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EFFECT OF MANUFACTURING SECTOR PERFORMANCE ON THE ECONOMIC GROWTH OF RWANDA

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Abstract

This paper intends to empirically examine the effect of manufacturing sector performance and economic growth in Rwanda from 1986 to 2021 using time series data obtained from local and international data banks/stores such as the National Institute of Statistics of Rwanda (NISR) and World Bank (WB). This research has been also considered and backed by different theories and models such Endogenous growth model and neoclassical theory/model, industrial enlightenment theory, and classical development economists' theories. The design of the research is based on quantitative research econometrics approaches and the researcher performs empirical estimations using the Augmented Dickey-fuller (ADF) test for stationary of the series. the ARDL bound test *and Error Correction Model (ECM) were used to test short and long-run effects of one- time series on another. This study resulted in a short-run positive effect of the manufacturing sector's performance on the economic growth of Rwanda. Some post-estimation techniques were also performed, for instance, BG-test was used to see whether there is autocorrelation between the residual (u)or not, Breusch-Pegan-Godfrey Test was also performed to see whether the variance of the residual (u) is constant (Homoscedasticity) or not, Skewness/Kurtosis test was performed for Normality test. Lastly, the main policy recommendations drawn in this research were in the line of strengthening the manufacturing sector as the key drove economic growth of Rwanda.*

1. Introduction

It has been discovered that the world's richest countries are the ones industrialized. A country is said to be industrialized when at least one-quarter of its Gross Domestic Product (GDP) is produced in its industrial sector. It was also highlighted that the industrial sector in any country would at least contribute a quarter (¼) of the Gross Domestic Product (GDP), otherwise, it would be viewed as a big challenge for economic growth (Bennett, Anyanwa, and Kalu, 2015).

Wisdom and Okon (2017) defined the manufacturing sector as a sub-sector of the industrial sector (craft, processing, mining, and quarrying,) that transforms raw materials into final products for consumer or intermediate or producer products. Manufacturing like other industrial activities creates an avenue for employment, helps to boost agriculture, and helps to diversify the economy while helping the nation to increase its foreign exchange and local labor to acquire skills as well as enhancing the economic growth of the country.

Factually, the most successful countries in economic growth /development and catch-up, have been able to grow and accumulate wealth by investing in their industries as well as the manufacturing sector since 1870 (Szirmai, 2012).

Most East African Countries' economies have been largely focused on the agriculture sector for a long time, tremendously, efforts were put in place to promote industrial diversification and development to rise industrial portions of Gross domestic product (GDP), and suddenly 20% at the regional level, manufacturing contributions was at 9.7% in 2008 (EAC Secretariat, 2012).

Similar to Rwanda, Manufacturing sector has been largely undiversified and concentrated in seven subsectors: Food, beverage and tobacco, textiles and clothing, woos, paper and printing, chemicals rubber and plastics, non-metallic, minerals, and furniture. Food, beverage, and tobacco products counted for more than 70% of the total manufacturing output (WB,2015). The strongest rise has

occurred in food output, which has seen its share in manufacturing increase from 23.25% in 2000 to 43.79% in 2012.

Over the years, the manufacturing sector has continued to be stagnant at around 5 percent (WB,2015), this is reflected in the country's low level of manufacturing exports, while export is becoming more diversified (English et al,2016). The weakness of Rwanda's manufacturing sector and its relatively moderate export contribution highlight the importance of tackling the obstacles in the economy's growth trajectory, the majority of the challenges to Rwandan manufacturing growth and manufacturing exports are real constraints. (Such as transport costs and Rwanda's landlocked geography (Calabrese, 2017)

In 2018, Rwanda approved the implementation of the Rwanda Special Economic Zone (SEZs) policy intended to boost the manufacturing sector as well promoting industrialization in Rwanda by solving the issue of insufficient industrial and commercial products, the cost of energy, limited transport linkages, market access and availability of skills (Accord, 2018).

In 2016, there were 44 operational manufacturing industries in Kigali Special Economic Zone (KSEZ), and now, as of today, more than 100 manufacturing industries were established which was a very promising thing for Rwanda's GDP.

In its vision, Rwanda highlighted the strategic interventions that focus on manufacturing export growth in the medium term to accelerate the economic growth of Rwanda, the set target was to achieve 25.6 % of its GDP from the manufacturing sector in 2020 (NISR, 2020).

