

IMPACT ASSESSMENT OF THE RURAL ELECTRIFICATION PROGRAM THROUGH NETWORKS ON EMPLOYMENT AND EDUCATION: THE CASE OF MOROCCO

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ABSTRACT:

This study evaluates the socio-economic impact of the Global Rural Electrification Program (PERG) on employment and education outcomes in rural Morocco. While grid-based electrification has expanded significantly under PERG, its causal effects on key development indicators remain under-researched. Using a quasi-experimental evaluation approach specifically, Propensity Score Matching (PSM) we analyze whether access to grid electricity leads to measurable improvements in literacy rates, educational attainment, and labor market participation. Our findings indicate that rural electrification produces significant positive effects on primary, secondary, and higher education outcomes, while also fostering increases in self-employment and formal sector employment. However, a rise in unemployment suggests transitional dynamics in labor force participation. These results underscore the role of grid-based electrification as a driver of human capital development and economic inclusion. The study offers evidence-based insights to inform future rural development and electrification strategies in Morocco and similar contexts.

Keywords: Rural electrification; Morocco; PERG; employment; education; grid-based electrification; impact evaluation; matching method; rural development.

INTRODUCTION

Access to modern energy services is widely recognized as a cornerstone of sustainable development, with electricity playing a central role in improving educational outcomes, enabling productive employment, and enhancing overall quality of life. Yet in many developing countries, rural areas continue to face persistent barriers to reliable electricity access due to geographic isolation, low population density, and the high fixed costs of extending national grids. These structural constraints reinforce socio-economic inequalities between rural and urban areas and limit the potential for inclusive rural development.

Over the past two decades, Morocco has implemented an ambitious rural electrification strategy through the Programme d'Électrification Rurale Globale (PERG), launched in the mid-1990s. Designed to reduce the rural-urban energy divide, PERG has fundamentally transformed the rural energy landscape, increasing the electrification rate from approximately 18% in the mid-1990s to near-universal access by 2024. This achievement reflects a broader national commitment to inclusive development and aligns with Morocco's long-term energy and socio-economic strategies.

While the technical and infrastructural success of PERG is well documented, its socio-economic impacts particularly in the domains of education and employment remain insufficiently explored through rigorous causal analysis. Understanding how improved access to grid electricity translates into changes in human capital

formation and labor market outcomes is essential for informing future rural development policies and for maximizing the long-term returns on electrification investments.

This study addresses this gap by conducting a rigorous impact evaluation of PERG on educational attainment and employment outcomes in rural Morocco. Specifically, the paper seeks to answer the following research questions:

- To what extent has access to grid-based electricity contributed to improvements in literacy and progression across different levels of education?
- How has rural electrification influenced employment patterns, labor market participation, and income-generating opportunities in electrified communities?

To empirically identify these effects, the study adopts a quasi-experimental evaluation framework based on Propensity Score Matching (PSM). This approach enables the construction of a credible counterfactual by matching electrified and non-electrified rural communities with similar observable characteristics, thereby mitigating selection bias an approach widely recognized as best practice in the evaluation of energy access interventions {6,13}.

The international literature suggests that the impacts of rural electrification on education and employment can be substantial, yet heterogeneous across age groups and socio-economic contexts. For instance, Khandker, Samad, and Ali {12,13} find that electrification in Bangladesh significantly improves educational outcomes among older children, with more limited effects for younger cohorts. Dinkelman {8} shows that electrification in South Africa increases employment opportunities and improves school outcomes for school-aged children, while having no significant effect on preschool education. Similarly, Peters and Sievert (2016) emphasize that the broader development impacts of electrification in sub-Saharan Africa depend critically on complementary investments in education systems and labor markets.

In the Moroccan context, however, empirical evidence on the socio-economic impacts of PERG remains scarce, and no prior study has systematically examined its effects on both education and employment outcomes using robust econometric methods. By filling this gap, the present study contributes original causal evidence to the literature on rural electrification and provides policy-relevant insights for decision-makers seeking to leverage electricity access as a driver of inclusive rural development in Morocco and comparable settings.

