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Analysis of the Influence of the Electric Energy Coverage Index on the Incidence of Monetary Poverty in Colombia through Path Analysis

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Abstract

This research aims to identify and analyze the potential connections between indicators that reflect living conditions in rural areas across various departments in Colombia. These indicators encompass various aspects such as education in households, well-being of children and youth, labor market characteristics, access to healthcare, availability of public services, and housing conditions. Each of these factors directly or indirectly affects the country's monetary poverty assessment.

The primary goal of the study is to create a model that can examine in detail how electricity coverage in rural areas is linked to the incidence of monetary poverty. To achieve this, the study utilizes a structural equation model approach, along with the path analysis technique. This method not only measures the direct relationships between the different indicators but also identifies indirect effects and interactions between the variables being analyzed.

The findings of the analysis reveal that electricity coverage significantly impacts the incidence of monetary poverty. Furthermore, the study indicates that informal employment plays a crucial role in perpetuating monetary poverty in rural areas. Informal work, characterized by job instability, lack of social security, and uncertain income, contributes to the persistence of poverty conditions.

As a result, the study emphasizes the necessity of improving infrastructure and access to basic services in rural areas and underscores the importance of addressing labor informality as a critical factor in reducing poverty.

Keywords: Rural areas; path analysis; Colombia; informal work; electricity coverage; incidence poverty monetary; structural equation; poverty indicators; direct relationships; indirect effects.

Analizar la Influencia del Índice de Cobertura de Energía Eléctrica en la Incidencia de Pobreza Monetaria en Colombia mediante Path Analysis

Resumen

Esta investigación tiene como objetivo identificar y analizar las posibles relaciones entre diversos indicadores que describen las condiciones de vida en las zonas rurales de varios departamentos de Colombia. Estos indicadores abarcan distintas dimensiones, tales como las condiciones educativas en los hogares, el bienestar de la niñez y juventud, las características del mercado laboral, el acceso a la salud, la disponibilidad de servicios públicos y las condiciones habitacionales. Se consideran cada uno de estos factores dada su influencia, de manera directa o indirecta, en la evaluación de la incidencia de la pobreza monetaria en el país.

El propósito central de este estudio es desarrollar un modelo de influencia que permita examinar detalladamente cómo el índice de cobertura de energía eléctrica en las zonas rurales se relaciona con la incidencia de la pobreza monetaria. Para ello, se utiliza un enfoque basado en un modelo de ecuaciones estructurales, usando la técnica de análisis de senderos. Este enfoque metodológico no solo mide las relaciones directas entre los diferentes indicadores, sino que también identifica los efectos indirectos y las interacciones entre las variables analizadas.

Los resultados del análisis muestran que la cobertura de energía eléctrica tiene un impacto significativo en la incidencia de la pobreza monetaria. Asimismo, se encontró que el trabajo informal desempeña un papel importante en la persistencia de la pobreza monetaria en las zonas rurales. El trabajo informal, caracterizado por la inestabilidad laboral, la falta de seguridad social y la precariedad de los ingresos, contribuye a perpetuar las condiciones de pobreza.

Palabras claves: Áreas rurales; análisis por senderos; Colombia; trabajo informal; índice de cobertura de energía eléctrica; incidencia en pobreza monetaria; ecuaciones estructurales; indicadores de pobreza; relaciones directas; relaciones indirectas.

1. Introduction

The term "poverty" is universally used to denote a population whose income is insufficient to meet their basic needs, thus classifying them as poor. A lack of monetary resources is the primary indicator for identifying individuals as poor. Basic needs for a population include ensuring a minimum standard of food, water, and electricity.

The quote "The ultimate test of a civilized society's growing kindness and increasing power would be the eradication of poverty" (de Jouvenel 2015) underscores the importance of creating societies that have access to basic needs and addressing the structural inequalities that exist in our society. This is not solely based on the ability to generate wealth but on seeking to ensure the dignity and well-being of the entire population as a collective good and not an individual one.

Therefore, the welfare state aims to reduce economic and social inequality, thereby minimizing the inherent asymmetries among people that are primarily based on their unstable environment, creating a constant struggle for survival and safety in difficult situations (Bilchitz 2009).

