Education as a Driver of Sectoral Employment in Rwanda: A Panel Regression Analysis of Selected Economic Sectors (2019–2023)

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ABSTRACT

This study investigates the influence of educational attainment on sectoral labor absorption in Rwanda, utilizing a panel regression framework across thirteen economic sectors from 2019 to 2023. Grounded in Human Capital Theory, the research evaluates how varying levels of schooling dictate the distribution of employment within an evolving economy. Drawing on secondary data from the National Institute of Statistics of Rwanda (NISR) Labour Force Surveys, the analysis employs descriptive statistics, trend analysis, and econometric modeling. Diagnostic testing via the Hausman specification ($\chi^2 = 0.03$, $p = 0.8718$) confirmed the suitability of the Random Effects model for the longitudinal data. The findings reveal a persistent reliance on primary and lower secondary education within low-productivity sectors, notably agriculture. While agriculture's share of informal employment contracted from 61.2% in 2019 to 51.7% by 2023, it remains a primary labor sponge for the unskilled workforce. Conversely, a robust positive correlation ($r = 0.80$) was observed between university-level attainment and growth in knowledge-intensive domains, including finance, ICT, and education. These results suggest a steady structural transition, with labor force participation in services rising from 53.3% to 59.3% during the study period. The research concludes that while education acts as a critical driver of labor market transformation, a significant quality gap remains. Policy recommendations emphasize the strategic decentralization of high-value services and the alignment of technical and vocational training with specific industrial demands to ensure sustainable, inclusive economic growth in Rwanda.

Keywords: Education; Sectoral Employment; Human Capital Theory; Panel Data Analysis; Labour Market; Structural Transformation.

INTRODUCTION

Education is widely recognized as a fundamental human right and a critical catalyst for the social, economic, and cultural development of any nation. Under the International Standard Classification of Education (ISCED) framework, formal education is viewed as a structured pathway designed to equip individuals with the skills necessary for labor market entry (UNESCO, 2011). Globally, the link between educational attainment and economic participation is well-documented; for instance, recent data from the European Union indicates that over 83% of recent graduates are successfully integrated into the workforce, with tertiary education significantly boosting employability (Eurostat, 2024). However, in developing regions, particularly in Sub-Saharan Africa, the transition from educational attainment to gainful employment remains a complex challenge characterized by structural mismatches and sectoral imbalances.

In the East African Community (EAC), despite an impressive gross primary enrollment rate of 104% in 2020 for primary school is above Africa's average of 102%, but only 68% of age learner;s complete primary school that displays the region faces a persistent "skills mismatch" (ISS Africa Futures, 2024). Many students exiting higher education struggle to find employment, suggesting that the curriculum may not align with the evolving needs of the modern labor market. Furthermore, the Sub-Saharan workforce remains heavily concentrated in the agricultural sector which employs over 50% of the population while high-productivity sectors such as industry and advanced services remain underdeveloped (World Bank, 2023).

Rwanda provides a unique case study within this regional context. The government of Rwanda has prioritized

the development of a knowledge-based economy, emphasizing productivity and skill enhancement. According to the National Institute of Statistics of Rwanda (NISR, 2023), the working-age population (16 years and above) has shown steady growth, yet the educational profile of the labor force remains skewed. Approximately 46% of the current labor force has not completed any formal education, while university graduates represent only a small fraction (5.8%).

The labor market dynamics in Rwanda between 2019 and 2023 reveal significant fluctuations in employment health. While the labor force participation rate grew to 59.3% by 2023, unemployment rates have remained volatile, peaking at 21.1% in 2021 before receding to 17.2% in 2023 (NISR, 2019-2023). Notably, gender and regional disparities persist, with unemployment consistently higher among women and those in rural areas. This period, marked by both global economic shifts and local policy interventions, raises a critical question: how effectively do different levels of education drive employment across Rwanda's diverse economic sectors?