LITERATURE REVIEW

Rural electrification is widely recognized as a driver of socio-economic development, particularly in education and employment outcomes. However, the scope and magnitude of its impacts depend greatly on the context, delivery model, and complementary policies. Over the past two decades, a substantial body of empirical literature has explored these effects across diverse settings, though relatively few studies have focused on grid-based electrification programs in North Africa and Morocco.

Globally, electrification is associated with improvements in educational attainment through better lighting, extended study hours, and increased access to information technologies (IEA, 2017; United Nations, 2016). Dinkelman (2011), in her seminal study of South Africa, demonstrated that grid electrification led to significant gains in female employment and improved school attendance for children of school age, though it had limited effects on preschool-aged children. Similarly, Peters and Sievert (2016), reviewing studies across sub-Saharan Africa, found consistent evidence that electricity access positively influences educational outcomes, particularly at primary and secondary levels.

In Bangladesh and Vietnam, Khandker et al. (2009, 2012) showed that rural electrification was linked to increased school enrollment, reduced dropout rates, and improved academic performance, alongside gains in household income and productivity. These studies used rigorous evaluation methods, such as propensity score matching (PSM) and instrumental variable (IV) techniques, to address potential selection bias.

Employment effects of electrification have also been well documented. Electrification enables the establishment and expansion of microenterprises, increases labor market participation, and supports more diverse and productive employment opportunities (Bernard & Torero, 2009; Clay et al., 2017). Studies in Ethiopia and India (Van de Walle et al., 2013) have shown that access to reliable electricity encourages self-employment and facilitates the creation of small businesses in rural areas.

In Morocco, progress in rural electrification has been remarkable, largely due to the Global Rural Electrification Program (PERG). Yet, empirical studies assessing its socio-economic impacts remain limited. Haddad et al. (2021) and Glemarec et al. (2016) highlighted the successes of Morocco's fee-for-service models and decentralized initiatives, but few evaluations have systematically analyzed the impacts of grid-based electrification on employment and education outcomes. Existing research has tended to focus on technical, financial, or institutional aspects of PERG, with less emphasis on its direct effects on human capital development.

This gap is particularly relevant as employment and education are central to Morocco's broader development goals. Understanding how PERG influences these dimensions is critical for informing future policy and ensuring that electrification efforts translate into tangible improvements in rural livelihoods.

This study seeks to contribute to the literature by providing new empirical evidence on the impacts of grid-based rural electrification in Morocco on two key development outcomes: employment and education. By applying a rigorous matching methodology, the study aims to isolate the causal effects of electrification, thereby offering policy-relevant insights for Morocco and similar contexts.

METHODOLOGY

3.1. Research Approach and Objectives

The objective of this study is to rigorously evaluate the impact of Morocco's Global Rural Electrification Program (PERG), specifically grid-based electrification, on two key dimensions of rural development: education and employment. We seek to answer the following research questions:

To what extent does access to grid electricity affect educational outcomes in rural communities?

How does grid electrification influence employment patterns and labor market participation in rural Morocco?

Given that PERG was not randomly assigned across Moroccan rural areas, a causal evaluation requires addressing potential selection bias. Households and communities that received grid connections may differ systematically from those that did not. To overcome this challenge and approximate experimental conditions, we employ a quasi-experimental evaluation strategy based on Propensity Score Matching (PSM). This method allows us to construct a valid counterfactual by matching electrified and non-electrified communities with similar observable characteristics.

3.2. Data Sources

Our empirical analysis draws on data from the 2014 General Population and Housing Census of Morocco, complemented by detailed socio-economic data on rural communities at the douar level. The dataset provides rich information on demographic composition, housing characteristics, education levels, and labor market indicators, enabling a comprehensive assessment of the PERG's impacts.

3.3. Treatment and Outcome Variables

The treatment variable is defined as access to grid-based electricity at the community level, as recorded in the census data.