The United Nations has established 17 global development goals, referred to as SDGs, to promote peace and prosperity for current and future generations (Schleicher et al. 2018). This research is focused on addressing Sustainable Development Goal 7 (SDG7), which seeks to ensure access to affordable, reliable, sustainable, and modern energy for all by 2030.

Various studies and interventions have been conducted to achieve this goal in different societies. For example, the Poverty Alleviation through Relocation (PAR) program involved relocating identified poor families to areas with higher economic growth (Liu et al. 2023). It was found that household poverty decreased with increased wages and property income. Additionally, a study in Kenya revealed that

energy poverty significantly affects human health, highlighting the importance of ensuring the availability of energy at affordable prices (Ang'u et al. 2023).

The International Energy Agency (IEA) emphasizes the crucial role of modern energy services in human well-being and economic development. Access to modern energy is essential for providing clean water, sanitation, and healthcare, as well as reliable and efficient services for lighting, heating, cooking, power, transport, and telecommunications (Khatib 2011).

In general, energy is an indispensable resource for living a dignified life today, driving economic growth and human progress. Therefore, this research aims to understand whether the incidence of monetary poverty is directly or indirectly related to the electric energy coverage index. Specifically, we consider the Path Analysis methodology, also known as PA, for our analysis.

PA is a statistical method that does not test causality but examines the hypothesis of a causal relationship between two or more variables (Lleras 2004), allowing the estimation of the magnitude and significance of the hypothesized relationships among a set of variables. This enables understanding of to what extent a change in one variable, connected through an arrow to another variable, relates and generates change. The arrows indicate multiple regressions and are known as directional paths. PA models only include directly observable variables, known as measured variables, to indicate the causal relationships between them.

2. Method

In Colombia, the National Administrative Department of Statistics (DANE) has identified two types of poverty: monetary poverty and multidimensional poverty. Monetary poverty is defined as the lack of income to cover a basic basket of food, services, and other essential goods for life. A person or family is considered to be living in monetary poverty when their per capita income falls below a certain threshold, which varies according to the departments in Colombia. On the other hand, multidimensional poverty takes into account various measurable indicators that have an impact on society.

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This article focuses on analyzing various indicators that influence the incidence of monetary poverty, specifically targeting dimensions such as educational conditions, childhood and youth conditions, labor, health, housing, and public services. It puts forth a hypothesis to establish relationships between indicators of these dimensions, emphasizing the direct and indirect effects of the electric energy coverage index on the incidence of monetary poverty in a population.

In our research, we aim to use a specific type of Structural Equation Modeling (SEM) to test our hypotheses about how access to electric energy affects the incidence of monetary poverty. SEM uses observed and unobserved variables to measure the relationship between theoretical constructs and measurable variables. This approach can be used for explanatory and predictive research and causal analysis. This method is used in both explanatory (confirmatory) and predictive (exploratory) research as well as predictive causal analysis (Bagozzi and Yi 2012).

A specific type of SEM, Path Analysis (PA), examines linear, additive, and causal relationships between observed variables. PA allows us to explore the causal pathways linking variables and evaluate the fit of theoretical models proposing dependency relationships. It is important to highlight that the model does not prove causality, it can help in selecting or inferring causal hypotheses and evidence relationships between variables (Lleras 2004; Streiner 2005; Pérez et al. 2013; Fadjryani and Lombang 2021).

In this research, the hypotheses posed by researchers and experts about the influence of the electric energy coverage index on the incidence of monetary poverty are examined using the proposed SEM, which is tested and evaluated for its fit level. Thus, it identifies to what extent the studied phenomenon behaves. SEM allows for both exploratory and confirmatory analysis of the model (Cheon 2009).

3. Model description

The proposed model addresses various aspects of multidimensional poverty, considering a range of factors that can impact the economic and social status of a population. The Alkire-Foster (AF) method is widely used to measure multidimensional

poverty because it offers flexibility and the ability to capture different aspects of human well-being (Alkire et al. 2021; Alkire [no date]). This method focuses on three main dimensions crucial for understanding multidimensional poverty: health, education, and living standards. It's important to note that these dimensions may differ depending on the specific focus of the research. For example, in studies examining the lack of access to modern energy services, dimensions like cooking, lighting, and access to entertainment/education and communication appliances may be considered (Nussbaumer et al. 2012).

