

The Interplay of Industrialization, Urbanization and Economic growth

(Evidence from Rwanda)

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Abstract-This study investigates the interplay of industrialization, urbanization, and economic growth in Rwanda. Using yearly data from 1973 to 2021, this study uses the Vector Error Correction Model technique to identify long-term and short-term relationships between industrialization, urbanization, and economic growth in Rwanda. The Granger Wald test is used to determine whether the variables are causally related. The study findings demonstrate the long-term and short-term reciprocal relationships between industrialization, urbanization, and economic growth. Moreover, a bidirectional causality from economic growth to industrialization in the long run and unidirectional causality from industrialization and economic growth to urbanization was found while only economic growth had a causal effect on urbanization in the short run. The study found that Decisions affecting one component can have far-reaching effects for others. It is critical to adequately manage this dynamic to maintain balanced and sustainable development.

Keywords:- Industrialization, Urbanization, Economic growth, Rwanda.

I. INTRODUCTION

Industrialization is the process by which an economy or society transitions from an agrarian or pre-industrial state to one dominated by industrial activities, as evidenced by a shift from agriculture and small-scale production to large-scale manufacturing, mechanization, and technological advancements. Similarly, urbanization refers to the ongoing process of rural-to-urban migration, in which a rising portion of a country's population relocates from rural areas to urban centres such as cities and towns. Urbanization refers to the growth and development of urban centres, as well as the evolution of critical infrastructure, housing, and other vital services While economic growth is defined as an overall expansion of a country's economy, it is often quantified by measurements such as GDP (gross domestic product) growth and other economic indicators[1].

The interaction of industrialization, urbanization, and economic growth implies that these three essential components have a multifaceted and linked relationship. It signifies that they are not isolated from one another, but rather are interconnected, they influence and are influenced by each other in various ways.

In stages of economic growth theory developed by [2], take-off stage of economic growth lays the groundwork for the interdependence of industrialization, urbanization and economic growth. Take off stage is regarded as a vital phase where economic growth becomes self-sustaining. The economy evolves away from being predominantly rural as industrialization and urbanization become more evident. The principal driver of this phase is economic expansion during the "Take-off" stage. Large increase in investment and innovation lead to large increase in productivity and overall economic development. This self-sustaining economic growth implies that the economy is no longer completely dependent on agricultural. As economic growth accelerates, industrialization becomes an important component of that expansion. The development and expansion of manufacturing and industrial sectors leads in greater production capacity, the establishment of new industries, and the migration of labour from agricultural to manufacture sector. Rising industry is closely linked to rising urbanization. As new businesses emerge and the manufacturing sector expands, more people migrate from rural to urban regions in pursuit of work. During this stage, the urbanization process accelerates as people flock to urban centres to participate in industrial and service-based activities. This results in the expansion of towns and cities, as well as the development of urban infrastructure.

Economic growth, industrialization, and urbanization together constitute a dynamic cycle that drives societal and economic progress. Economic growth acts as a catalyst for industrialization by increasing demand for goods and services, which encourages industry expansion. Simultaneously, industrialization reciprocates by improving economic growth, increasing output, and attracting investment, so strengthening the nation's economic foundation. The relationship between industrialization and urbanization is characterized by mutual assistance, with industrial success accelerating urban expansion. Industries move to cities, taking advantage of the enormous markets and transportation networks accessible there, hastening the rate of urban growth. Urban industrial hubs attract competent workers and managers, thereby boosting the industrial environment. Urban regions provide higher living standards and easier access to key services, making them an appealing option for individuals. Urbanization is stimulated by improved economic prospects and quality of life, resulting in a symbiotic relationship with economic expansion and industrialization. Urbanization also stimulates economic growth because the concentration of people in urban areas stimulates business and trade, establishing an ecosystem that is essential for a nation's economic vitality Top of Form[3].

Rwanda has seen strong economic growth averaging a rate of 7.2% per year between 2010 and 2019. This growth has been supported by significant increase in living standards and achievement of health-related Millennium Development Goals. Despite multiple problems, the country's resiliency was exhibited in 2022, with GDP expanding by 8.2%. The economy continued to function strongly in the first quarter of 2023, growing by 9.2% [4].

Rwanda's industrial policy, which is aligned with the National Strategy for Transformation 2017-2024, targets inclusive economic growth by stressing high-value agricultural, manufacturing, tourism, and knowledge-based services. Since the implementation of the National Industrial Policy in 2011, the industrial sector has grown steadily increasing by 8% in fiscal year 2017/18 from 6% the previous fiscal year. The industrial sector contributed 22% in the first quarter of 2023, up from 21% in the same period in 2022. The government has put in place policies such as Special Economic Zones and Industrial Parks to stimulate domestic and international manufacturing, which contributes to the country's GDP [5].