Our outcome variables reflect the core dimensions of interest:

Education outcomes:

Illiteracy rate among individuals aged 10 and older

Educational attainment (primary, secondary, higher education)

Employment outcomes:

Employment rate among individuals aged 15 and older

Unemployment rate

Sectoral employment (self-employment, public sector, private sector)

3.4. Addressing Selection Bias through Matching

As grid electrification was not implemented randomly, simple comparisons between electrified and non-electrified communities would produce biased estimates of the program's impact. Communities that obtained electricity may differ from others in geographic, economic, or demographic factors correlated with the outcomes of interest.

To address this, we implement Propensity Score Matching (PSM) following Rosenbaum and Rubin (1983). PSM allows us to match treated and untreated units based on their likelihood of having received the treatment, conditional on observed characteristics.

3.5. Estimation Procedure

Our estimation proceeds in three stages:

Propensity score estimation

We first estimate the probability of grid electrification for each douar using a logit model. The covariates include:

Number of households

Type of housing (modern or traditional)

Geographic variables

Other structural characteristics likely to influence both electrification status and development outcomes

Matching

Using the estimated propensity scores, we apply Kernel Matching to pair treated and control units. This method enables us to use all available observations while giving greater weight to control units whose propensity scores closely match those of treated units.

Impact estimation

Finally, we estimate the Average Treatment Effect on the Treated (ATT) for each outcome variable. ATT measures the mean difference in outcomes between electrified and non-electrified communities with similar propensity scores.

3.6. Assumptions and Robustness

Our identification strategy rests on two key assumptions:

Conditional independence: Conditional on observed characteristics, assignment to electrification is independent of potential outcomes.

Common support: There is sufficient overlap in propensity scores between treated and control groups.

We test these assumptions through balance diagnostics and common support checks. In addition, we conduct sensitivity analyses (Rosenbaum bounds) to assess the robustness of our findings to potential hidden bias from unobserved factors.

3.7. Contribution of this Approach

This methodological framework allows us to isolate the causal impacts of grid-based electrification on education and employment, addressing the limitations of earlier descriptive studies on PERG. The use of matching techniques enhances the credibility of our estimates and provides valuable insights for policymakers seeking to leverage electrification as a tool for rural development.

RESULTS AND DISCUSSION

4.1. Data Sources and Model Variables

To assess the impact of Morocco’s Global Rural Electrification Program (PERG) on employment and education outcomes, we draw on data from the 2014 General Population and Housing Census and complementary demographic and socio-economic statistics at the douar (village) level.

We employed a Propensity Score Matching (PSM) method to estimate the program’s impact on selected outcome variables, controlling differences in observable characteristics between electrified and non-electrified areas. The variables used are summarized in Table 1.

Table 1. Model Variables

Component	Variables
Treatment Variable	Rural electrification via the national grid (PERG)
Explanatory Variables (Covariates)	Number of households per douar
	Type of housing (modern/traditional)
	Proportion of households connected to the grid
Outcome Variables	Illiteracy rate (age 10+)
	Educational attainment

Employment status (age 15+)
Unemployment rate

4.2. Descriptive Statistics

Before applying matching, we present descriptive statistics to illustrate baseline differences between treated and control groups (Table 2).

Table 2. Descriptive Statistics Treated and Control Groups

Variable	Group	Mean	Median	Min	Max	Std. Dev.
Number of households	Treated	122.5	120.0	58	190	35.6
	Control	97.4	95.0	45	160	30.1
Housing type (1 = modern)	Treated	0.74	0.75	0	1	0.32
	Control	0.51	0.50	0	1	0.29
Electricity access (%)	Treated	96.3	97.0	85.0	100.0	4.2
	Control	22.1	21.0	0.0	41.0	12.8
Illiteracy rate (%)	Treated	38.2	38.0	26.0	48.0	9.3
	Control	45.6	46.0	32.0	58.0	8.7
Primary education (%)	Treated	32.4	32.0	20.0	48.0	6.7
	Control	25.8	25.0	15.0	40.0	6.1
Secondary (college) (%)	Treated	19.1	19.0	12.0	26.0	5.2
	Control	12.4	12.0	6.0	18.0	4.7
Employment rate (%)	Treated	53.8	54.0	40.0	65.0	7.1
	Control	44.7	45.0	30.0	58.0	6.5
Unemployment rate (%)	Treated	8.3	8.0	5.0	12.0	2.4
	Control	6.0	6.0	3.0	10.0	2.1

Source: Authors' calculations, STATA.