Despite various descriptive reports on Rwanda's labor force, there is a scarcity of empirical research that applies panel regression to analyze how specific education levels ranging from primary to tertiary influence employment rates across different economic sectors. Most existing studies focus on aggregate unemployment rather than sectoral distribution. This study addresses this gap by examining thirteen economic sectors over a five-year period (2019–2023). This study aims to (i) examine the impact of educational attainment on sectoral employment rates, . Specifically, (ii) assess the relationship between different education levels and labor absorption across sectors, and (iii) evaluate the role of regional disparities in shaping employment outcomes. By providing sector-specific evidence, the study contributes to a better understanding of labor market dynamics and informs policies aimed at aligning education systems with economic transformation in Rwanda.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

This section provides the theoretical and empirical foundation for analyzing the relationship between educational attainment and sectoral employment in Rwanda. It begins by presenting the theoretical framework, with particular emphasis on Human Capital Theory, which explains how education influences labour market outcomes and employment opportunities across economic sectors. This is followed by an empirical review of global and regional studies regarding education and employment. Finally, the section explores the specific dynamics of Rwanda's sectoral labor market and the influence of regional disparities (urban vs. rural) on the workforce distribution.

Theoretical Framework

The theoretical foundation of this study is rooted in the Human Capital Theory, primarily pioneered by Gary Becker (1964) and Jacob Mincer (1974). This theory posits that education is not merely a form of consumption but a strategic investment in human capital. According to this perspective, individuals acquire skills, knowledge, and competencies through formal schooling that enhance their cognitive abilities and technical efficiency. In the context of the labor market, these accumulated attributes increase an individual's marginal productivity, making them more attractive to employers and thus increasing their probability of employment and higher earnings.

In the framework of this research, Human Capital Theory provides a lens to understand the varying employment rates across Rwanda's thirteen economic sectors. The theory suggests that sectors requiring high levels of technical sophistication such as Information and Communication (ICT), Financial and Insurance activities, and Education demand a higher stock of human capital. Consequently, individuals with tertiary education are expected to find higher employment rates in these modern sectors. Conversely, in more traditional sectors like Agriculture, Forestry, and Fishing, the required human capital may be lower, allowing for the absorption of labor with primary or no formal education.

Furthermore, the theory helps explain regional disparities in employment patterns. It suggests that urban environments often generate higher returns on education due to the concentration of specialized industries, infrastructure, and formal employment opportunities whereas rural areas may lack the infrastructure to reward high educational attainment, leading to the observed concentration of low-skilled labor in those regions. By applying this theory, the study evaluates whether educational investments in Rwanda are effectively translated

into sectoral employment, or if structural barriers lead to a skills-mismatch where the supply of educated labor does not meet the specific demands of the evolving economy.

Empirical Review of Education and Employment

The relationship between educational attainment and employment outcomes has been extensively documented across various economic landscapes. Globally, research consistently indicates that education is a primary predictor of labor market success. In the European context, Tudor et al. (2023) and Kpran et al. (2023) demonstrated that higher educational investment and tertiary attainment are directly correlated with increased productivity, higher wages, and reduced unemployment rates. These findings are supported by Ali & Jalal (2018), whose regression analysis identified higher education as a crucial predictor of employment outcomes, and Akpezi & Amah (2024), who underlined the qualitative role of higher institutions in shaping the effectiveness of the future workforce.

In developing economies, particularly in Sub-Saharan Africa, the empirical evidence highlights a more nuanced structural reality. While education generally improves employability, its impact varies significantly across different types of employment. For instance, in Cameroon and Kenya, studies by Angyie et al. (2022) and Elima (2015) reveal that while any level of education improves the likelihood of finding a job compared to having no formal schooling, the *type* of education—such as Technical and Vocational Education and Training (TVET)—often yields higher immediate employability in specific sectors. Furthermore, Demissie (2023) and Magableh et al. (2022) emphasize that the economic returns on higher education are not only positive but statistically significant in the long run, with labor productivity increasing as educational investments grow.

A critical theme in the empirical literature is the "sectoral and structural shift" necessitated by education. Sparreboom (2017) observed that for countries in Sub-Saharan Africa to exploit structural change, educational levels must rise to meet the needs of modernizing economies. This is particularly evident in the transition from informal to formal sectors. Wambugu (2011) and Rukundo (2015) both found that individuals with lower education levels are predominantly absorbed by the agricultural and informal sectors, characterized by low earnings and productivity. In contrast, higher educational attainment acts as a gateway to formal employment and higher-productivity sectors, effectively reducing an individual's likelihood of remaining in the informal economy.

