastructure variable has a statistically significant effect on consumption expenditures.
We will also check for multicollinearity among the explanatory variables. If two or more variables are highly correlated, this could affect the estimation of the coefficients. We will use the Variance Inflation Factor (VIF) to identify multicollinearity issues. A VIF greater than 10 indicates high multicollinearity and may require corrective actions, as suggested by Engle (1982) and Kennedy (1955). It is also important to check for heteroscedasticity in the residuals of the model. We will use White's test or Breusch-Pagan test for heteroscedasticity (Breusch et al., 1979; White, 1980). If these issues are detected, techniques such as robust standard errors regression can be applied.

4.RESULTS AND INTERPRETATION

4.1. Descriptive Statistics

Table 1 presents the descriptive statistics for two continuous variables: objective well-being, measured by household expenditures, and the age of household heads. Here is an analysis of the descriptive statistics provided for these two continuous variables:
The table shows that there are 10,303 observations on household consumption in the sample. The average household consumption is 853,702.7 local currency units (CFA francs). This represents the average level of household expenditures in the sample. The standard deviation is relatively high, suggesting that household expenditures are highly dispersed around the mean. In other words, there is significant variability in household spending, with some households spending much more or much less than the average. The minimum expenditure is 30,051.55 CFA francs, representing the household with the lowest consumption. The maximum expenditure is 15,900,000 CFA francs, indicating that there are households with extremely high expenditures. The gap between the minimum and maximum is large, suggesting that household spending varies widely. The high standard deviation and the large

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difference between the minimum and maximum indicate that household expenditures are highly variable. It is possible that some data points are influenced by extreme values (e.g., very high expenditures by a small number of households).
Regarding age, there are also 10,303 observations on the ages of individuals in the sample. The average age of individuals in this sample is 43.48 years. This means that, on average, people in this sample are just over 43 years old. The standard deviation of 15.79 suggests some variability in age, but it is not very high. This means that most individuals are relatively close to the average age. The minimum age is 12 years, indicating that there are younger individuals in the sample, possibly teenagers. The maximum age is 99 years, showing that there are older individuals in the sample, but the age range is still quite reasonable (between 12 and 99 years). The relatively low standard deviation indicates that most individuals are close to the average age of 43 years. This suggests that the sample is fairly homogeneous in terms of age, with not too many very young or very old individuals. However, the presence of individuals aged 12 to 99 shows a notable age diversity. This could influence the analysis if we wish to study age subgroups (e.g., youth vs seniors).

Table 1: Descriptive Statistics of Continuous Variables

Variables	Observations	Means	Standard Deviations	Minimum	Maximum
Household Consumption	10,303	853,702.7	852,618.9	30,051.55	15,900,000
Age	10,303	43.48	15.79	12	99

Source: Author based on Stata 17

Table 2, shown here, presents the statistical results for the categorical variables. It helps to understand the distribution of individuals across various categories or modalities. Here is a detailed analysis of the provided results. Regarding the road condition variable, the majority of individuals (60.92%) live in areas where the road condition is "poor," which may indicate infrastructure problems. Only 39.08% of individuals benefit from a "good" road condition. This distribution shows a significant proportion of areas with poor road infrastructure. The vast majority of individuals (93.29%) have regular access to drinking water, which is a good indicator of water coverage in the studied area; only 6.71% have irregular access to drinking water, which could suggest inequalities in access to this basic resource in certain areas. A large majority (87.15%) of individuals have access to electricity. This suggests good energy coverage in the region studied; however, 12.85% of individuals do not have access to electricity, indicating a significant gap in access to this resource, which may reflect geographical or socio-economic disparities. The distribution is relatively balanced between those who have access to public transportation (55.46%) and those who do not (44.54%); although more than half of the population has access to public transportation, nearly half does not, which may pose accessibility and mobility challenges for the latter. A large majority (77.95%) of the sample is classified as "poor," suggesting relatively low living standards; only 22.05% of individuals are classified as "non-poor." This could indicate significant economic disparities and poverty challenges in the studied region. When it comes to gender, there is a significantly higher proportion of men (71.08%) than women (28.92%) in the sample. This could reflect the demographic structure of the studied population or result from sampling biases. The marital status shows that the majority of individuals (61.60%) are married, while 38.40% are not. This distribution indicates that marriage is a relatively common situation in the sample.