During the fiscal year 2019/20, the Rwandan economy recorded its lowest GDP growth since the fiscal year 2016/2017, with 2.3 percent growth, compared to 8.8 percent the previous year. The industrial sector has grown 3 percent and contributed 0.5 percent to the point overall GDP growth rate and 12 percentage points lower than the previous fiscal year (Minecofin AER, 2021).

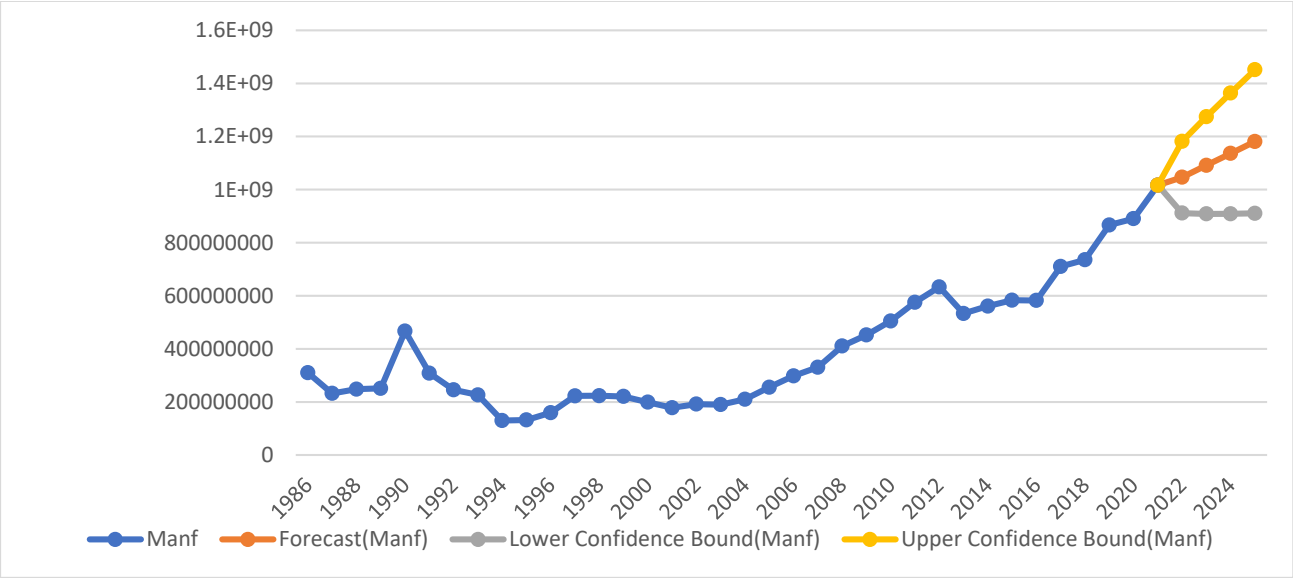

Figure 1: A graph shows the performance of the manufacturing sector and forecasting

As it has shown in figure1, over the years, there is an increment in returns from the manufacturing sector. for instance, from 2002 to 2011, manufacturing has been gradually increased and since 2014 up to date, there is also a positive significant change happened. After that, the Researcher s forecasted the performance of the manufacturing sector from 2021 up to 2025, he found that there will be an increase in the manufacturing return from 1,016,601,040 to 1,181,011,774 Rfw which is equal to 16.2%. (Researcher, 2022).

Rwanda continues to grow its manufacturing sector by 8% for the fiscal year 2017/2018 from 6% in the previous financial year (NISR Annual economic report, 2019), a sector that was still small, but has been growing steadily. , Currently, Rwanda registered and welcomed a couple of manufacturing plants such as Volkswagen, and Mara phone manufacturers to be based in Rwanda, and thereafter on June 23, 2022, the CEO of BioNTech launches a construction plant of vaccines in Rwanda (Larsson, 2022.

In its report, the Rwanda Development Board indicated that 72% of the total investment registration in 2022, manufacturing occupies only 15% of the total) after Construction accounted for 31%, and Real Estate for 26% (RDB,2022).

In the last Fiscal year of 2019/2022, the National Institute of statistics Rwandan also revealed that the GDP at the current market price was estimated to be 9399 billion up from 8713 billion Rwandan francs in 2018-2019. The services sector contributed 48 percent while the agriculture sector contributed 25 percent, and the industry sector contributed 19 percent of the GDP (NISR, 2021).