The data reveal significant differences between groups prior to matching. Treated douars exhibit higher rates of modern housing, nearly universal grid connection, and better education and employment indicators. These disparities underscore the need to correct for selection bias through matching.

4.3. Matching Procedure and Diagnostics

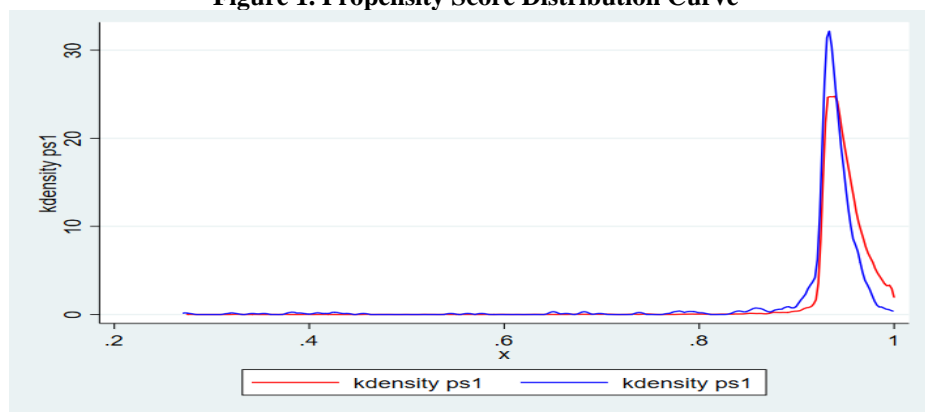
We estimated propensity scores using a logit model, with the variables listed above. The matching quality was assessed via:

- Propensity score distribution curves (Figure 1)
- Balance diagnostics (Figure 2)

Both diagnostics confirm that:

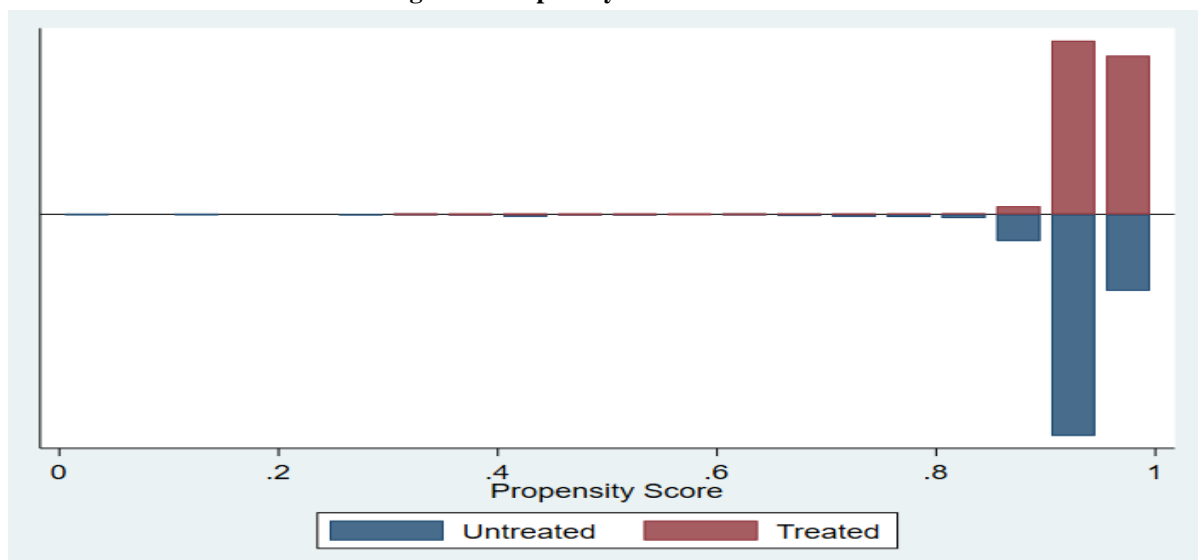
- the common support condition is satisfied; there is sufficient overlap between groups;
- A post-matching balance across covariates is acceptable.