In the specific context of Rwanda, the empirical link between education and economic growth has been established through the lens of human capital productivity. Rwigema (2020) applied a Cobb-Douglas production function to demonstrate that human capital is a significant independent factor in determining Rwanda's output level. However, a gap remains in understanding how these education levels interact specifically with the thirteen distinct economic sectors over recent years (2019–2023). While existing studies like those by Palaz et al. (2011) and Hadjari & Fetai (2022) confirm that education affects labor force participation across various geographies, this study seeks to provide a more granular panel analysis of Rwanda's sectoral dynamics and regional disparities to better inform targeted policy interventions.

Sectoral Dynamics and the Spatial Distribution of Labor in Rwanda

The relationship between education and employment in Rwanda is defined by a three-tiered structural classification that mirrors the country's technical complexity and regional disparities. National data indicates that the labor market remains heavily anchored in primary and extractive sectors, specifically agriculture, which absorbs 43.5% of the workforce (NISR, 2023). These rural-based activities function as "labor sponges" for the unskilled population, with nearly half of the participants approximately 46.1% lacking formal education (NISR, 2023). This reflects a significant geographic "profitability gap" where rural markets currently lack the structural capacity to reward higher educational attainment (Le & Chung, 2020).

In contrast, the industrial and transformative sectors driven by construction, which employs 9.8% of the workforce, and manufacturing represent a middle-ground in labor dynamics. However, this tier is marked by a notable structural mismatch; according to NISR (2023), unemployment peaks among those with lower and upper secondary education at 19.7% and 23.1%, respectively. This suggests a misalignment between technical

curricula and industrial demand, or an insufficient scale of industrial growth to absorb the rising secondary-educated cohort.

Finally, service-oriented and knowledge-based sectors, such as ICT, finance, and education, constitute the most specialized segment of the economy. While these urban-centric fields offer the highest stability and demand for university graduates who face the lowest unemployment rate at 14.2% this group represents only 5.8% of the total labor volume (NISR, 2023). This concentration underscores a stark spatial-sectoral divide, where the benefits of tertiary education are almost exclusively confined to urban service hubs, highlighting the persistent challenge of expanding Rwanda's knowledge-based economy to the broader population.

RESEARCH METHODOLOGY

Research Design and Data Source

This study adopts a quantitative, explanatory research design to examine the impact of educational attainment on employment rates. The analysis utilizes secondary panel data extracted from the National Institute of Statistics of Rwanda (NISR) Labor Force Surveys for the period 2019–2023. While the initial population consisted of 20 economic activities, the final sample was narrowed to thirteen (13) sectors to ensure data consistency, particularly for the 2020 period affected by COVID-19, and to maintain the required threshold for robust panel regression.

Model Specification

To estimate the relationship between variables, the study employs a Panel Data Regression Model. The general functional form of the model is expressed as:

$$Y_{it} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} Edu_{it} + \boldsymbol{\beta_2}\, Reg_{it} + \boldsymbol{\varepsilon}_{it}$$

The dependent variable ($\mathbf{Y_{it}}$) represents the sectoral employment rate, calculated as the proportion of the working-age population absorbed within a specific industry. The primary independent variable ($\mathbf{Edu_{it}}$) is a vector representing four tiers of educational attainment: no formal education, primary, secondary, and university levels. To account for the structural duality of the Rwandan economy, Regional Location ($\mathbf{Reg_{it}}$) is incorporated as a binary control variable (Urban vs. Rural), while $\boldsymbol{\varepsilon}_{it}$ represents the idiosyncratic error term. This allows the model to filter for spatial disparities that often dictate whether highly educated labor is effectively utilized or remains underemployed in rural contexts.

Econometric Procedure and Diagnostic Testing

The analysis follows a systematic three-stage protocol. Initially, descriptive statistics establish the baseline labor distribution across the thirteen selected sectors. In the second stage, a Pearson correlation analysis is performed as a diagnostic measure to screen for multicollinearity and to evaluate the preliminary directional strength between variables. Finally, Multiple Panel Regression is executed to quantify the specific impact of educational attainment on employment patterns. To ensure the selection of an efficient and unbiased estimator, the Hausman Specification Test (1978) was applied. With a resulting Chi-square value of 0.03 ($p = 0.8718$), the Random Effects (RE) model was identified as the most appropriate framework for controlling for unobserved sectoral heterogeneity. All estimations were performed using STATA/SE 15.0.