The following text outlines different dimensions used to measure multidimensional poverty (OPHI [no date]). For instance, in Mexico, these dimensions may include income, educational attainment, access to healthcare, social security, housing quality, and space, as well as access to public services within households. In Chile, the dimensions may cover education, healthcare, employment and social security, housing and environment, and social networks and cohesion. Meanwhile, in Colombia, they may encompass educational conditions within households, childhood and youth, employment, healthcare, access to public services, and housing.

These dimensions, along with their respective indicators, were presented in Colombia in 2011 as part of a new National Development Plan that includes a multidimensional poverty index based on the Alkire-Foster method (Alkire [no date]). The formulation of this index took into account various data sources, surveys measuring the standard of living in Colombia, multidimensional indices of Colombia and Latin America, discussions with experts, priorities in terms of social rights established by the constitution, as well as qualitative studies such as "Voices of the Poor for Colombia", the Millennium Development Goals, and the millennium social policy aimed at poverty reduction (Roberto Carlos Angulo Salazar 2013).

In this research, we have considered indicators for various dimensions, focusing on the case study in Colombia. These indicators encompass school absenteeism, long-term unemployment, informal work, child labor, overcrowding, illiteracy, low educational achievement, monetary poverty, and lack of health insurance. The

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primary objective is to examine the direct and indirect impact of the electric energy coverage index on multidimensional poverty.

To gather the necessary data, we have consulted reliable governmental sources such as the National Administrative Department of Statistics (DANE), XM, and the Superintendence of Public Utilities. These institutions are responsible for collecting and maintaining relevant and updated information on various socio-economic aspects, including poverty and access to basic public services in the country.

The data collected from these governmental sources provides a strong and dependable foundation for analyzing the relationships between different dimensions of multidimensional poverty and the electric energy coverage index. This analysis allows for the identification of potential patterns and areas for intervention to address poverty more effectively.

For this research, the indicators presented in Table 1 for each dimension have been considered, specifically regarding the incidence of monetary poverty (IPM). It is important to consider these specific indicators to understand and address multidimensional poverty comprehensively and effectively.

Table 1: *Dimensions and indicators*

Dimension	Indicator	Abbreviature
Home education conditions	Illiteracy	ILL
	Low educational achievement	LEA
Childhood and youth conditions	School absenteeism	SA
	Child labor	CL
Employment	Long-term unemployment	LTU
	Informal work	IW
Health	Lack of health insurance	LHI
Access to public services and housing conditions	Overcrowding	OV
	Electric energy coverage index	EEI

The definitions of each indicator and dimension in Table 1: Dimensions and indicators for forming the multidimensional poverty index are as follows:

1. Home education conditions refer to the socio-educational circumstances within households that impact literacy and educational attainment levels. These conditions offer insights into the educational challenges individuals and families face, highlighting disparities and barriers to education. Key indicators of home education conditions typically include:

   1.1. Illiteracy refers to individuals over 15 years old who are unable to read or write.

   1.2. Low educational achievement refers to households with an average education level of less than nine years for people aged 15 and older are classified as having low educational achievement.

2. Childhood and youth conditions encompass the socioeconomic and educational circumstances that impact children and adolescents. These conditions are crucial for understanding the well-being and development of younger populations. Key indicators under Childhood and Youth Conditions typically include:

   2.1. School absenteeism refers to the situation where children between the ages of 6 and 16 do not attend school.

   2.2. Child labor refers to work that robs children of their childhood.

3. Employment encompasses various facets of the workforce and job market conditions specific to a given context. Key dimensions and indicators within the Employment category typically include:

   3.1. Long-term unemployment is defined as job seekers being unemployed for a period equal to or greater than 12 months.

   3.2. Informal work refers to jobs that are not regulated by national legislation.

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4. Health, within multidimensional poverty indices or assessments, encompasses various indicators reflecting well-being and access to healthcare for individuals or households. Key indicators included under the health dimension may include:

   4.1. Lack of health insurance refers to the population in levels 1 and 2 of SISBEN (a poverty classification under Colombian law) that has never been affiliated with the social security health system.

5. Access to public services and housing conditions. This dimension includes indicators reflecting the quality of living conditions and access to essential public services.