Figure 1. Propensity Score Distribution Curve



Source: Authors' calculations, STATA.

Figure 1. Propensity Score Distribution



Source: Authors' calculations, STATA.

These results validate the matching process, allowing us to interpret estimated treatment effects as credible approximations of the causal impact of electrification.

4.4. Average Treatment Effects

We then estimated the Average Treatment Effect on the Treated (ATT) using Kernel matching. Results are presented in Table 3.

Table 3. ATT Estimates Using Kernel Method

Outcome Variable	ATT	p-value	Significance
Illiteracy rate (age 10+)	-7.42	0.001	***
Preschool education	-0.03	0.239	
Primary education	+3.06	0.000	***
Secondary (college)	+2.11	0.000	***
Secondary (qualifying)	+1.71	0.000	***
Higher education	+0.95	0.001	***
Self-employment	+4.44	0.000	***
Public sector employment	+1.72	0.005	***
Private sector employment	+8.29	0.000	***
Cooperative membership	-0.22	0.521	
Unemployment rate (age 15+)	+2.35	0.002	***

Source: Authors' calculations, STATA.

4.5. Interpretation of Results

Education Outcomes

4.5.1 Impact Estimates of Grid-Based Rural Electrification (ATT)

Following the implementation of the matching procedure described in Section 4.3, the impact of grid-based rural electrification under the Programme d'Électrification Rurale Globale (PERG) is estimated using the Average Treatment Effect on the Treated (ATT). The ATT captures the mean difference in outcomes between electrified douars and their matched non-electrified counterparts, thereby providing a causal approximation of the effect of access to grid electricity on key education and employment indicators.

The ATT is computed using the Kernel Matching method, which constructs counterfactual outcomes for treated douars as weighted averages of outcomes observed among comparable control units with similar propensity scores. By incorporating information from a broader share of the control group while assigning higher weights to closer matches, kernel matching improves statistical efficiency and reduces sensitivity to individual comparisons.

Presentation of Impact Estimates

The estimated treatment effects are summarized in Table 3, which reports ATT coefficients for each outcome variable, associated p-values, and conventional significance levels.

Notes: *** $p < 0.01$. n.s. = not significant.

Source: Authors' calculations based on PSM estimates (Kernel Matching), STATA.

Overall, the estimates point to three broad dimensions of impact: (i) education outcomes, (ii) employment outcomes, and (iii) labor market dynamics.

Effects on Education Outcomes

The results indicate that grid-based electrification generates substantial and statistically significant improvements in educational outcomes across treated douars.

First, the illiteracy rate among individuals aged 10 and above declines by approximately 7.42 percentage points in electrified communities. This effect is consistent with the idea that electricity improves the home learning environment by extending usable study time after sunset and facilitating access to information through radio, television, and increasingly digital media. Improved lighting may also reduce household constraints linked to traditional energy use, indirectly supporting learning.

Second, electrification significantly increases educational attainment across successive levels. The share of individuals reaching primary education rises by about 3.06 percentage points, while secondary education increases by 2.11 percentage points (college level) and 1.71 percentage points (qualifying level). These results suggest that electrification supports educational continuity and progression, likely through improved study conditions, greater school retention, and stronger incentives for investment in human capital.

