Uneven Gains: Sectoral Employment Elasticity and Structural Transformation in Rwanda, 1990-2018

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Abstract- ***Rwanda's structural transformation has progressed steadily over the past two decades, yet the employment impact of sectoral growth remains uneven and under examined. This study analyzes how output growth in manufacturing and services translates into job creation, using time-series data from 1990 to 2018 drawn from the GGDC Economic Transformation Database and national labor force surveys. Sector-specific employment elasticities are estimated using log-log and first-differenced regression models, complemented by stationarity and cointegration tests. The results show a sharp divergence in employment responsiveness: manufacturing exhibits a high short-run elasticity of 1.02, indicating strong labor absorption potential, while services record a much lower and more volatile elasticity of 0.29. Neither sector demonstrates a stable long-run relationship between output and employment, underscoring the dominance of short-run dynamics in shaping labor market outcomes. Although services account for the bulk of employment, jobs are increasingly concentrated in low-productivity, informal segments. In contrast, manufacturing though smaller offers more inclusive employment prospects when supported by industrial policy. The findings highlight the uneven nature of Rwanda's employment gains across sectors and underscore the importance of dual-sector strategies to boost both job quantity and job quality as structural transformation advances.***

Indexed Terms- ***Employment elasticity, job creation, structural transformation, manufacturing, services, labor absorption, time-series analysis, Rwanda, inclusive growth, industrial policy.***

I. INTRODUCTION

Rwanda has undergone substantial economic transformation over the past three decades, transitioning from a predominantly agrarian economy to one increasingly driven by services and industry. This shift reflects deliberate policy interventions under national development frameworks such as Vision 2020 and Vision 2050, which emphasize industrialization and employment generation as pillars of sustainable growth (Ministry of Finance and Economic Planning [MINECOFIN], 2020). As of Q4 2024, services accounted for approximately 42.6% of total employment, followed by agriculture at 39.3%, while the industrial sector contributed 18.1%—with manufacturing comprising just 5.5% (National Institute of Statistics Rwanda [NISR], 2024a; NISR, 2024b). Despite its modest share, manufacturing remains central to Rwanda's structural transformation agenda and is supported by initiatives such as the "Made in Rwanda" policy. However, informality persists across sectors, with over 90% of the labor force in 2023 engaged in informal employment, particularly in services and small-scale manufacturing (NISR, 2023).

Employment elasticity, defined as the percentage change in employment associated with a one percent change in sectoral value added serves as a diagnostic tool for assessing a sector's labor absorption capacity (Felipe et al., 2019). Higher elasticity indicates that economic growth translates more effectively into job creation, which is critical for labor-abundant, low-income economies such as Rwanda. While some studies find that services are increasingly driving employment growth in African economies, others warn of premature deindustrialization and declining manufacturing intensity (Rodrik, 2016; Kruse et al., 2022). This study investigates the employment elasticity of manufacturing and services in Rwanda between 1990 and 2018, aiming to determine which sector has been more effective at translating output growth into employment. This is a key consideration for inclusive economic development and sectoral policy prioritization. The central research question

guiding this work is: Which sector, manufacturing or services exhibits higher employment elasticity in Rwanda over the period 1990- 2018?

Although existing literature has explored employment trends in Sub-Saharan Africa (Rodrik, 2016; Kruse et al., 2022), few studies provide comparative sector-specific elasticity estimates at the country level, especially within the post-conflict context of Rwanda. Kruse et al. (2022), for instance, highlight a continent-wide resurgence in manufacturing employment, driven largely by informal firms, but offer limited country-level disaggregation. Meanwhile, national reports (NISR, 2023; NISR, 2024a) document Rwanda's employment transitions but do not quantify employment-output responsiveness. This study addresses this empirical gap by estimating and comparing sectoral employment elasticities using harmonized data from the GGDC Economic Transformation Database and Rwanda's national labor force statistics. The analysis is intended to inform targeted employment policy and structural transformation strategies aligned with Vision 2050.

II. LITERATURE REVIEW

This section provides an in-depth review of key theoretical and empirical literature relevant to employment elasticity, with a specific focus on the structural dynamics of Rwanda's manufacturing and services sectors. It integrates theoretical rationale with a comprehensive synthesis and critique of existing studies, aligned with the study's central objectives.