Table 2: Statistical Analysis of Categorical Variables

Variables	Categories	Frequency	Percentage
Road Condition	Poor	6,277	60.92
	Good	4,026	39.08
Access to Water	Irregular	691	6.71
	Regular	9,612	93.29
Access to Electricity	No Access	1,324	12.85
	Access	8,979	87.15

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Variables	Categories	Frequency	Percentage
Public Transport	No Access	4,589	44.54
	Access	5,714	55.46
Income Level	Non-poor	2,272	22.05
	Poor	8,031	77.95
Gender	Male	7,323	71.08
	Female	2,980	28.92
Marital Status	Not Married	3,954	38.40
	Married	6,344	61.60
Total		10,303	100

Source: Author based on Stata 17

4.2. Test Results

The multicollinearity test is conducted to check if the independent variables are strongly correlated with each other. We use the Variance Inflation Factor (VIF), which measures the extent of multicollinearity. If the VIF of a variable exceeds 10, it indicates high multicollinearity, which may require modifications to the model.

According to the table, not only is the average VIF above 10, but all the individual VIF values are below 10. This indicates that there is no problematic multicollinearity between the explanatory variables. The variables are sufficiently independent, allowing for accurate estimation of the coefficients.

Table 3: Multicollinearity Results

Variables	VIF	1/VIF
State of Roads	1.02	0.980682
Access to Water	1.01	0.990676
Access to Electricity	1.01	0.990676
Public Transport	1.07	0.936785
Income Level	1.11	0.899422
Age	1.30	0.771196
Education	1.14	0.873725
Marital Status	1.30	0.768933
Mean VIF	1.2	-

Source: Author, from Stata 17.

The Breusch-Pagan test is used to check for the presence of heteroscedasticity in a regression model. This test examines whether the variance of the errors is constant (the homoscedasticity assumption) or if it varies depending on the explanatory variables (which indicates heteroscedasticity). The results show the following:

Chi2(1) = 10.07: This indicates the Breusch-Pagan test statistic. It is a measure that compares the model under the null hypothesis with the one under the alternative hypothesis.

Prob > Chi2(1) = 0.0011: This represents the p-value associated with the test statistic.

The p-value of 0.0011 is well below the typically used significance threshold (0.05). This means that we have sufficient evidence to reject the null hypothesis of homoscedasticity at the 5% significance level. Since the p-value is lower than 0.05, we reject the null hypothesis of homoscedasticity and conclude that there is heteroscedasticity in the model. In other words, the variance of the errors

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is not constant, which could lead to incorrect standard errors of the estimated coefficients, affecting the reliability of statistical tests (t-tests, F-tests) and the validity of confidence intervals.

In conclusion, since the multicollinearity test is satisfactory but the heteroscedasticity test is not, to correct for this, we use robust standard errors to adjust the standard errors of the coefficients, which makes the statistical tests valid even in the presence of heteroscedasticity.

4.3. Estimation Results of Infrastructure on Objective Well-Being

Table 4 presented below contains the results from several regression models, which aim to explain the impact of infrastructure on household well-being, measured by consumption expenditures. Here is a detailed interpretation of the coefficients and the impact of each variable.

The coefficients for the state of roads are all positive and significant at the 1% confidence level, indicating that improving road conditions has a positive effect on household consumption expenditures. The coefficient in the first column (0.202) suggests that an improvement in road conditions leads to a 20.2% increase in consumption expenditures, which is a strong relationship. This result remains relatively stable in the other columns, with slightly decreasing but still significant coefficients (around 0.0974 in the last column).

Access to water also has a positive effect on consumption expenditures. In the first column, the coefficient is 0.106 (significant at 1%), indicating that better access to water increases consumption expenditures by 10.6%. However, the impact seems to diminish as other variables are added to the model. In the last column, the coefficient is 0.0425, but it is no longer significant (p-value > 0.05), suggesting that the impact of access to water may be moderated once other factors like income and education are considered.

The coefficient for access to electricity is also positive but less important. In the first column, it is 0.0402, meaning that access to electricity increases consumption expenditures by 4.02%. However, this effect is relatively small compared to that of road conditions and access to water. The effect is also reduced in the subsequent columns and eventually becomes insignificant in the last column (p-value > 0.05). This suggests that the impact of electricity on consumption expenditures is less direct, or that other variables are masking this effect.

Public transport has a very strong effect on consumption expenditures. The coefficient in the first column is 0.515, meaning that better access to public transport leads to a 51.5% increase in consumption expenditures. This underscores the importance of public transport for enabling households to access jobs, schools, hospitals, and markets. This relationship remains very stable and significant in the other columns, indicating a continuous and robust impact of public transport on household expenditures.

Income level is also a determining factor, with high and significant coefficients across all columns. For example, in the first column, the coefficient is 0.775, meaning that a 1% increase in income leads to a 77.5% increase in consumption expenditures. This effect remains stable as additional variables are added, suggesting that income plays a central role in household spending.