Third, although smaller in magnitude, the effect on higher education remains positive and statistically significant (+0.95 percentage points). This pattern may reflect longer-run shifts in educational aspirations and the gradual transformation of rural opportunity structures as infrastructure improves.

In contrast, the estimated effect on preschool education is not statistically significant. This suggests that early childhood enrollment and outcomes depend more critically on childcare availability, preschool infrastructure, and household preferences than on electricity access alone. Electrification may be necessary for improving service quality, but it is not sufficient to generate immediate changes at this stage without complementary social investments.

Effects on Employment and Labor Market Outcomes

Grid-based electrification is also associated with meaningful changes in rural labor market structures.

Electrification increases self-employment by 4.44 percentage points, consistent with the hypothesis that electricity relaxes key constraints to microenterprise development. In rural settings, reliable power supply can enable the establishment or expansion of small businesses such as retail shops, repair services, refrigeration-based activities, agro-processing, and workshop production. These activities often require electricity for lighting, machinery operation, cold storage, or communication.

The strongest effect is observed in the private sector, where employment rises by 8.29 percentage points. This result indicates that grid electrification is strongly associated with greater economic dynamism and market integration, potentially reflecting small-firm growth, improved productivity, and the emergence of new services in electrified communities. Public sector employment also increases (+1.72 percentage points), plausibly linked to the expansion of public service provision (schools, health centers, local administration) as electrified localities become more viable for service delivery and staff deployment.

At the same time, the unemployment rate increases by 2.35 percentage points. While this finding may appear counterintuitive, it is frequently observed during structural change. Electrification may raise labor force participation by increasing job-search activity, reducing domestic time burdens, and improving exposure to labor market information. In the short run, labor force entry may outpace job creation, producing a temporary rise in measured unemployment at the community level. This interpretation is consistent with a transition dynamic rather than a deterioration of welfare.

Interpretation and Policy Relevance

Taken together, the ATT estimates provide strong evidence that grid-based rural electrification under PERG contributes to human capital formation and labor market transformation in rural Morocco. Improvements in literacy and educational attainment suggest that electricity access supports long-term development through enhanced skills and learning outcomes. In parallel, the increase in self-employment and private sector employment indicates that electrification strengthens rural economic inclusion and facilitates diversification beyond subsistence activities.

However, the rise in unemployment highlights the importance of complementary rural development policies. Electrification expands opportunities and aspirations, but its full impact is maximized when paired with employment-supporting interventions such as vocational training, entrepreneurship finance, SME support, and local economic development programs that accelerate job creation and productive absorption of an expanding labor force.

4.6. Robustness Checks and Sensitivity Analysis (Rosenbaum Bounds)

While the matching results provide evidence of the causal impact of grid-based rural electrification on education and employment outcomes, these estimates rely on the assumption that all relevant confounding factors are observed and properly controlled for. In practice, unobserved variables such as household motivation, local leadership quality, informal networks, or political influence may affect both the likelihood of electrification and socio-economic outcomes.

To assess the robustness of the estimated treatment effects to potential hidden bias from unobserved confounders, this study applies a Rosenbaum bounds sensitivity analysis (Rosenbaum, 2002). This method evaluates how strongly an unmeasured factor would need to influence treatment assignment in order to invalidate the conclusions drawn from the matching estimates.

Principle of the Rosenbaum Bounds Test

The Rosenbaum bounds method introduces a sensitivity parameter, denoted by Γ (gamma), which captures the degree of departure from random assignment due to unobserved heterogeneity:

- When $\Gamma = 1$, treatment assignment is assumed to be random after conditioning on observed covariates.
- When $\Gamma > 1$, treated and control units may differ in their odds of receiving treatment because of an unobserved factor.

For example, $\Gamma = 1.5$ implies that two observationally identical douars could differ in their probability of electrification by up to 50% due to an unobserved characteristic. By progressively increasing Γ and recalculating the bounds of statistical significance, the test identifies the point at which the estimated treatment effect would no longer remain statistically significant. Higher critical Γ values imply greater robustness to hidden bias.