Rapid and well-managed urbanization is critical for Rwanda's growth goals, since it provides significant economic benefits through specialization, and greater access to services and skilled labour. Rwanda's urban population has maintained an average growth of 2.67% each year for the past two decades with ambitious aims of 35% urbanization by 2024. There are regulatory policies in place to drive economic growth until 2050, making urbanization a key engine of dynamic transformation [6]. Top of Form

Reaching middle- or high-income levels necessitates numerous critical steps including the development of industry, the expansion of cities and the creation of vibrant metropolitan neighbourhoods. This transition from farming-based economies to more modern ones is inextricably linked to people moving to congested cities. Even while the rapid rise of cities in developing countries appears unequal, it is part of a historical trend that demonstrates how economies change and emphasizes the importance of cities for economic growth [7].

Numerous studies have demonstrated the advantageous impacts of urbanization and industrialization together on economic growth [8][9][10][11]. According to historical perspectives, urbanization and industrialization are related, with the former frequently occurring before the latter. However, the relationship varies across nations and historical periods [12]. Studies have also indicated that urbanization can negatively impact economic growth in less developed economies with few job opportunities [13][14]. Studies also reveal that economic growth can have negative influence on the urbanization quality [15] and an overurbanization can be a result of industrialization in a region [16]. Hence gaining a deeper understanding of connections between urbanization, industrialization and economic growth will help us better understand their developmental impacts. Doing research that are specific to a given country is essential due to the differences in socioeconomic conditions throughout nations.

This research investigates how industrialization, urbanization, and economic growth are interconnected in Rwanda. This study which focuses on Rwanda, provides empirical insights into the intricate linkages between industrialization, urbanization, and economic growth. It gives evidence-based policy advice to Rwanda and other developing country authorities, perhaps enabling more successful development policies and enriching global understanding of these dynamics. It contributes to the body of knowledge by being the first study undertaken exclusively in Rwanda as far as my understanding.

II. LITERATURE REVIEW

Several authors have extensively researched the relationship between industrialization, urbanization, and economic growth.

The relationship between urbanization, industrial structure upgrade, and economic growth has been studied by [17] using a spatial econometric technique and data from 26 cities in the Yangtze River Delta (YRD) between 2006 and 2017. The study discovered that upgrading the industrial structure induces a structural economic deceleration, slowing regional economic growth in the YRD. However, a synergy of urbanization and industry structural upgrade has a favourable effect on YRD economic growth.

The impact of industrialization and energy consumption on Indonesian economic growth from 1984 to 2018 has been investigated by [18]. The ARDL (autoregressive distributed lag) model was used in the study to estimate the long-run and short-run connection between the variables. The actual results of the ARDL model showed that industrialization has a favourable long-run impact on economic growth. The findings give compelling empirical evidence that industrialization is critical to achieving long-term economic growth in Indonesia.

The study carried by [19] used a vector error correction model, with the proportion of manufacturing in the whole national economy serving as a representative variable of industrialization to investigate the impact of industrialization on economic growth in Cameroon from 1986 to 2020. The model's results revealed that increasing the share of manufacturing in GDP greatly boost Cameroon's economic growth.

[20] examined the impact of industrialization on economic growth in Senegal via the lens of Senegalese manufacturing enterprises. The research included the years 1960 to 2017 and used Ordinary Least Square (OLS) methodology to estimate the relationship between industrial output, inflation rate, Foreign direct investment, Foreign Exchange Rate, and economic growth. According to the econometric analysis, increasing industrial output positively improve Senegal's economic growth. As a result, there is a strong link between industrial development and Senegalese economic growth.

Using balanced panel data from six Southern African countries from 1978 to 2019,[21]assessed the impact of industrialisation on economic growth using multiple econometric methodologies, including pooled mean group, mean group, dynamic fixed effects, and common correlated effects. Manufacturing value added is used as a proxy for industrialisation in the estimation. Empirical evidence suggests that more industrialisation relates to increased economic growth in both the short and long term. The policy implications of this research include industrialization to remain as one of the most important economic transformation instruments in Southern Africa.

The influence of industrialization on Tanzanian economic growth focusing on the causes of structural changes in the manufacturing sector investigated by [22]with vector error correction model covering the years of 1970 to 2017showed that there is a positive correlation between the manufacturing sector's value added and Tanzania's economic growth.

[23]analysed the impact of the industrial sector on Nigerian economic growth from 1981 to 2020.The parameters' values were estimated using the Ordinary Least Squares (OLS) estimation approach. According to the regression results, industrial sector output has a positive link with economic growth.