2.1 Theoretical Foundation

This study draws on two interrelated theoretical frameworks to interpret the employment-output relationship in Rwanda: the structural transformation framework (Herrendorf & Valentinyi, 2014) and the theory of premature deindustrialization (Rodrik, 2016). Together, these frameworks provide a nuanced understanding of the sectoral dynamics shaping labor absorption during economic transformation. The structural transformation framework outlines how economies evolve by reallocating labor from low-productivity agriculture to high-productivity sectors, such as manufacturing and later services. Manufacturing plays a central role in this trajectory due to its potential for scale economies, productivity spillovers, and backward and forward linkages (Herrendorf & Valentinyi, 2014). Employment elasticity, within this context, is used to assess the responsiveness of employment to output growth. High employment elasticity in manufacturing is indicative of its potential to support inclusive growth through labor absorption (Szirmai, 2012).

Rodrik's (2016) theory of premature deindustrialization challenges the traditional structural transformation model by asserting that developing economies are transitioning out of manufacturing at earlier stages and lower income levels compared to historical experiences. This premature shift restricts opportunities for sustained job creation in manufacturing and drives labor into services sectors that are often informal and characterized by low productivity and weak employment elasticity. This dual theoretical framing reflects the empirical reality of Rwanda, where structural transformation policies prioritize industrialization, yet the majority of labor reallocation has occurred in low-productivity services (Byiers et al., 2021). The study's findings, which highlight relatively stronger short-run employment elasticity in manufacturing compared to services, align with this theoretical lens. While manufacturing retains potential for employment-led growth, its small base and structural constraints necessitate deliberate policy support.

2.1 Rwanda Labor Market Dynamics

Rwanda's labor market transformation over the past three decades illustrates key features of structural change in low-income economies. Theoretical models (Herrendorf et al., 2014) propose a reallocation of labor from agriculture to industry and eventually services, driven by shifts in demand and productivity. However, Rwanda's experience deviates from this linear progression. Despite significant policy efforts and productivity improvements in select sectors, a large share of the labor force remains engaged in low-productivity informal services and agriculture. Even as the contribution of services to GDP has increased, much of the sector's growth has been concentrated in non-tradable activities with limited employment

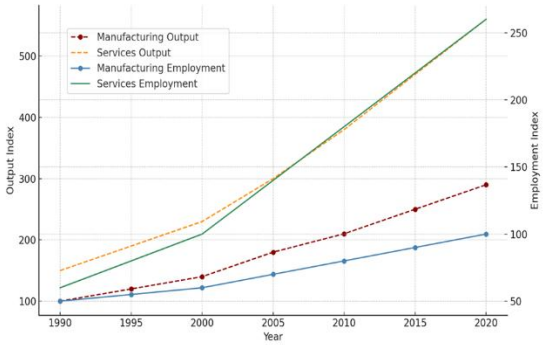
elasticity (World Bank, 2023; African Development Bank [AfDB], 2023).

2.2.1 Sectoral Employment Dynamics: Manufacturing vs Services

A deeper comparative analysis of manufacturing and services highlights important divergences in employment creation and elasticity trends that are central to the study's objective. Between 1990 and 1999, Rwanda's labor market was predominantly agrarian, with over 90% of the workforce in agriculture. Industrial capacity was limited, and investment in manufacturing was weak (Booth & Golooba-Mutebi, 2012). Rwanda's structural transformation accelerated in the 2000s through Vision 2020 and key policy frameworks such as the Economic Development and Poverty Reduction Strategies (EDPRS I and II) and the first National Strategy for Transformation (NST1; Government of Rwanda [GoR], 2017). These national frameworks emphasized human capital development, industrial promotion, and employment creation, targeting structural shifts in the labor force. From 2000 to 2024, manufacturing employment increased from 1.3% to 5.5% of the labor force. This was underpinned by state-led industrial policy, including the creation of Special Economic Zones (SEZs), fiscal incentives for light manufacturing, and the "Made in Rwanda" campaign (Ministry of Commerce and Industry [MINICOM], 2019). Nevertheless, the sector remains constrained by limited access to affordable inputs, high capital intensity, and narrow export bases. Elasticity estimates reflect these structural rigidities, showing relatively stronger but still modest employment responsiveness.