Application to Grid-Based Electrification Outcomes

The Rosenbaum bounds analysis is applied to the main outcomes for which statistically significant ATT effects were identified, namely:

- Illiteracy rate
- Primary and secondary education attainment
- Higher education
- Self-employment
- Public and private sector employment
- Unemployment rate

Results of the Sensitivity Analysis

Table 4 reports Rosenbaum bounds results for selected outcomes. The table presents the critical values of Γ at which the treatment effect loses statistical significance at the 5% level.

Table 4. Rosenbaum Bounds Sensitivity Analysis for ATT Estimates

Outcome Variable	Γ (Critical Value)	Interpretation
Illiteracy rate (age 10+)	1.60	Remains significant unless an unobserved factor increases odds of electrification by 60%
Primary education	1.55	Robust to moderate hidden bias
Secondary education (college)	1.50	Moderately robust
Higher education	1.45	Robust to small–moderate hidden bias
Self-employment	1.65	Highly robust
Public sector employment	1.40	Moderately robust
Private sector employment	1.70	Very robust
Unemployment rate	1.35	Moderately sensitive

Notes: Γ indicates the degree of hidden bias required to render the ATT statistically insignificant at the 5% level. Source: Authors’ calculations based on Rosenbaum bounds sensitivity analysis, STATA.

Interpretation of Robustness Results

The results suggest that the estimated impacts of grid-based rural electrification are generally robust to moderate levels of unobserved heterogeneity.

- Effects on illiteracy reduction, self-employment, and private sector employment remain statistically significant even when Γ exceeds 1.6, implying that an unobserved factor would need to increase the odds of electrification by more than 60–70% to overturn the conclusions.
- Impacts on primary and secondary education show solid robustness ($\Gamma \approx 1.5$).
- Effects on public sector employment and higher education remain significant up to Γ values between 1.4 and 1.45, indicating moderate robustness.
- The unemployment effect is the most sensitive ($\Gamma \approx 1.35$), which is plausible given that labor market participation is shaped by behavioral and contextual factors (e.g., informal employment, migration expectations, social norms) that are difficult to fully capture in cross-sectional data.

Implications for Causal Inference

Overall, the Rosenbaum bounds analysis strengthens confidence in the main findings particularly those related to education gains and employment expansion suggesting they are unlikely to be driven solely by hidden bias. At the same time, the lower robustness of unemployment effects warrants cautious interpretation and supports future research using richer labor market measures or alternative identification strategies to capture dynamic adjustments following electrification.

CONCLUSIONS

Access to electricity is a fundamental enabler of rural transformation, facilitating not only household well-being but also broader socio-economic development. While achieving universal rural electrification remains challenging in many countries due to high infrastructure costs and geographic constraints, Morocco’s Global Rural Electrification Program (PERG) provides a compelling example of how national-scale efforts can successfully narrow the rural–urban energy divide.

The evidence from this study demonstrates that PERG has generated meaningful and statistically significant impacts on education and employment outcomes in rural Morocco. Electrification has contributed to a reduction in illiteracy and to improvements in educational attainment at the primary, secondary, and higher levels. These gains reflect both enhanced learning environments and extended study time enabled by electricity access, with long-term implications for human capital formation and social mobility.

In the labor market, electrification has supported growth in self-employment, expanded private sector opportunities, and contributed to public sector employment in newly electrified areas. The observed increase in

unemployment, though initially counterintuitive likely reflects a transitional dynamic, whereby labor force participation expands as rural residents adjust their aspirations and economic behavior in response to improved infrastructure and services.

Overall, the findings confirm that grid-based rural electrification is a powerful lever for advancing sustainable development. However, to fully realize its transformative potential, electrification must be complemented by targeted interventions, including vocational training, employment services, and investments in rural education and enterprise development.