Study done by [24] on the relationship between economic growth and urbanization in South Africa's Gauteng Province using Granger causality test to determine the connection between the variables by covering the years 1997-2020quarterly data found that there is a unidirectional causality going from economic growth to employment in Gauteng, which means that a rise in economic growth allows for more jobs to be generated which leads to migration of people to the province. People want to get out of poverty by living in cities where they can gain socioeconomic benefits and develop knowledge and skills that are more easily accessible.

[25]used a bootstrap panel Granger causality test to analyse the relationship between urbanization and economic growth in India at the state level from 1971 to 2020. It has been discovered that most Indian states exhibit unidirectional Granger causation from economic growth to urbanization. This study implies not only a reduced propellant power of urban centres but also an imbalanced development of social overhead capita between urban centres and rural areas, resulting in a migration of individuals to cities with higher incomes to take use of urban facilities.

The dynamic relationships between economic growth and the urbanization rate of the resident population, the urbanization rate of land and the quality of urbanization in China were studied using time series data from 1982 to 2014 and a VAR (vector autoregressive) model by [15]. The following are the findings of the study: There is unidirectional causality between resident population urbanization and China's economic growth with the former encouraging the latter's long-term expansion; there is also unidirectional causality between the rate of land

urbanization and China's economic growth. Unlike the resident population urbanization rate, China's economic growth promotes the increase of land urbanization rate and the increase of land urbanization rate cannot promote China's economic growth; the relationship between the quality of urbanization and China's economic growth is a two-way causality. The improvement of urbanization quality has a cumulative positive influence on China's economic growth whereas economic growth has a negative effect on urbanization quality improvement in the short term but a positive effect on economic growth in the long term.

The exploration of how urbanization influences economic growth and development via external economies, institutional development, and human capital accumulation in Pakistan from 1979 to 2019 was performed by [26]. The study discovered using econometric time series approaches and the Vector autoregression model that urbanization plays a crucial role in the accumulation of human capital through structural changes and has a long-term association with economic growth and development in Pakistan.

[27]studied the relationship between urbanization and economic growth in six ASEAN nations from 1993 to 2014. The Granger causality test was employed as well as the regression estimation method with static and dynamic panel data (Fixed Effect, Random Effect, Driscoll, and Kraay). The findings indicate that there is at least a causal association between urbanization and economic growth. The study revealed that urbanization has a favourable impact on economic growth. The relationship between urbanization and economic growth on the other hand is non-linear. After a certain level of urbanization, economic growth may be hampered.

[28]evaluated the industrialization process and its socioeconomic results in three Ethiopian cities: Galan, Dukem, and Bishoftu. To obtain the necessary data, a household survey, key informant interviews and a document review were done in July and August of 2021 and the information gathered was analysed using multivariate analysis techniques. The findings suggest that the continuous industrialization process in the three cities has had a variety of consequences for livelihood and sustainable development throwing doubt on industrialization's catalytic role. Industrialization was discovered to be negatively related to urban development.

Based on estimations in a simultaneous equations framework,[29]investigated the links between industrialization, urbanization, energy consumption, CO2 emissions and economic growth for the years 2000-2016.A country panel of 30 Chinese provinces/cities and three regional panels were estimated using the Augmented Mean Group (AMG) and Common Correlated Effects Mean Group (CCEMG) estimators. The study's empirical findings are as follows: (i) the impact of urbanization on economic growth varied from negative to neutral to positive for the western, intermediate, and eastern economic zonesrespectively; (ii) as regions develop, industry expansion has a more powerful impact on economic growth and (iii) industrialization promotes rapid urbanization in less developed and less

employment saturated regions. (iv) Economic expansion in more developed regions pushed CO2 emissions down whereas it pushed them up in less developed regions.

The empirical review demonstrates the existence of a link between industrialization, urbanization and economic expansion. However, the conclusions of prior research are not identical and the review also reveals that Rwanda lacks empirical studies on industrial development, urbanization and economic growth interconnectedness. This information gap underlines the need for in-depth research into how these factors interact in Rwanda. As a result, this study will fill this gap.

III. METHODOLOGY

The purpose of this research is to investigate the relationship between industrialization, urbanization, and economic growth in Rwanda from 1973 to 2021. This quantitative analysis used annual secondary data on GDP growth (annual%) measuring economic growth, industry

(including construction), value added (annual % growth) proxying industrialization and urban population growth (annual %) representing urbanization as variables of interest and were collected from The World Bank's World development indicators (WDI) data set.