   5.1. Overcrowding is defined as having more than three people per room in a household.

   5.2. Electric energy coverage index represents the percentage of households with electric service out of the total number of households.

The previous indicators were chosen for 31 out of the 32 departments (provinces) of Colombia. The department of San Andrés and Providencia was not included due to the lack of available information for all the indicators in the designated dispersed rural and populated center areas. These territorial divisions are defined by the National Administrative Department of Statistics (DANE) and have distinct characteristics that affect the living conditions of their residents.

The term "dispersed rural" refers to areas where homes and agricultural holdings are spread out over the territory, indicating a scattered population distribution and often limited access to basic services and development opportunities. On the other hand, a "populated center" is defined as a concentration of at least twenty contiguous homes, suggesting a higher population density and potentially better access to services and infrastructure compared to dispersed rural areas (DANE 2005).

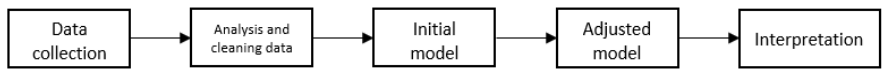
Considering these indicators in the dispersed rural and populated center areas allows for a more comprehensive understanding of

the specific needs and challenges faced by communities in these zones. This perspective is crucial for guiding policies and programs that address socioeconomic differences and promote inclusive development across the Colombian territory.

4. Methodology used for the research

The methodology of the research followed an organized structure in different key stages, summarized in Figure 1: Methodology structure

Figure 1: *Methodology structure*



First, the rural areas of various departments of Colombia were identified as the main context for the study, and relevant indicators within different dimensions that significantly impact the evaluation of the incidence of monetary poverty in the country were selected. Subsequently, these indicators were analyzed to better understand their interrelationships and their influence on monetary poverty in rural areas. This involved data collection, processing, and analysis using appropriate statistical techniques and models.

In Table 2: Data sample, the data obtained for each indicator in rural areas and municipal centers in six of the 31 departments considered for the study are included.

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Table 2: *Data sample*

Department	Antioquia	Arauca	Bogotá D.C.	Chocó	La Guajira	Valle del Cauca
IMP	35.4	33.3	19.2	60.3	72.9	23.2
ILL	20	15.8	8.5	38.5	44.5	14.2
LEA	79.3	75.8	66	82.6	82.9	66.5
SA	5.5	6.1	3	7.6	8.2	4.8
CL	3.9	1.9	1.5	2	4.6	3.7
LTU	10.5	11.7	10	12.6	8.5	10.4
IW	85.5	97	80.5	94.6	93.9	81.4
LHI	8	26.2	13.3	1,7	11.1	10.7
OV	6	6.3	4.5	13	25.7	4.4
EEI	95.18	83.28	94.83	63.25	25.06	88.67

Additionally, a conceptual or theoretical model was designed to identify and select the relationship between the poverty situation and the underlying factors in these specific areas. This initial model provided a basis for starting the model adjustment process.

The Path model was developed in R software using the lavaan package. During data analysis, it was identified that the data did not follow a normal distribution, which led to the need to employ the Bootstrap technique within the model to simulate the data and improve the robustness of the results.

Subsequently, the model was adjusted, considering governmental references and the identification of statistically significant factors. This adjustment involved refining the proposed relationships between the variables to obtain a coherent and representative model of the studied reality.

Once the model adjustment was completed, the significance of the main obtained statistics was evaluated. This evaluation allowed verifying whether the adjusted model met the necessary statistical criteria to reliably interpret the results.

Based on the significant results obtained from the adjusted model, the interpretation of the results was carried out. This process included analyzing the relationships between the proposed

variables in the Path model and their implications on the incidence of monetary poverty or other studied phenomena. This interpretation provided valuable information about the interactions between variables and contributed to the theoretical understanding of the observed phenomena in the context of this study.

5. Model results

The Path Analysis (PA) model was developed using the R software to provide a plausible theoretical explanation of the relationships between the variables. Given that the data did not follow a normal distribution, it was necessary to employ the resampling technique (bootstrapping) implemented in the lavaan package of the R software. A total of 1000 resampling's were performed, and it was observed that there was no significant change compared to 100 or 10,000 additional resampling's.