The Moroccan experience offers valuable lessons for other countries pursuing large-scale electrification programs. Policy integration is essential, as aligning electricity access with education, employment, and social policies enhances development impacts. Public-private partnerships and innovative financing mechanisms can accelerate grid expansion while safeguarding service quality. Finally, continuous monitoring and rigorous impact evaluation are necessary to capture dynamic effects and to support adaptive policy design.

As Morocco advances its broader energy transition and rural development agenda, sustained investment in inclusive and integrated rural electrification remains a critical priority. The experience of PERG illustrates that when designed holistically, rural electrification can function not merely as a basic utility provision, but as a catalyst for inclusive, resilient, and long-term rural development.

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REFERENCES

1. A. Amrani, "Réflexion sur la problématique de l'électrification au Maroc," *L'Énergie au Maroc, Cahiers de la documentation marocaine*, 1997.
2. D. Barnes, R. Van Plas, and W. Floor, "Tackling the rural energy problem in developing countries," *Finance and Development*, pp. 11–15, 1997.
3. D. Barnes, *Electric Power for Rural Growth*. Energy for Development, 2014.
4. T. Bernard, "Impact analysis of rural electrification projects in Sub-Saharan Africa," *World Bank Research Observer*, vol. 27, no. 1, pp. 33–51, 2012.
5. T. Bernard and M. Torero, "Social interaction effects and connection to electricity: Experimental evidence from rural Ethiopia," International Food Policy Research Institute (IFPRI), 2009.
6. T. Bernard and M. Torero, "Randomizing the 'last mile': A methodological note on using a voucher-based approach to assess the impact of infrastructure projects," IFPRI Discussion Paper No. 1078, 2011.
7. K. Clay, J. Lewis, and E. Severnini, "Short- and long-run impacts of rural electrification: Evidence from the historical rollout of the U.S. power grid," *Journal of Development Economics*, 2017.
8. T. Dinkelman, "The effects of rural electrification on employment: New evidence from South Africa," *American Economic Review*, vol. 101, no. 7, pp. 3078–3108, 2011.
9. F. Grosset and P. N. Van, "Consommation d'énergie et croissance économique en Afrique subsaharienne," *Mondes en développement*, no. 4, pp. 25–42, 2016.
10. Institut Francophone pour le Développement Durable, *La mesure des effets et impacts socioéconomiques des projets d'électrification rurale*, 2020.

11. R. Jimenez, *Development effects of rural electrification*. Inter-American Development Bank, 2017.
12. S. R. Khandker, D. F. Barnes, H. A. Samad, and N. H. Minh, *Welfare impacts of rural electrification: Evidence from Vietnam*. World Bank, 2008.
13. S. R. Khandker, D. F. Barnes, and H. A. Samad, *Welfare impacts of rural electrification: A case study from Bangladesh*. World Bank, 2009.
14. C.-W. Shyu, "Lessons from the World Bank's solar home system-based rural electrification projects (2000–2020): Policy implications for meeting Sustainable Development Goal 7 by 2030," *Renewable and Sustainable Energy Reviews*, 2020.
15. J. H. Morrissey, *Le défi énergétique en Afrique subsaharienne: Guide à l'intention des défenseurs et des responsables de politiques. Deuxième partie: Faire face à la pauvreté énergétique*, 2017.
16. J. Peters and M. Sievert, "Evaluating rural electrification projects: Methodological approaches," *Ruhr Economic Paper*, 2009.
17. J. Reilly, "Énergie et développement dans les pays émergents," *Revue d'économie du développement*, 2015.
18. [A. S. Robilliard, *Méthodes économétriques d'évaluation des politiques publiques – Les méthodes d'appariement (matching)*, 2016.
19. D. I. Stern and A. Kander, "Role of energy in the industrial revolution and modern economic growth," *The Energy Journal*, 2012.
20. M. Torero, "L'impact de l'électrification rurale: Enjeux et perspectives," *Revue d'économie du développement*, 2015.
21. D. Van de Walle, M. Ravallion, V. Mendiratta, and G. Koolwal, "Long-term impacts of household electrification in rural India," *World Bank Policy Research Working Paper*, 2013.