To investigate the long-run and short-run relationships between the variables, this study used the Vector Error Correction Model (VECM) technique, which permits each variable in the model to be both an independent and dependent variable. Since time series data are in use for this investigation, the stationarity of the variables is tested using the augmented dickey fuller (ADF) test as a prerequisite. Johansen tests for cointegration is utilized to find out if there is a long-run relationship among the variables, the Granger Wald test is used for causation analysis [30] and STATA 17 software is used for econometric analysis.

Equations (1) through (3) describe the VECM which is used in this investigation.

$$\Delta GDP_t = \sigma + \sum_{i=1}^{k-1} \beta_i \Delta GDP_{t-i} + \sum_{j=1}^{k-1} \phi_j \Delta INDU_{t-j} + \sum_{m=1}^{k-1} \varphi_m \Delta URB_{t-m} + \lambda_1 ECT_{t-1} + \mu_1 t \tag{1}$$

$$\Delta INDU_t = \psi + \sum_{i=1}^{k-1} \beta_i \Delta GDP_{t-i} + \sum_{j=1}^{k-1} \phi_j \Delta INDU_{t-j} + \sum_{m=1}^{k-1} \varphi_m \Delta URB_{t-m} + \lambda_2 ECT_{t-1} + \mu_2 t \tag{2}$$

$$\Delta URB_t = \gamma + \sum_{i=1}^{k-1} \beta_i \Delta GDP_{t-i} + \sum_{j=1}^{k-1} \phi_j \Delta INDU_{t-j} + \sum_{m=1}^{k-1} \varphi_m \Delta URB_{t-m} + \lambda_3 ECT_{t-1} + \mu_3 t \tag{3}$$

GDP=gross domestic product (economic growth)

INDU=industrialization

URB=urbanization

k-1=the lag length is reduced by 1

$\beta_i, \phi_j, \varphi_m$ =short run dynamic coefficients of the model representing short run relationship

λ_i =speed of adjustment parameter

ECT_{t-1}=the error correction term representing long run relationship

$\mu_i t$ =residuals(stochastic error term)

IV. RESULTS AND DISCUSSION

A. Stationarity test

Table 1: Summary of Augmented Dickey Fuller (ADF) unit root test

Variables	GDP	INDU	URB
ADF statistics trend	-7.595	-7.947	-4.788
ADF statistics drift	-7.572	-7.893	-4.614
ADF statistics without	-7.572	-7.893	-4.614
Probability	0.0000.		0.0005./ 0.0000/0.0001.
Order of integration	1(0)	1(0)	1(0)

Source: Author's Computation using STATA 17

From the result shown in table 1, GDP, INDU and URB are stationary at levels, that is they are integrated of order zero 1(0) therefore, the research data are eligible to use VECM model.

B. Cointegration test

Table 2: Johansen tests for cointegration results (Ho: no cointegration H1: cointegration)

Maximum rank	Trace statistics	Critical values at 5%	Maximum statistics	Critical values at 5%
0	70.9382	29.68	49.4947	20.97
1	21.4435	15.41	16.5432	14.07
2	4.9003	3.76	4.9003	3.76

Source: Author's Computation using STATA 17

At all maximum rank, both trace statistics and maximum statistics are greater than critical values at 5% level of significance, by the rule of thumb we reject null hypothesis among variables of no cointegration and follow the alternative of cointegration. Therefore, there are more

than 2 equations that are cointegrated in our model implying a long run relationship among the variables.

C. VECM Results

Because the cointegration test findings suggested a long run relationship among the variables, VECM is used to

determine the long run and short run relationships among the variables.

Table 3: VECM long run and short run results, economic growth (GDP) as dependent variable

Dependent variable	Independent variables	Coefficient	P -values
Long run results			
GDP	INDU	0.4121972	0.000
	URB	-0.4419256	0.000
Short run results			
GDP	Δ GDP	1.541037	0.002
	Δ GDP (2)	1.622414	0.001
	Δ GDP (3)	0.8271163	0.012
	Δ INDU	-1.014123	0.000
	Δ INDU (1)	-0.5656552	0.014
	Δ URB	-0.0391617	0.938
	ECM (-) adjustment speed	-2.393922	0.000
	Constant term	-0.1403914	0.911
R square		0.7876	

Source: Author’s Computation using STATA 17

From the results presented in table 4, INDU has a very significant positive impact on GDP in the long run while URB has a highly significant negative impact on GDP. According to the coefficients, a unit increase in INDU is associated with 0.4121972 units increase in GDP on average ceteris paribus at the 1% level of significance. These findings suggest that industrial expansion boosts economic growth significantly in the long run. These findings are supported by [18][19][21][31].