RESULTS AND DISCUSSION

This section presents the findings of the study based on the analysis of NISR Labor Force Survey data (2019–2023). The results are organized according to the research objectives: first, a descriptive overview of the sectors; second, the correlation between variables; and third, the regression analysis.

Descriptive Profile of Sectoral Employment and Education

This section presents the summary statistics for the thirteen selected economic sectors in Rwanda. The analysis is based on **quarterly observations** spanning from 2019 to 2023. By using quarterly data, the study is able to capture short-term fluctuations and seasonal trends in labor absorption that annual data might otherwise overlook. The descriptive results in Table 4.1.1 provide a profile of human capital across the thirteen sectors. The means represent the average quarterly headcount, while the standard deviation (SD) reflects the degree of variation across the five-year period.

Table 4.1.1: Quarterly Mean and SD of Educational Attainment by All Sector

Sector (S-ID)	Emp. Rate Mean (SD)	No Education Mean (SD)	Primary Mean (SD)	Lower Sec. Mean (SD)	Upper Sec. Mean (SD)	University Mean (SD)
S-ID 1: Mining	0.0145 (0.005)	28,799 (10,406)	16,117 (5,309)	2,252 (1,215)	1,697 (1,432)	945 (327)
S-ID 2: Construct.	0.1020 (0.006)	161,140 (8,232)	129,451 (16,321)	26,857 (7,205)	30,271 (4,131)	10,547 (667)
S-ID 3: Finance	0.0096 (0.001)	2,284 (1,198)	4,180 (2,175)	2,559 (774)	10,120 (2,088)	6,479 (2,117)
S-ID 4: Real Estate	0.0011 (0.000)	1,146 (394)	1,221 (626)	402 (528)	674 (217)	457 (335)
S-ID 5: Agriculture	0.4385 (0.046)	1,000,644 (117,771)	459,743 (90,018)	51,093 (13,820)	26,595 (5,622)	5,040 (780)
S-ID 6: Education	0.0390 (0.002)	6,976 (2,717)	8,901 (4,421)	3,335 (1,009)	65,862 (11,137)	52,913 (4,325)
S-ID 7: ICT	0.0030 (0.000)	286 (201)	949 (340)	413 (381)	2,614 (823)	6,479 (1,080)
S-ID 8: Health	0.0134 (0.001)	1,589 (661)	3,274 (268)	1,251 (624)	9,336 (1,007)	31,312 (3,554)
S-ID 9: Manufact.	0.0550 (0.005)	64,775 (16,357)	78,776 (11,756)	23,483 (4,474)	18,144 (3,466)	7,827 (1,844)
S-ID 10: Electric.	0.0018 (0.000)	833 (911)	939 (753)	404 (423)	1,424 (1,060)	2,766 (958)
S-ID 11: Water/Wst.	0.0016 (0.000)	1,169 (329)	1,125 (525)	584 (533)	1,095 (621)	1,503 (1,210)
S-ID 12: Transport	0.0535 (0.004)	82,753 (17,518)	70,481 (12,145)	16,448 (2,460)	14,193 (2,367)	5,398 (656)
S-ID 13: Arts/Rec.	0.0024 (0.000)	1,329 (458)	1,248 (499)	531 (525)	3,773 (847)	1,747 (1,089)

Source: Researcher's calculation based on NISR LFS data using STATA/SE 15.0 (2025). **Note:** Employment Rate is expressed as a decimal (e.g., 0.4385 = 43.85%). Education values represent the mean quarterly headcount. Standard Deviations are provided in parentheses.

The descriptive statistics (Table 4.1.1) reveal a labor market that characterized the quarterly data highlights that Agriculture (S-ID 5) is the largest labor absorber, with a mean employment rate of 43.8%. However, the high standard deviation (SD) for the "No Education" group (117,771) indicates that agricultural employment is highly volatile on a quarterly basis, likely reflecting the seasonal nature of farming cycles in Rwanda which causes labor demand to peak and trough throughout the year. Conversely, sectors like Education (S-ID 6) and Human Health (S-ID 8) show much lower SD values relative to their size, suggesting that professional, high-skilled employment is more structurally stable across different quarters. Furthermore, the sharp decline in labor absorption as education levels rise within primary sectors contrasted with the high concentration of university graduates (52,913) in the Education sector underscores a persistent mismatch between the mass labor force and the requirements of the expanding knowledge-based economy. This division suggests that while the supply of human capital is increasing, the capacity of the knowledge-based economy to absorb university-level talent remains concentrated in niche sectors, leaving a significant gap in broad-based technical labor utilization.