In this context, an initial model was constructed, represented in Figure 2: Initial model, where the interrelationships between the indicators are explored. The main objective of this model is to primarily evaluate whether the electricity coverage index has direct and indirect effects on the incidence of monetary poverty.

The scheme of the initial model shows the connections between the selected indicators and the incidence of monetary poverty, providing a visual representation of the proposed relationships between the variables.

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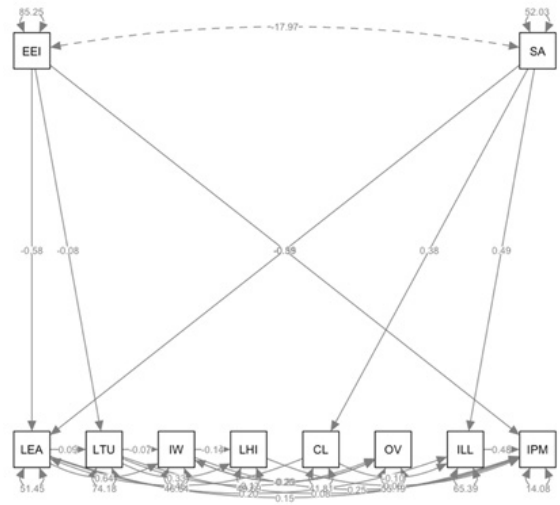
Figure 2: *Initial model*



The analysis of the initial model provided information about the strength and direction of the relationships between the variables. The relationships in this model were as follows:

- The electric energy coverage index (EEI) influences low educational achievement (LEA), with an influence of -0.58, meaning that a higher electric energy coverage index corresponds to lower low educational achievement. Additionally, the electric energy coverage index (EEI) influences long-term unemployment (LTU), with an influence of -0.08, meaning that a higher electric energy coverage index corresponds to lower long-term unemployment. Lastly, the electric energy coverage index (EEI) influences the incidence of monetary poverty (IPM), with an influence of -0.386, meaning that a higher electric energy coverage index corresponds to a lower incidence of monetary poverty in rural areas and municipal capitals in Colombia.
- School absenteeism (SA) exerts an influence on illiteracy (ILL), with an influence of 0.49, meaning that if school absenteeism increases, illiteracy increases. Similarly, it exerts an influence of 0.38 on child labor (CL), meaning that higher school absenteeism leads to higher child labor. On the other hand, school absenteeism

(SA) influences low educational achievement (LEA), with an influence of -0.548, meaning that if school absenteeism increases, low educational achievement decreases in rural areas and municipal capitals.

- Low educational achievement (LEA) influences long-term unemployment (LTU), exerting an influence of 0.09. This means that higher low educational achievement leads to higher long-term unemployment in rural areas and municipal capitals in Colombia.
- Long-term unemployment (LTU) exerts an influence on informal work (IW), with an influence of -0.07. This means that higher long-term unemployment leads to less informal work in rural areas and municipal capitals in Colombia.
- Informal work (IW) influences the lack of health coverage (LHI), with an influence of -0.14. This means that higher informal work leads to a lower proportion of the population in rural areas and municipal capitals of Colombia being without health coverage.
- Illiteracy (ILL) influences the incidence of monetary poverty (IPM), with an influence of 0.48. This means that higher illiteracy leads to higher incidence of monetary poverty in rural areas and municipal capitals in Colombia.

In this Path Analysis (PA) model, we can conclude the relationships between different components. After analyzing the model, we found both significant and non-significant relationships. However, when we looked at the fit statistics and their reference criteria, we found that the model did not have strong statistical support. This is evident in Table 3: Initial model statistics, where the values did not meet the recommended standards for statistical significance.