On average ceteris paribus, a unit rise in URB is associated with a loss in GDP of 0.4419256 units at the 1% level of significance. These findings suggest that in the long run, urbanization has a major negative influence on economic growth. The rationale for these findings is that urbanization can worsen income and wealth inequality since some people benefit more from economic possibilities in cities while others are left behind. Urbanization may also be related with environmental degradation and high living costs. These findings are in line with [32][33][14][34].

The results from table 4 show that all previous periods of GDP have a highly statistically significant impact on current GDP. These findings imply that the Rwandan economy's prior efforts have had a substantial impact on current economic growth. The findings also show that INDU has a statistically significant negative impact on GDP in short term. Industrialization's negative short-term impact on economic growth can be linked to reasons such as high initial investment costs, labour market disruptions and environmental damage. Before long-term growth gains are realized, the change to industrial production may cause economic disruptions and environmental concerns.[35][36] found similar results in their study. Urbanization has insignificant effect on economic growth in the short run.

The error correction term ECM (-1) is -2.393922 and statistically significant at 1%. Meaning that following a deviation or a shock in the structure of the economy, economic growth adjusts very quickly at a rate of 239% back to its long run equilibrium. The R-squared value indicates that INDU and URB have 78% explanatory power on GDP, indicating that 73% of the fluctuations in GDP are explained by INDU and URB.

Table 4: VECM long run and short run results, industrialization(INDU) as dependent variable

Dependent variable	Independent variables	Coefficient	P -values
Long run results			
INDU	GDP	2.426024	0.000
	URB	1.072122	0.000
Short run results			
INDU	Δ INDU	-1.801959	0.000
	Δ INDU (2)	-0.9499319	0.014
	Δ GDP	2.194343	0.010
	Δ GDP (1)	1.857111	0.026
	Δ URB	-0.255142	0.766
	ECM (-)/speed of adjustment	-1.78814	0.051
	Constant term	0.2089482	0.922
R square		0.7319	

Source: Author’s Computation using STATA 17

Table 5 reveal that in the long run, GDP and URB have a highly significant positive impact on INDU. Based on coefficients, a unit rise in GDP is associated with 2.426024 units increase in INDU on average ceteris paribus at the 1% level of significance. These findings suggest that economic expansion boosts industrialization in the long run and they are reinforced by [37][38] who discovered similar outcomes in their investigations. On average ceteris paribus, a unit increase in URB is related with a rise in INDU of 1.072122 units at the 1% level of significance.

These findings suggest that in the long run, urbanization has a significant positive impact on industrialization. These results are corroborated by [39] who discovered comparable in the study carried out.

Table 5 also show that all prior periods of INDU have a statistically significant negative impact on current INDU. A negative statistical significance of previous industrialization attainment on current industrialization may be attributed to

diminishing returns where earlier industrial growth hits a saturation point making further expansion less significant. It could also be due to resource depletion, environmental limits, or a shift in economic activity. The findings also show that GDP has a statistically significant positive impact on INDU, which explains why GDP promotes INDU in the short term. These findings are supported by [37][38]. URB is insignificant, it has no immediate impact on industrial progress in short run.

The error correction term ECM (-1) is -1.78814 and statistically significant at 10% meaning that following a deviation or a shock in the economy, industrialization adjusts relatively quickly at a rate of 178% back to its long run equilibrium. The R-squared value indicates that GDP and URB have 73% explanatory power on INDU indicating that fluctuations in INDU are explained by GDP and URB at 73%.

Table 5: VECM long run and short run results, urbanization (URB) as dependent variable

Dependent variable	Independent variables	Coefficient	P-values
Long run results			
URB	GDP	-2.262824	0.000
	INDU	0.9327298	0.000
Short run results			
URB	Δ URB	0.0685897	0.679
	Δ GDP	0.8522387	0.000
	Δ GDP (1)	0.4809188	0.003
	Δ INDU	-0.2739859	0.000
	Δ INDU (1)	-0.1713247	0.022
	ECM(-)adjustment speed	-0.318178	0.000
	Constant term	-0.052144	0.899
R square		0.7319	

Source: Author's Computation using STATA 17

Table 6 shows that in the long run, GDP has a negative impact on URB whereas INDU has a considerable positive impact on URB. According to the coefficients, a unit rise in GDP is related with a drop in URB of 2.262824 units on average ceteris paribus at the 1% level of significance. These findings suggest that economic expansion reduces urbanization significantly in the long run. Economic growth has the potential to reduce urbanization in the long run by increasing opportunities in rural areas, closing the income gap between urban and rural areas, and improving living conditions in non-urban areas. This may result in a slower rate of urban migration and a more balanced distribution of economic activity ultimately reducing urbanization.[40]affirm these results. Table 6 also report that on average ceteris paribus, a unit increase in INDU is related with a rise in URB of 0.9327298 units at the 1% level of significance. These findings suggest that industrial expansion has a considerable long-term favourable impact on urbanization. These findings have been validated by [41][42]who discovered similar findings in their investigations.