Correlation Analysis.

Table 4.2.1 displays the Pearson correlation coefficients (r) between the sectoral employment rate and the different levels of educational attainment.

Table 4.2.1: Correlation Matrix of Employment Rate vs. Education Levels (Full Economy)

Sector (S-ID)	No Edu	Primary	Lower Sec	Upper Sec	University
S-ID 1: Mining	**1.000**	**1.000**	0.200	**0.800**	0.200
S-ID 2: Construction	0.150	0.200	0.400	**1.000**	0.300
S-ID 3: Finance	0.100	0.400	0.200	0.400	**0.800**
S-ID 4: Real Estate	**0.850**	0.100	**0.850**	0.200	0.100
S-ID 5: Agriculture	**1.000**	**1.000**	**1.000**	0.050	0.020
S-ID 6: Education	0.010	0.120	0.230	0.750	**0.800**
S-ID 7: ICT	0.050	0.100	0.150	0.300	**0.800**
S-ID 8: Health	0.050	0.200	0.300	**0.800**	0.400
S-ID 9: Manufacturing	**0.894**	**0.894**	0.447	-0.447	-0.447
S-ID 10: Electricity	-0.400	**0.800**	0.400	0.400	**0.800**
S-ID 11: Water/Waste	**0.948**	**0.948**	0.632	0.632	0.316
S-ID 12: Transport	**1.000**	**0.800**	**0.800**	**0.800**	0.400
S-ID 13: Arts/Rec.	**0.800**	0.200	**0.800**	0.000	**1.000**

Source: Researcher's computation using STATA/SE 15.0 (2025). **Note: Bold** values indicate strong positive correlations (**$r \geq 0.8$).**

The Pearson correlation coefficients presented in Table 4.2.1 highlight a "structural duality" in Rwanda's labor demand. On one hand, traditional and labor-intensive sectors such as Agriculture (S-ID 5), Mining (S-ID 1), and Water Management (S-ID 11) show perfect or near-perfect correlations ($r \geq 0.90$) with workers who have No Education or Primary schooling. This confirms that these sectors function as the primary absorbers of the

unskilled workforce. Interestingly, Transport (S-ID 12) also falls into this category, with its perfect correlation to uneducated labor suggesting a reliance on manual tasks and drivers.

On the other hand, service and utility sectors demonstrate a shift toward human capital intensification. Finance (S-ID 3), Education (S-ID 6), and ICT (S-ID 7) all maintain strong positive correlations (0.80) with University graduates, proving that these sectors require higher qualifications to sustain their operations. However, a "middle-ground" exists in sectors like Electricity (S-ID 10) and Health (S-ID 8), which show strong correlations with both technical (Secondary) and professional (University) levels, reflecting a need for specialized vocational skills. Finally, the negative correlation between Manufacturing (S-ID 9) and higher levels of education suggests that the sector continues to rely primarily on lower-skilled labor. This pattern indicates that manufacturing activity in Rwanda remains at an early stage of technological upgrading, with limited demand for university-educated workers. This structural transition gap highlights a key constraint in the industrial transformation process, as the sector has not yet evolved to absorb the growing supply of highly educated labor.

Panel Regression Results and Model Specification

This section evaluates the impact of educational attainment on sectoral employment rates using panel data regression. Both Fixed Effect (FE) and Random Effect (RE) models were estimated to ensure the robustness of the findings.

Table 4.3.1: Panel Regression Results (Fixed and Random Effects)

Variables	Fixed Effect (FE)	Random Effect (RE)
No Education	Coefficient (p > |t|)	Coefficient (p > |z|)
Primary	**Positive (Significant)***	**Positive (Significant)***
Lower Secondary	Insignificant	**Positive (Significant)***
Upper Secondary	**Positive (Significant)***	Insignificant
University	Insignificant	Insignificant
R-squared (Between)	**92.90%**	**99.94%**
R-squared (Within)	71.74%	59.83%
R-squared (Overall)	91.68%	98.77%
Model Significance	Prob > F = 0.000	Prob > chi2 = 0.000

Source: Researcher's calculation using STATA/SE 15.0 (2025). **Note:** * denotes statistical significance at the 5% level.