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Table 3: *Initial model statistics*

Indicator	Recommended measurement	Value in the model
Gl	> 0	22
		0.005
CFI		0.792
TLI		0.584
RMSEA		0.173
SRMR		0.143

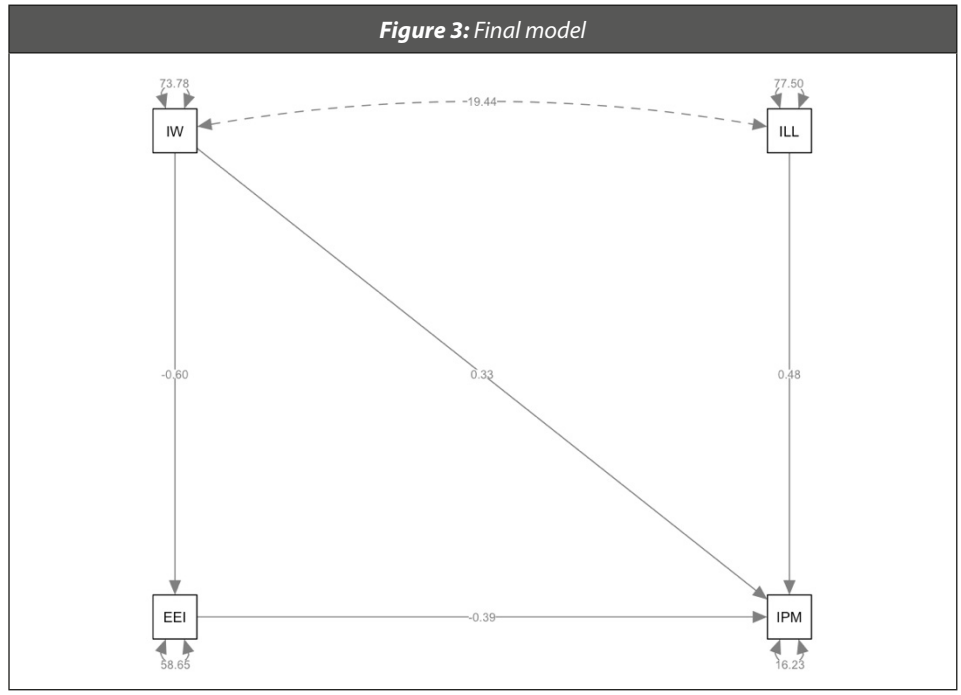
Due to the lack of statistical coherence, the relationships between the identified variables do not provide sufficient evidence to infer a robust causal hypothesis. Therefore, a model adjustment process was initiated to achieve greater statistical coherence by simplifying the model and concentrating the strength on the fewest possible variables. This adjustment was carried out to identify the priority criteria that need to be addressed by the public sector to reduce the incidence of monetary poverty in rural areas and municipal capitals of Colombia.

The model adjustment process included the elimination of non-significant variables and relationships, as well as the restructuring of the model to improve its explanatory and predictive capacity. In this way, the goal was to obtain a more coherent model that would allow for a more precise identification of the key factors influencing monetary poverty.

The variables were chosen based on indicators found in the literature that are known to affect the incidence of monetary poverty. In order to streamline the model, non-statistically significant relationships were gradually removed, resulting in a final model that only included statistically significant relationships. This model was created using data collected from rural areas and municipal capitals in Colombia..

The new adjusted model is presented in Figure 3: Final model. The results obtained after the adjustment indicated a significant improvement in the fit statistics, suggesting greater validity and reliability of the proposed model.

Figure 3: *Final model*



The model statistics are presented in Table 4: Adjusted model statistics. The values of these statistics determine whether the relationships between the variables in the estimated model adequately reflect the relationships observed in the data.

These statistics provide a measure of model fit, allowing us to evaluate how well the observed data align with the specified relationships in the model. By comparing these statistics to established reference criteria, it is possible to determine whether the adjusted model provides an acceptable fit to the data.

It is important to highlight that the analysis of these statistics is crucial for evaluating the validity and reliability of the adjusted model and for determining whether the relationships between the variables are being adequately captured.

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Table 4: *Adjusted model statistics*

Indicator	Recommended measurement	Value in the model
Gl	> 0	5
		0.994
CFI		1.000
TLI		1.088
RMSEA		0.000
SRMR		0.000

This model reflects the essential relationships between the variables considered in the analysis, eliminating those that did not show a significant contribution or whose inclusion did not improve the understanding of the studied phenomenon. This simplification allows for a clearer and more precise interpretation of the relationships between the variables, facilitating the comprehension of the results obtained in the Path Analysis. It is considered that this model provides a solid and effective representation of the underlying structure of the studied phenomenon.