Table 6 also show that all former periods of urbanization (URB) had no effect on current urbanization. It implies that past patterns of urbanization do not sufficiently anticipate or explain current urbanization trends. The findings also show that GDP has a statistically significant positive impact on URB in short term. These findings are supported by [24][10].The other findings of short run show that INDU has a negative effect on URB. Industrialization can prevent urbanization by increasing employment prospects in rural areas, decreasing the influx of people into cities. When enterprises establish themselves outside of urban areas, they can halt the urbanization process by providing jobs and economic opportunities in rural areas, so moderating immediate urban population increase. These results are supported by [16].

The error correction term ECM (-1) is -0.318178 and statistically significant at 5% meaning that following an economic deviation or shock, urbanization adjusts at a rate of 31% back to its long run equilibrium. The R-squared value indicates that GDP and INDU have 73% explanatory power on URB, indicating that fluctuations in URB are explained by GDP and INDU at 73%.In terms of the diagnostic tests performed on the models (1) to (3), the basic statistical requirements and classical assumptions are

primarily met, the models do not exhibit multicollinearity, heteroscedasticity, or autocorrelation, and the models are

stable and dependable for policy implications.

D. CAUSALITY ANALYSIS

Table 6: Granger Wald test results

Variables	chi2 value	Prob > chi2	Decision
GDP-INDU	1.39	0.2384	Industrialization has no causal effect on economic growth in short run
GDP-URB	0.10	0.7547	Urbanization has no causal effect on economic growth in short run
INDU-GDP	0.41	0.5244	Economic growth has no causal effect on industrialization in short run
INDU-URB	0.51	0.4764	urbanization have no causal effect on industrialization in short run
URB-INDU	0.00	0.9803	Industrialization has no causal effect on urbanization in short run
URB-GDP	8.44	0.0037	Economic growth has causal effect on urbanization in short run

Source: Author’s Computation using STATA 17

For the long run causality among the variables, based on the error correction term and the significance of the coefficients in the model's equations (1) to (3), there is long run bidirectional causality from GDP to INDU and long run unidirectional causality from INDU and GDP to URB.

term challenges posed by industrialization on economic growth, implementing short-term economic stability measures, like trade incentives and small business support is recommended. To mitigate the long-term negative impact of urbanization on economic growth, focusing on sustainable urban planning, infrastructure development, and rural investment for economic opportunity redistribution is suggested. To counteract the long-term negative effects of economic growth on urbanization, promoting equitable urban development, affordable housing, and resource accessibility for all residents should be implemented. Ongoing monitoring and evaluation are essential for effective, adaptable strategies to drive Rwanda's sustainable development. Policymakers should prioritize balanced urbanization strategies that capitalize on the long-term interdependence of economic growth, industrialization, and urbanization.

V. CONCLUSION AND RECOMMENDATIONS

The interplay of industrialization, urbanization, and economic growth in the context of Rwanda is investigated in this study. The Vector Error Correction Model and Johansen tests for cointegration are used to detect long run and short run relationships between industrialization, urbanization, and economic growth with annual data from 1973 to 2021, and the Granger Wald test is used for causality analysis.

The variables of interest in this study are GDP growth (annual%) as an indicator of economic growth, Industry (including construction), value added (annual% growth) as a proxy for industrialization, and Urban population growth (annual%) as a measure of urbanization.

The study findings demonstrated that economic growth has a long-term and short-term positive impact on industrialization. In the long term, urbanization has beneficial effect on industrialization but in the short run, no association is revealed. Other study findings show that industrialization has an advantageous effect on economic growth in the long run but has a negative impact on economic growth in the short term. Urbanization has a negative impact on economic growth in long run and insignificant negative impact is observed in the short run. Furthermore, this study found that economic growth has a negative long-run influence on urbanization but a positive short-run effect whereas industrialization has a positive long-run effect on urbanization but a negative short-run effect. The study also found a bidirectional causality from economic growth to industrialization in the long run and unidirectional causality from industrialization and economic growth to urbanization in long run while only economic growth had a causal effect on urbanization in the short run.