In contrast, services grew from under 10% to over 42% of employment during the same period. Liberalization of telecoms, public sector hiring, and growth in ICT and finance contributed to this expansion, particularly through policy frameworks such as the Smart Rwanda Master Plan (Ministry of ICT and Innovation [MINICT], 2021). However, services employment is segmented with a small share in high-skill, high-wage segments and a large share in low-productivity, informal segments such as retail and transport. Elasticity in services has been positive but more volatile and generally lower compared to manufacturing, indicating weaker linkages between output growth and employment gains. Elasticity in services has been positive but more volatile and generally lower compared to manufacturing, indicating weaker linkages between output growth and employment gains.

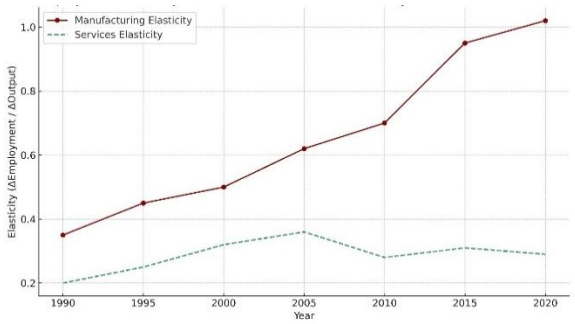
Figure 1. Output and Employment Trends in Rwanda's Manufacturing and Services Sector (1990 2020)



Source: Author's estimates based on Kruse et al. (2022) and NISR Labor Force Survey (2023, 2024).

Figure 1 illustrates sectoral patterns in output and employment trends over time, based on existing national and regional data sources (Kruse et al., 2022; NISR, 2024a). While output has grown steadily in both sectors, manufacturing's output growth appears to outpace employment expansion suggesting increasing productivity or capital intensity. In contrast, the service sector demonstrates broader employment absorption, but with flatter employment gains relative to output, potentially reflecting lower elasticity and higher informality. These observed historical patterns support the conceptual rationale for studying employment elasticity comparatively and help to clarify the structural challenges Rwanda faces in translating growth into jobs.

Figure 2. Employment Elasticity Trends in Rwanda's Manufacturing and Services Sectors (1990–2020)



Source: Author's estimates based on Kruse et al. (2022) and NISR Labor Force Survey (2023, 2024).

Figure 2 illustrates the evolution of employment elasticity in manufacturing and services between 1990 and 2020. The data show a steady increase in manufacturing elasticity, especially in the last decade, likely reflecting gradual structural reforms and productivity gains. In contrast, services elasticity remains low and erratic, reinforcing concerns about informality and weak output-employment linkages in the sector.

2.1 Synthesis / Critique Of Previous Research

The empirical literature on employment elasticity in Rwanda is evolving but remains underdeveloped. While several policy documents and statistical reports track labor market transitions, few provide consistent sector-specific elasticity estimates over time. Chemouni (2018) underscores the role of coordinated state intervention and industrial policy in enabling job creation, especially through flagship policies like "Made in Rwanda", but these analyses are primarily qualitative. Muhire (2018) offers a micro-level examination of employment determinants in Rwandan firms, noting that firm size and wage levels significantly influence employment generation in manufacturing and services. However, the study stops short of connecting these firm-level dynamics to macroeconomic employment elasticity. More recently, government-backed industrial initiatives, such as Special Economic Zones (SEZs) and agro-processing clusters, have aimed to stimulate job creation. Yet formal employment in manufacturing remains concentrated in a few urban areas, and structural rigidities such as high operational costs, input shortages, and limited market access continue to constrain broader elasticity gains (AfDB, 2024; World Bank, 2023).

Moreover, while services have absorbed a larger share of total employment, this expansion has been driven largely by informal activities with limited productivity spillovers echoing Karacuka et al. (2024)'s findings on the digitalization–productivity paradox in Sub-Saharan Africa. Despite the growth of ICT and finance-related services, employment elasticity in the broader service sector remains modest, raising questions about the quality and sustainability of job growth. This study addresses the existing gap by producing new sector-specific elasticity estimates using harmonized time-series data. It also offers a longitudinal lens spanning from 1990 to 2018 that enables the assessment of employment responsiveness to growth across economic cycles and policy regimes. In doing so, it provides an evidence base to support targeted employment and industrial development strategies under Rwanda's Vision 2050.