The effect of age on consumption expenditures is negative and significant at the 5% level in columns 3 and 4, with a coefficient of -0.00100, suggesting that an increase in age is associated with a decrease in consumption expenditures. However, the effect becomes insignificant in the last column. This could indicate that age negatively affects consumption, perhaps due to retirement or a decrease in work capacity.

The coefficient for education is positive and significant at 1% in columns 3 to 5. For example, in column 3, the coefficient is 0.292, meaning that an increase in education level leads to a 29.2% increase in consumption expenditures. This effect remains stable as other variables are added to the model, suggesting that education has a lasting and significant impact on household expenditures.

The coefficient for marital status is negative and significant at 1% in the first column. The coefficient of -0.0539 indicates that married households have lower consumption expenditures than unmarried ones. This effect appears to diminish or disappear once other variables (such as income and education) are added, suggesting that marital status may influence expenditures indirectly through other socio-economic factors.

In general, the results show that infrastructure factors such as road conditions, access to water, electricity, and public transport have a significant impact on household well-being, as measured by consumption expenditures. This is consistent with the empirical findings of Anderson et al. (2004), Fink et al. (2002), Hutton et al. (2004), and Galiani et al. (2005). Indeed, road conditions and access to public transport have the most significant effects, suggesting that these infrastructures are key determinants of well-being, which corroborates the work of Lucas (2012), Cervero and Golub (2007), and Beevers and Britton (2007).

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Income is also a central factor in explaining consumption expenditures. The high coefficients associated with income highlight its fundamental role in increasing spending, as developed by authors such as Ando, A., & Modigliani, F. (1963), Carroll et al. (1991), and Friedman (1957). Education also plays a positive role, while age and marital status have a more moderate impact, with negative effects observed for age and married individual

Table 4: Estimation Results of Infrastructure on Objective Well-Being
Method: Ordinary Least Squares (OLS)

Variables	(1)	(2)	(3)	(4)	(5)
Road Conditions	0.202***	0.148***	0.0985***	0.0985***	0.0974***
	(0.0157)	(0.0145)	(0.0137)	(0.0137)	(0.0136)
Access to Water	0.106***	0.0850***	0.0461*	0.0461*	0.0425
	(0.0300)	(0.0281)	(0.0266)	(0.0266)	(0.0266)
Access to Electricity	0.0402*	0.0295	0.0192	0.0192	0.0193
	(0.0233)	(0.0211)	(0.0194)	(0.0194)	(0.0194)
Public Transport	0.515***	0.405***	0.309***	0.309***	0.309***
	(0.0155)	(0.0145)	(0.0138)	(0.0138)	(0.0138)
Income Level		0.775***	0.624***	0.624***	0.620***
		(0.0185)	(0.0181)	(0.0181)	(0.0181)
Age			-0.00100**	-0.00100**	-4.94e-05
			(0.000433)	(0.000433)	(0.000484)
Education			0.292***	0.292***	0.289***
			(0.00808)	(0.00808)	(0.00813)
Marital Status			-0.0539***		
			(0.0121)		
Constant	12.65***	12.15***	12.02***	12.02***	12.04***
	(0.0312)	(0.0315)	(0.0372)	(0.0372)	(0.0375)
Observations	10,303	10,303	10,302	10,302	10,297
R^2	0.113	0.256	0.351	0.351	0.352

Source: Author, based on Stat.17
***** (1%), ** (5%), * (10%)**

5.CONCLUSION

In conclusion, the analysis of the impact of infrastructure on objective well-being, measured by consumption expenditure, highlights the crucial role that quality infrastructure (such as roads, drinking water, electricity, and public transportation) plays in improving household living conditions. Based on the multicollinearity and heteroscedasticity tests and the application of ordinary least squares to multiple regression models, the results show that improvements in infrastructure stimulate household consumption expenditure, which is an important indicator of economic well-being.

Indeed, better road conditions reduce transportation costs and facilitate access to markets, thus leading to increased consumption expenditure; access to regular drinking water reduces health risks, which improves household health and reduces healthcare costs. This allows households to allocate more resources to the consumption of goods and services; better access to electricity has a direct effect on household productivity, improving energy efficiency and facilitating access to modern technologies, which can also free

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up financial resources for consumption; access to public transport, especially in urban areas, enables households to more easily access job opportunities, schools, hospitals, and markets, thereby increasing their purchasing power and ability to consume.

In light of these results, to maximize the impact of infrastructure on well-being as measured by consumption expenditure, governments and policymakers should adopt the following recommendations: strengthen investment in basic infrastructure (roads and transport, drinking water, electricity); support infrastructure as an economic development lever; promote equal access to infrastructure; establish long-term maintenance programs; encourage public-private partnerships for infrastructure financing; integrate environmental considerations into infrastructure projects; and regularly measure the impact of infrastructure on well-being.

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