The panel regression results indicate (Table 4.3.1) that the models possess high explanatory power. The Fixed Effect model explains 92.90% of the variance between sectors, while the Random Effect model explains a remarkable 99.94%. The statistical significance of both models (Prob > F and Prob > chi2 = 0.000) confirms that educational attainment is a reliable predictor of sectoral employment rates in Rwanda. Interestingly, the impact of education on labor absorption is most significant at the Primary and Secondary levels. In the Fixed Effect model, Primary and Upper Secondary education levels show small but statistically significant positive effects on employment rates. In the Random Effect model, this significance is mirrored in Primary and Lower Secondary levels.

These findings suggest that for the majority of Rwanda's economic sectors, basic and intermediate education are currently the strongest drivers of labor absorption. The lack of statistical significance for University education in the overall panel indicates that while tertiary education is vital for specific sectors (like ICT and Finance, as seen in the correlation analysis), it has not yet reached a sufficient scale to significantly drive employment rates across the entire economy. This indicates a gap in the integration of intermediate and advanced skills, resulting in continued dependence on foundational education for widespread labor absorption

To determine the most appropriate specification between the Fixed Effect and Random Effect models, the Hausman (1978) specification test was conducted.

Table 4.4.1: Hausman Test for Model Selection

Test Statistic	Value
Chi-square (χ^2)	0.03
Prob > χ^2	**0.8718**
Decision	**Fail to Reject H_0 (Use Random Effects)**

Source: Researcher's calculation using STATA/SE 15.0 (2025).

To determine the most efficient estimator between Fixed Effects (FE) and Random Effects (RE), a Hausman specification test was performed. The test yielded a Chi-square value of 0.03 with a p-value of 0.8718. Since the p-value exceeds the standard 0.05 significance level, the test fails to find systematic differences between the two models. Consequently, the Random Effects (RE) model is selected as the most efficient and appropriate statistical framework for this analysis. The findings suggest that Rwanda's labor market is predominantly driven by primary and secondary education levels, while tertiary education remains structurally concentrated in a limited number of high-skill sectors. This pattern highlights a structural imbalance in which the expansion of university education has not yet translated into broad-based labor market absorption.

The Influence of Regional Disparities on Sectoral Employment

This section evaluates the influence of geographic location on labor absorption. By analyzing the distribution of the 13 sectors across Urban and Rural regions, we can determine how regional disparities shape the demand for different levels of human capital.

Table 4.4.1: Sectoral Labor Absorption by Region (Quarterly Mean and SD)

Sector (S-ID)	Urban Mean (SD)	Rural Mean (SD)	Regional Dominance
S-ID 1: Mining	3,262 (1,154)	46,608 (16,211)	**Rural**
S-ID 2: Construction	109,053 (15,432)	249,214 (28,944)	**Rural**
S-ID 3: Finance	21,966 (3,454)	11,349 (2,567)	**Urban**
S-ID 4: Real Estate	2,828 (615)	1,073 (422)	**Urban**
S-ID 5: Agriculture	106,917 (62,637)	1,436,215 (179,055)	**Rural**
S-ID 6: Education	50,845 (8,331)	87,144 (12,556)	**Rural**
S-ID 7: ICT	8,885 (1,115)	1,875 (716)	**Urban**

S-ID 8: Health	32,914 (4,112)	13,850 (2,334)	**Urban**
S-ID 9: Manufacturing	65,067 (9,443)	127,939 (18,221)	**Rural**
S-ID 10: Electricity	3,762 (887)	2,605 (742)	**Urban**
S-ID 11: Water/Waste	2,274 (541)	3,203 (633)	**Rural**
S-ID 12: Transport	70,299 (8,554)	118,975 (14,321)	**Rural**
S-ID 13: Arts/Rec.	6,516 (1,225)	2,114 (944)	**Urban**

Source: Researcher's calculation using STATA/SE 15.0 (2025).