The broader regional literature on employment elasticity offers valuable comparative context for understanding Rwanda's trajectory, especially in terms of manufacturing potential, structural transformation, and the implications of digitalization. Ali, Ait Lahrach, and Emini (2017) observed that manufacturing employment elasticity is relatively higher in low-income Sub-Saharan African (SSA) countries compared to their Latin American counterparts, suggesting that SSA still holds latent potential for industrial employment expansion. Kruse et al. (2022), using the GGDC/UNU-WIDER Economic Transformation Database, highlight that between 2000 and 2018, SSA's manufacturing employment rose from 6 million to over 20 million, largely driven by informal and small-scale enterprises. Rodrik (2016) documents the broader trend of premature deindustrialization, emphasizing that many SSA countries are reaching peak manufacturing shares at lower income levels compared to historical precedents. Huneeus and Rogerson (2022) extend this analysis by showing that heterogeneity in productivity growth especially agricultural productivity plays a central role in explaining differences in the timing and scale of industrialization. Countries with slower agricultural productivity growth, such as Rwanda,

tend to experience lower and earlier peaks in manufacturing employment.

Gelb et al. (2020) contextualize Rwanda's manufacturing challenges by analyzing firm-level labor cost competitiveness. Their findings indicate that, relative to productivity, wages in SSA's manufacturing sector are often higher than comparator countries, reducing cost-based advantages. World Bank (2021) and African Development Bank (2024) emphasize the importance of global value chain (GVC) integration in supporting manufacturing employment. Although SSA's GVC engagement is currently concentrated in low-skill tasks and primary exports, backward linkages have shown more significant employment effects. Rwanda, in particular, has focused on agro-processing and light manufacturing as entry points. However, AfDB (2024) notes that the country's progress in structural transformation has been uneven. Karacuka, and Haucap (2024) assess the role of digitalization in labor productivity across African sectors. They find digitalization improves labor productivity in manufacturing and agriculture, but not in services—echoing Rwanda's pattern where digital adoption has not translated into high employment or productivity in informal service segments.

Finally, Abreha et al. (2021) challenge the narrative of widespread premature deindustrialization, arguing that SSA countries have experienced job growth in manufacturing through GVC participation. Yet, to sustain these gains, they emphasize the need for competitiveness-enhancing investments in transport, skills, and finance. Taken together, these studies reinforce the need for a differentiated, sector-specific employment strategy in Rwanda. The manufacturing sector offers higher employment elasticity, but scaling this potential requires investments in productivity, competitiveness, and industrial linkages. Meanwhile, the services sector's capacity to generate sustainable employment depends on formalization, digital productivity alignment, and addressing skills mismatches.

III. METHODOLOGY

3.1 Research Design

The objective of this study is to estimate and compare the employment elasticity of the manufacturing and services sectors in Rwanda between 1990 and 2018. This inquiry seeks to determine which sector more effectively converts output growth into employment in the context of Rwanda's structural transformation agenda. This study adopts a quantitative, time-series econometric approach to estimate and compare the employment elasticity of Rwanda's manufacturing and services sectors from 1990 to 2018. Employment elasticity is defined as the percentage change in employment resulting from a one percent change in sectoral value added. The analysis relies on log-linear regression models estimated separately for each sector.

3.2 Research Questions And Hypotheses

The study's research question is:Which sector, manufacturing or services exhibits higher employment elasticity in Rwanda over the period 1990-2018? From this question, the following hypothesis formulated:

H0: There is no significant difference in employment elasticity between the manufacturing and services sectors in Rwanda.
H1: There is a significant difference in employment elasticity between the manufacturing and services sectors in Rwanda.

3.3 Data Sources

The study draws on two main data sources:

- GGDC/UNU-WIDER Economic Transformation Database (ETD): Provides annual sectoral data on employment and real value added for manufacturing and services sectors from 1990 to 2018.
- National Institute of Statistics of Rwanda (NISR): Supplements the analysis with labor force data, particularly for informal sector trends and post-2018 developments used in contextual discussion.