For sustainable development in Rwanda, a comprehensive approach is vital. Policymakers should prioritize balanced urbanization policies that leverage the interconnected long-term relationships between economic growth, industrialization, and urbanization. To address short-

REFERENCES

- [1.] T. P. Soubbotina, *Beyond Economic Growth: An Introduction to Sustainable Development*, Second Edi. 2004.
- [2.] W. . W. . Rostow, “The Take-Off Into Self-Sustained Growth,” *Oxford Univ. Press behalf R. Econ. Soc. Stable*, vol. 66, no. 261, pp. 25–48, 1956, [Online]. Available: <https://www.jstor.org/stable/2227401>
- [3.] H. Hughes, “Industrialization, Employment, and Urbanization,” *Int. Monet. Fund*, vol. 8, no. 001, pp. 42–49, 1971, [Online]. Available: <https://www.elibrary.imf.org/view/journals/022/0008/001/article-A007-en.xml>
- [4.] The World Bank, “The World Bank in Rwanda: Overview,” The World Bank, 2023. <https://www.worldbank.org/en/country/rwanda/overview>
- [5.] RDB, “Product directory: Manufacturing sector overview,” Rwanda Development Board, 2023. <https://rdb.rw/export/export/products-directory/manufacturing-sector/>
- [6.] MININFRA, “RWANDA TARGETS 35% OF SUSTAINABLE URBANIZATION BY 2024,” MININFRA, 2019. <https://www.mininfra.gov.rw/updates/news-details/rwanda-targets-35-of-sustainable-urbanization-by-2024>

- [7.] The World Bank, world development report: Reshaping Economic Geography. 2009.
- [8.] M. Chen, H. Zhang, W. Liu, and W. Zhang, "The Global Pattern of Urbanization and Economic Growth: Evidence from the Last Three Decades," vol. 9, no. 8, 2014, doi: 10.1371/journal.pone.0103799.
- [9.] S. Feng, "The Impact of Urbanization and Population Policy on China's Economy," *Rudn J. Polit. Sci.*, vol. 25, no. 3, pp. 564–580, 2023, doi: 10.22363/2313-1438-2023-25-3-564-580.
- [10.] O. Lubonja, "Impact of Urbanization and Economic Growth in Albania," *J. Educ. Soc. Res.*, pp. 282–297, 2022.
- [11.] L. M. Quan, "A STUDY ON THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND URBANIZATION IN THE NORTHERN VIETNAM KEY ECONOMIC REGION," 2014.
- [12.] P. Bairoch, *Cities and Economic Development: From the Dawn of History to the Present*. The University of Chicago Press, 1988.
- [13.] R. Singh, N. S. Swami, and B. C. Prasad, "Urbanization and Economic Growth: An Empirical Study of Pacific Island Economies," no. December 2014, 2016, doi: 10.13140/RG.2.2.35805.61927.
- [14.] Z. Fatima, "An Empirical Analysis of Urbanization and Economic Growth in South Asian Countries," 2022.
- [15.] L. Y. Zi, "Urbanization and Economic Growth in China — An Empirical Research Based on VAR Model," *Int. J. Econ. Financ.*, vol. 9, no. 3, pp. 210–219, 2017, doi: 10.5539/ijef.v9n3p210.
- [16.] S. Wilonoyudho, "Overurbanization in Semarang city," pp. 191–200, 2000.
- [17.] L. Guo and Y. Liu, "Urban-Industrial Development and Regional Economic Growth in a Developing Country: A Spatial Econometric Approach," 2022, doi: 10.1177/21582440221102425.
- [18.] K. E. Elfaki, R. D. Handoyo, and K. H. Ibrahim, "The Impact of Industrialization, Trade Openness, Financial Development, and Energy Consumption on Economic Growth in Indonesia," 2021.
- [19.] G. M. Djakou and X. Jiang, "The Role of Industrialization on Economic Growth: Case of Cameroon from 1986-2020," pp. 1–14, 2022, doi: 10.5281/zenodo.6596978.
- [20.] C. Ndiaya and K. Lv, "Role of Industrialization on Economic Growth: The Experience of Senegal (1960-2017)," pp. 2072–2085, 2018, doi: 10.4236/ajibm.2018.810137.
- [21.] F. K. Bokosi, "African Journal of Economic Review, The Effects of Industrialisation on Economic Growth: Panel data evidence for SADC countries," *African J. Econ. Rev.*, vol. 10, no. June, pp. 89–109, 2022.
- [22.] E. J. Lugina, A. Beni, S. Mwakalobo, and F. Lwesya, "Effects of industrialization on Tanzania's economic growth: a case of manufacturing sector," *Futur. Bus. J.*, vol. 8, no. 1, pp. 1–11, 2022, doi: 10.1186/s43093-022-00177-x.
- [23.] B. C. Chukwu, "Impact of industrial sector on economic growth in Nigeria (1981-2020)," pp. 1–17, 2021.
- [24.] S. Jacobs, O. O. David, and A. S. Wyk, "The Impact of Urbanization on Economic Growth in Gauteng Province, South Africa," *Int. J. Econ. Financ. Issues*, vol. 13, no. 2, pp. 1–11, 2023.
- [25.] A. Shaban, K. Kourtit, and P. Nijkamp, "Causality Between Urbanization and Economic Growth: Evidence From the Indian States," vol. 4, no. May, 2022, doi: 10.3389/frsc.2022.901346.
- [26.] R. Mehmood, Z. Ullah, and I. Lal, "Human Capital, Urbanization and Dynamics of Economic Growth and Development in Pakistan," *J. Human, Earth, Futur.*, vol. 2, no. 4, pp. 382–394, 2021.
- [27.] H. M. Nguyen and L. D. Nguyen, "The relationship between urbanization and economic growth: an empirical study on ASEAN countries," *Int. J. Soc. Econ.*, 2017.
- [28.] M. Tanku and B. Woldetensae, "City, Culture and Society Industrialization and urban socio-economic dynamics next to a primate city: The case of three Ethiopian cities," *City, Cult. Soc.*, vol. 34, no. May, p. 100537, 2023, doi: 10.1016/j.ccs.2023.100537.
- [29.] M. Ahmad and Z.-Y. Zhao, "Empirics on linkages among industrialization, urbanization, energy consumption, CO2 emissions and economic growth: a heterogeneous panel study of China," pp. 30617–30632, 2018.
- [30.] D. N. Gujarati and D. C. Porter, *Basic Econometrics*, 5th editio. 2009.
- [31.] O. J. Ibitoye, A. A. Ogunoye, and E. P. J. Kleynhans, "Impact of industrialisation on economic growth in Nigeria," *J. Econ. Financ. Sci.*, vol. 15, no. 1, pp. 1–15, 2022.
- [32.] H. Sadi, S. Prince, G. Uzuner, F. Victor, and S. Asumadu, "Heliyon Trivariate modelling of the nexus between electricity consumption, urbanization and economic growth in Nigeria: fresh insights from Maki Cointegration and causality tests," *Heliyon*, vol. 6, no. February, p. e03400, 2020, doi: 10.1016/j.heliyon.2020.e03400.
- [33.] D. Linkage, A. Population, and E. Growth, "Dynamic Linkage Among Population, Urbanization, Poverty and Indonesian Economic Growth," *Econ. Dev. Anal. J.*, no. 4, pp. 415–424, 2022.
- [34.] M. Brückner, "Economic growth, size of the agricultural sector, and urbanization in Africa," *J. Urban Econ.*, vol. 71, pp. 26–36, 2012, doi: 10.1016/j.jue.2011.08.004.
- [35.] C. S. Saba and N. Ngepah, "ICT diffusion, Industrialization and Economic Growth Nexus: an International Cross-Country Analysis," *J. Knowl. Econ.*, vol. 13, no. 3, pp. 2030–2069, 2022.
- [36.] A. Elmakki, S. Bakari, and M. Mabrouki, "The Nexus between Industrial Exports and Economic Growth in Tunisia: Empirical Analysis," *Munich Pers. RePEc Arch.*, no. 79360, 2017.
- [37.] Q. Liu, "A Study on the Two-way Causal Relationship Between Industrial Structure Evolution and Economic Growth: Empirical Test Based on 40 Years of Reform and Opening-up in China," *Glob. J.*