As illustrated in Table 4.4.1, regional disparities create a structural divide in Rwanda's labor market, where Rural regions act as "labor sponges" dominated by Agriculture (S-ID 5) and Construction (S-ID 2). These sectors collectively absorb nearly 1.7 million workers, with the high rural construction mean reflecting a reliance on labor-intensive infrastructure projects for those with primary education. Conversely, Urban centers serve as specialized hubs for high-value sectors like Finance (S-ID 3) and ICT (S-ID 7), which provide the structural capacity to absorb university graduates. While Education (S-ID 6) is widespread rural-wise, the overall trend confirms that geographic location dictates labor quality. This spatial mismatch constitutes a significant policy challenge. In the absence of deliberate decentralization of high-value services, Rwanda risks a "spatial brain drain," as educated workers migrate toward urban centers where their skills can be utilized more effectively. This dynamic perpetuates rural underdevelopment and reinforces the persistence of low-productivity employment structures.

CONCLUSION AND POLICY RECOMMENDATIONS

Conclusion

This study provides empirical evidence of the critical role educational attainment plays in shaping sectoral labor absorption in Rwanda. The research concludes that while Rwanda is successfully transitioning toward a service-oriented economy, the labor market remains characterized by a "structural duality". Traditional and labor-intensive sectors, such as Agriculture and Mining, remain the primary absorbers of the unskilled and primary-educated workforce, particularly in rural regions where these sectors function as "labor sponges".

The inferential analysis through the Random Effects model reveals that Primary and Secondary education levels are currently the most significant drivers of broad-based employment. In contrast, high-productivity sectors like ICT, Finance, and Health are the exclusive domains for university graduates, yet these sectors do not yet possess the scale to drive employment rates across the entire national economy. Ultimately, the study confirms that geographic location is a fundamental mediator of labor quality; urbanization serves as a catalyst for a knowledge-based economy, while rurality remains a constraint anchoring the workforce in low-productivity activities.

Policy Recommendations

To bridge the gaps identified in this study specifically the "brain waste" among graduates and the productivity bottleneck in manufacturing the following interventions are recommended:

- **Spatial Decentralization of the Knowledge Economy:** To mitigate "spatial brain drain," the government should incentivize the decentralization of ICT and financial services beyond Kigali. Establishing regional "innovation hubs" would allow the increasingly educated rural youth to access high-value employment without being forced into urban migration.

- **Targeted TVET Integration for Manufacturing:** Given that Manufacturing currently relies on low-skill labor (showing a negative correlation with higher education), TVET programs should be specifically

redesigned to provide technical certifications in industrial automation and professional management. This would transition the sector from labor-intensive assembly to technology-driven production.

- **Agribusiness Modernization for Rural Stability:** Since agriculture remains the largest but most volatile employer, policies must prioritize the transition from subsistence farming to high-value agribusiness. By investing in rural processing infrastructure, Rwanda can create stable, year-round "value-addition" jobs that shield uneducated and primary-educated workers from the seasonal "peaks and troughs" identified in this study.

- **Bridging the Intermediate Skills Mismatch:** To address the high unemployment among secondary school leavers, the government should establish "Sector-Specific Skills Councils." These councils would ensure that secondary and university curricula are not merely theoretical but are strictly aligned with the evolving technical requirements of Rwanda's growing service and infrastructure industries.

LIMITATIONS OF THE STUDY

Despite providing valuable empirical evidence on sectoral labor dynamics in Rwanda, this study is subject to several limitations. First, the reliance on Labor Force Survey (LFS) data may underrepresent informal employment activities, thereby limiting the full depiction of labor market structures. Second, while the Random Effects model controls for unobserved heterogeneity, the lack of detailed sector-level data particularly on infrastructure indicators such as transport networks and energy access restricts the ability to fully account for regional variations in employment patterns. Third, the relatively short study period (2019–2023) constrains the analysis of long-term structural changes, particularly in relation to evolving education policies and their delayed effects on labor market outcomes.

Suggestions for Future Research

Future studies should aim to bridge the gaps identified in this research by incorporating informal sector data to provide a more holistic view of labor absorption. Additionally, there is a significant opportunity to conduct impact evaluations on specific TVET interventions to determine which technical curricula most effectively reduce the "intermediate skills mismatch." Finally, investigating the spatial correlation between rural infrastructure development and the growth of non-farm employment would offer deeper insights for policy-makers seeking to decentralize the knowledge economy.

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