3.3.1 Variables and Measurement

The table 1 below summarizes the core variables used in the estimation.

Table 1.
Description of Variables Used in the Elasticity Estimation Model

Variable	Description	Type	Source
Employment (Manufacturing)	Annual employment in the manufacturing sector	Dependent	GGDC ETD
Employment (Services)	Annual employment in the services sector	Dependent	GGDC ETD
Value Added (Manufacturing)	Real output of manufacturing sector (constant LCU)	Independent	GGDC ETD
Value Added (Services)	Real output of services sector (constant LCU)		

3.4 Model Specification

The employment elasticity model is expressed in log-linear form:

$$\log(E_t) = \alpha + \beta \log(VA_t) + \varepsilon_t$$

Where:

- E_t is sectoral employment at time t
- VA_t is real value added at time t
- β is the elasticity of employment with respect to output
- ε_t is the error term

Separate models were estimated for manufacturing and services.

3.5 Estimation Strategy

The econometric analysis proceeded as follows. First, stationarity of the time series was assessed using the Augmented Dickey-Fuller (ADF) test. Where necessary, non-stationary series were log-differenced to achieve stationarity. Next, the Engle-Granger two-step method was applied to evaluate whether a long-run cointegrating relationship exists between employment and sectoral value added in both manufacturing and services. To assess short-run employment responsiveness, additional regressions were conducted using first-differenced variables, providing robustness checks for elasticity estimates under dynamic adjustment conditions. All analyses were implemented using Stata version 18.

Estimated elasticity coefficients were interpreted as:

- $\beta > 1$: Output growth leads to disproportionately higher employment growth (high elasticity)
- $0 < \beta < 1$: Output growth generates employment at a lower rate (moderate elasticity)
- $\beta = 0$: No employment effect from output growth

The comparison between manufacturing and services elasticity identified which sector more effectively converts output growth into employment gains in Rwanda's structural context.

IV. DATA ANALYSIS

This section presents the results of the elasticity estimations using time-series data from 1990 to 2018 for the manufacturing and services sectors in Rwanda. The analysis includes both long-run and short-run employment elasticities, based on log-linear and first-differenced regressions.

4.1 Descriptive Statistics

To establish a foundational understanding of sectoral labor and output dynamics in Rwanda, summary statistics were generated for employment and value added in the manufacturing and services sectors. These statistics help contextualize the scale, variation, and distribution of the variables used in the regression analysis. Summary statistics for the main variables are presented below, based on 29 annual observations from 1990 to 2018.

Table 2.

Descriptive Statistics for Sectoral Employment and Value Added (1990–2018)

Variable	Mean	Standard Deviation	Minimum	Maximum
Employment (Manufacturing)	72.57	43.98	24.46	205.30
Employment (Services)	501.98	363.47	107.65	1,337.83
Value Added (Manufacturing)	165,580.70	140,239.50	27,677.87	482,000.00
Value Added (Services)	1,139,684	1,177,314	45,564.86	3,915,000

The data confirm that both employment and value added are consistently larger in the services sector than in manufacturing. Services also exhibit greater dispersion across years, as evidenced by the higher standard deviations and wider value ranges, suggesting more volatility in both labor absorption and output performance.

4.2 Econometric Results

4.2.1 Long-Run Employment Elasticity Estimates

In the first stage of analysis, employment elasticity was estimated using log-log models that evaluate the proportional relationship between employment and value added in the long run. These results, shown in Table 3, reflect stable association patterns over the full 1990–2018 period.

Table 3.Long-Run Employment Elasticity Estimates (1990–2018)

Sector	Coefficient (β)	Std. Error	t-Statistic	p-Value	R^2
Manufacturing	0.563	0.040	14.04	0.000	0.879
Services	0.561	0.040	14.02	0.000	0.879

Results in table 3 above indicate that both sectors exhibit similar long-run elasticities, with coefficients of approximately 0.56. This implies that, over time, a 1% increase in sectoral output is associated with a 0.56% increase in employment. These findings suggest moderate employment intensity for both sectors in the long run, but do not allow us to distinguish sectoral differences in responsiveness without additional analysis.