- Emerg. Mark. Econ., 2019, doi: 10.1177/0974910119871375.
- [38.] [38] A. Bashir and D. P. Atiyatna, "The Causality Between Agriculture , Industry , and Economic Growth : Evidence from Indonesia," *Etikonomi*, vol. 18, no. 2, pp. 155–168, 2019.
- [39.] R. Patty and M. Kuncoro, "The linkage between industrialization, urbanization, and tourism: lessons from asean and indonesia," *Int. J. Business, Econ. Law*, vol. 11, no. 3, pp. 17–18, 2016.
- [40.] T. Liu, "Is economic growth improving urbanisation? A cross-regional study of China," *Urban Stud. J. Ltd.*, vol. 52, no. 10, pp. 1883–1898, 2015, doi: 10.1177/0042098014540348.
- [41.] M. B. Azzulin, M. Jazar, A. Jedy, and V. Fernandes, "Industrialization and Urbanization : An Intrinsic Relationship in the Global South," *J. Soc. Technol. Environ. Sci.*, no. September, 2022, doi: 10.21664/2238-8869.2022v11i3.p.
- [42.] M. Parvaneh, K. Hajipour, and M. Hosseinpour, "Assessing Impact of Industrialization on Urban Expansion in Surrounding Cities (Case Study : Assalouyeh , Iran)," *J. Appl. Sci.*, no. 16, pp. 167–177, 2016, doi: 10.3923/jas.2016.167.177.