The interpretation of Figure 3: Final model can be summarized as follows:

- Informal work (IW) influences the index of electrical energy coverage (EEI), with an influence of -0.6. This means that higher levels of informal work lead to lower electrical energy coverage in rural areas and municipal capitals in Colombia.
- Informal work (IW) influences the incidence of monetary poverty (IPM), with an influence of 0.33. This means that higher levels of informal work lead to higher incidences of monetary poverty in rural areas and municipal capitals in Colombia.
- The index of electrical energy coverage (EEI) influences the incidence of monetary poverty (IPM), with an influence of -0.39. This means that higher electrical energy coverage leads to lower incidence of monetary poverty in rural areas and municipal capitals in Colombia.

- Illiteracy (ILL) influences the incidence of monetary poverty (IPM), with an influence of 0.48. This means that higher illiteracy leads to higher incidence of monetary poverty in rural areas and municipal capitals in Colombia.

These findings provide an important understanding of the relationships between these variables in the context of rural areas in Colombia, highlighting the importance of addressing informal work, improving electric energy coverage, and combating illiteracy to reduce the incidence of monetary poverty in these communities.

The regression values are represented in Figure 4: Regression values, where the significance of each estimator in the model can be observed. This visual representation allows for a clearer and more objective identification of the relationships and the impact of each variable in the model.

Figure 4: *Regression values*

Regressions:

	Estimate	Std.Err	z-value	P(>|z|)	Std.lv	Std.all
EEI ~						
IW	-0.600	0.152	-3.944	0.000	-0.600	-0.559
IPM ~						
ILL	0.484	0.117	4.128	0.000	0.484	0.483
IW	0.333	0.128	2.594	0.009	0.333	0.325
EEI	-0.390	0.084	-4.653	0.000	-0.390	-0.408

6. Discussion of the results and suggestions

Throughout history, different countries have experienced remarkable periods of economic growth, often referred to as “economic miracles.” One well-known example is the Marshall Plan, which contributed to the recovery of countries such as Germany, Greece, and other Western European nations after World War II. The plan focused on substantial investments, the removal of trade barriers, the reduction of trade regulations, and the promotion of productivity, labor unions, and new business models (McCourt and Mudge 2023).

In the case of Colombia, it is essential to implement state policies that improve the population’s situation through various

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interventions. Here are some examples to highlight the importance of implementing changes considered economic miracles.

Japan underwent an economic miracle by overcoming the real estate bubble of the 1980s through continuous improvement of products and processes. This led to an improvement in the population's standard of living, achieved through wages supplemented with state subsidies in health and education (Correa Restrepo 2016).

Similarly, Singapore has shown adaptability over time, initially through "Import Substitution Industrialization," then transitioning to "Export-Oriented Industrialization," and more recently focusing on building a "Knowledge-Based Economy." This strategy emphasized the educational development of the population to attract foreign investments and develop local industries, with a strong emphasis on educational quality (David Mesa Noack 2024). High-quality education was realized through investment in teachers and the recognition of individual differences among students. This approach provides more learning time to students who need it while prioritizing educational quality over the quantity of content. Furthermore, challenging tasks are offered to exceptional students, creating a more inclusive and stimulating educational environment.

Another example can be seen in Germany, known for its low unemployment rate, economic growth, and increased exports. However, the country is currently grappling with problems such as wage stagnation, leading to a decrease in the standard of living and domestic consumption. Job instability is a major factor, as the average job consists of only 12 hours per week and lacks social security. There is also a crisis in the pension system, increasing the country's poverty risk (Marcelo Justo 2024).

Some of these interventions have been attempted in Colombia. For example, measures such as free public primary and secondary education have been put in place to enhance access to education and reduce educational segregation. Despite these efforts, the country still struggles to improve the level of education due to the insufficient recruitment of highly qualified teachers with better salaries. Private and expensive education continues to dominate, leading to significant

disparities, especially in rural areas where private schools are scarce (Armando Montenegro y Rafael Rivas 2005; Ángel Pérez 2023).