4.2.2 Short-Run Employment Elasticity Estimates

Given the non-stationarity of the series and the absence of cointegration, first-difference regressions were estimated to capture short-run responsiveness of employment to output growth. Table 4 presents the short-run elasticity estimates for both sectors.

Table 4. Short-Run Employment Elasticity Estimates (First Differences)

Sector	Coefficient (β)	Std. Error	t-Statistic	p-Value	R^2
Manufacturing	1.02	0.165	6.17	0.000	0.595
Services	0.29	0.109	2.61	0.015	0.208

The results in table 4 show a marked difference between the two sectors. Manufacturing exhibits a high short-run elasticity of 1.02, suggesting that employment responds more than proportionally to changes in output. In contrast, the elasticity for services is significantly lower at 0.29, indicating weaker short-term employment responsiveness. These findings support the hypothesis that manufacturing holds stronger potential for job creation in the short run compared to services.

4.2.3 Cointegration Test Results

Following the elasticity estimation, we tested for long-run equilibrium relationships between employment and output using the Engle-Granger residual-based cointegration method. This step aimed at determining whether the associations observed in the long-run regressions represent stable relationships over time. The results are shown in Table 5.

Table 5. Cointegration Test-ADF on Residuals

Sector	ADF Test Statistic	5% Critical Value	p-Value	Cointegration
Manufacturing	-1.990	-2.992	0.291	No
Services	-2.444	-2.992	0.130	No

The findings indicate that for both sectors, the residuals from the log-log regressions are non-stationary and do not meet the critical value thresholds for rejecting the null hypothesis of a unit root. This confirms the absence of long-run cointegration and underscores the relevance of short-run elasticity estimates for interpreting sectoral employment dynamics in Rwanda.

CONCLUSION

This This study examined employment elasticity in Rwanda's manufacturing and services sectors from 1990 to 2018, using sector-disaggregated time-series data. By estimating both long-run and short-run elasticities through log-log and first-differenced models, the analysis offers a granular understanding of how sectoral output growth translates into employment gains in the context of structural transformation. Long-run elasticity estimates for both sectors were approximately 0.56, indicating moderate employment intensity. However, the absence of cointegration suggests that output and employment do not move together consistently over time, reinforcing the need for caution when using historical sectoral growth patterns to inform long-term employment projections. Short-run dynamics proved more revealing. Manufacturing exhibited a high short-run elasticity of 1.02, signaling a strong and more-than-proportional employment response to output growth. In contrast, the services sector displayed significantly lower short-run elasticity at 0.29, highlighting its

weaker capacity to absorb labor in the immediate term despite its growing economic prominence.

This divergence reflects a core tension in Rwanda's structural transformation between service sector expansion and its relatively low job creation potential. The findings resonate with broader concerns that economies may transition prematurely into low-productivity services without fully harnessing the employment potential of industrialization. Rwanda's policy frameworks including Vision 2050, the National Strategy for Transformation, and the National Skills Development and Employment Promotion Strategy acknowledge this challenge by prioritizing industrial development, workforce readiness, and job creation. Yet, the success of these strategies will depend on implementation effectiveness, particularly in closing skill gaps, formalizing employment, and aligning education and training with labor market demands. Methodologically, this study contributes by distinguishing between short-run and long-run employment responses using nationally grounded, sector-specific data. This approach allows for more precise policy insights than cross-country averages, which often obscure local economic realities. The lack of a long-run equilibrium relationship also reinforces the importance of adaptive, responsive labor market strategies rather than static policy assumptions.

In conclusion, Rwanda's employment strategy should pursue a dual path: scaling manufacturing as an immediate driver of job creation, while investing in reforms to raise productivity and labor absorption in services. Priority should be given to value chains with strong domestic demand linkages and employment multipliers particularly in light manufacturing, agro-processing, and digital services. These efforts must be reinforced by investments in infrastructure, access to finance, and a modernized skills ecosystem. Future research should build on this framework by incorporating firm-level and regional data, disaggregating service subsectors, and evaluating the labor market impact of major policy shifts such as the "Made in Rwanda" initiative and the post-COVID recovery phase. Together, these insights can support a more inclusive and employment-responsive model of structural transformation in Rwanda and across similar economies.

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