The research has demonstrated the direct and indirect impact of informal work on the level of monetary poverty in rural areas and municipal centers in Colombia. This emphasizes the importance of focusing on formalizing jobs to reduce the incidence of monetary poverty. This issue is not unique to Colombia. The International Labour Organization (ILO), a specialized agency of the United Nations, is dedicated to promoting social justice and improving working conditions worldwide. The ILO has recognized that informal employment poses a significant barrier to maximizing the potential of a core sector in the economy. In response, the ILO has initiated the FORLAC project (Formalization of Informality) to facilitate the transition from the informal to the formal economy in the Latin American and Caribbean regions.

This project focuses on addressing the equation: , identifying the costs associated with labor informality that perpetuate poverty, limit productivity, and deepen inequality in these regions. The ILO recognizes the importance of formalizing informal employment to improve working conditions, promote inclusive economic growth, and reduce socioeconomic disparities in the region (International Labour Organization [no date]).

In Colombia, formal employees have access to a series of labor benefits covering important aspects of their well-being and their families. These benefits include the right to social security, regular wages, a service bonus (equivalent to a month's salary annually), provision of work clothing and footwear, paid rest on Sundays and holidays, interest on severance pay (a savings fund for workers), and paid vacations. These benefits significantly cover the basic needs of individuals and their families.

However, despite these benefits, according to DANE, informal work in rural areas of Colombia reached an alarming 83.3% in 2022, while the incidence of monetary poverty in these same areas increased to 23.3% for the same year. Nationally, informal work represented 55.7% of the workforce, and the incidence of monetary poverty was 13.8% in 2022.

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These figures reveal a concerning situation regarding labor informality and monetary poverty in Colombia, especially in rural areas. The high percentage of informal work indicates a lack of access to formal jobs with adequate labor benefits, contributing to a higher incidence of monetary poverty. This situation highlights the importance of addressing informal work and promoting labor formalization as part of strategies to improve the socioeconomic conditions of rural communities and the country as a whole.

According to this and other research, informal work and illiteracy are key factors that need to be addressed in countries to reduce monetary poverty. In Colombia, efforts have been made to improve working conditions, but controlling informal work requires long-term action as it remains widespread. Similarly, although policies have been implemented to combat illiteracy, ongoing efforts are necessary.

The study also reveals that an increase in electricity coverage significantly contributes to reducing monetary poverty. While this requires substantial investment, it is a necessary solution that should be guaranteed in the short term. Access to electricity is not only a fundamental right but also helps to diminish social inequality by ensuring equal opportunities.

7. Conclusions

The electricity coverage level directly impacts the incidence of monetary poverty in Colombia, which is a significant finding for advancing towards Sustainable Development Goal 1 (SDG 1), which aims to eliminate poverty in all its forms and dimensions.

Informal work has both direct and indirect effects on the incidence of monetary poverty in the country. Implementing policies that encourage formal and decent work, aligning with SDG 8, which aims for decent work and sustained economic growth.

The study has shown that in order to address the measurement and reduction of monetary poverty effectively, it is recommended to simplify the selection of indicators. This will focus efforts on key factors that facilitate assessing and monitoring changes in socio-economic conditions. Even though it is known that installing a

safe and reliable electricity service is not profitable for individuals or private companies, improving access to electricity leads to a reduction in informal work. This, in turn, would decrease the incidence of monetary poverty in rural areas and municipal centers in Colombia.

Taking a comprehensive approach that combines improvements in basic service coverage with strategies for inclusive and sustainable economic development is important. We need public policy to serve as a planning tool aimed at achieving priority objectives that enhance electricity service in the country. In the long term, promoting adequate working conditions and formalizing employment will significantly reduce poverty.

Given the diversity and complexity of poverty in Colombia, it is crucial to focus efforts and resources on the most vulnerable areas and populations. This will ensure greater effectiveness of interventions and a positive impact on the quality of life of affected communities. Therefore, reducing monetary poverty in rural areas and municipal centers through investments by public entities will improve access to informal work, ultimately leading to a decrease in the incidence of monetary poverty in these areas over the long term.

To effectively address monetary poverty in Colombia, a comprehensive approach is needed to tackle the issue's root causes and visible effects. This involves using more detailed indicators and directing public funds towards enhancing access to electricity in rural areas and urban centers. Implementing these policies is crucial for promoting fair employment opportunities and fostering inclusive progress, which are necessary for building a more prosperous and just society.

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