In addition to that, Rwanda has enjoyed comparatively high ranks in the World Bank's Ease of Doing Business Index, which placed Rwanda 38th out of 190 economies in 2020, several opportunities have been initiated to help Rwanda to gain some profit from free trade benefits as well as increase its revenues. For instance, Rwanda joined the African Continental Free Trade Area (AfCFTA), the EAC, and the Commonwealth in 2007, 2009, and 2018, respectively, and has also long been a member of the World Trade Organization

Despite any other challenges faced, Rwanda has invested a lot in the manufacturing sector as a good way of strengthening export as well as fading imports, however, its contribution to GDP seems to be still too low compared to other sectors, and this needs any empirical study to verify the reason why it is still lagging behind in its contribution to GDP.

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And again, in many studies that have been conducted in Rwanda, researchers concentrated on the other sectors like service and agriculture, the manufacturing sector was left behind. there is no current empirical study concerning the manufacturing performance on economic growth in Rwanda considering the key variables that have been used in the model of this research,

For instance, in the study conducted by Barham MUHIRE, in 2018 focused on Employment in Manufacturing and service firms in Rwanda, there is no consideration of the key factors like Total factor productivity, inflation, or exchange. Similar to the study conducted by Linda and Tyson in 2017 on financing the manufacturing sector in Rwanda and its effect on GDP.

It is in that way; this paper comes into empirical presenting the effect of manufacturing sector performance on the economic growth (GDP) of Rwanda from 1986-2021.

2. Conceptual Review

In this part of this paper, the researcher put together some theories that help the readers to understand more about this topic

2.1. Theoretical Framework

2.1.1. Engel's law on the contribution of the manufacturing sector to the economic growth

In the view of the Engel law, the lower a country's per capita income, the higher the proportion of that funds spent on basic agricultural foodstuffs. As per capita income goes up, the demand for agricultural products declines, and the demand for industrial commodities starts to rise. Economic development results in the formation of a mass market for industrial products. This opens up whole new opportunities for manufacturing sectors to play a big role in economic advancement. If a country continues largely depend on agriculture and fails to grow its manufacturing industry, it will be forced to import more manufactured products (Engel 1857).

2.1.2. Classical development economists' theory of Manufacturing and economic growth

Throughout the 1960s, historical evidence suggested that there was a strong relationship between manufacturing expansion and economic growth. classical development economists offered two theories for why manufacturing is the engine of economic growth. The first concentrated on manufacturing's internal special features,' while the second examined how these special properties' spread to the rest of the economy, initiating processes of improving returns and economic growth. (Antonio A, Mike G,2013).

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2.1.2.1. Special properties of Manufacturing advancement

The special qualities expressed in the second law) that make manufacturing more successful than other aspects of economic activity in sparking total economic growth (via the first and third laws) are threefold. For starters, there are more opportunities for capital accumulation and intensification in manufacturing. Second, there are more opportunities to capitalize on economies of scale brought about by large-scale production and technical irrevocability, both within and between industries. Finally, there are higher learning opportunities in manufacturing output, which generates both embodied and disembodied technological advancement. Given these characteristics, manufacturing specialization implies a double productivity gain (it allows countries to enjoy a "structural change benefit" while avoiding a "structural change burden" (Antonio A, Mike G, (2013)

2.1.2.2. Mechanism for special properties' spread to the rest of the economy

In 1988, Albert Hirschman specifically outlined the mechanisms by which manufacturing can extend its particular potential to the rest of the economy. In his 'unbalanced growth model,' each sector is linked to the rest of the economic system by direct and indirect intermediate purchases of productive inputs and sales of productive outputs, which means that backward and forward linkages. As per its connection structure, each sector applies 'push' and 'pull' forces to the real economy. Whereas agriculture, the industrial sector possesses a significant multiplier effect and thus appears as the major factor in the development of Antonio A, Mike G, (2013).

2.2. Structural change bonus theory

One fundamental argument in favor of industrialization is that agribusiness labor productivity is considerably lower than industrial labor productivity. Transferring labor from low-productivity agriculture to high-productivity industry immediately increases overall productivity and income per capita. In developing economies, this transfer has been an essential source of growth (Timmer and de Vries 2009).

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2.3. Schumpeter’s theory of economic growth

Schumpeter’s theory of economic growth is founded on the assumptions of private property, a competitive market, and the efficiency of financial systems, which might enable the production of new discoveries. However, in nations lacking a democracy, these prerequisites are typically not met. Thus, Schumpeter's theory is targeted at democratic and economically developed countries.

2.4. Arthur Lewis and Walt Rostow’s theory of economic growth

In his work, he addressed the issue of underdeveloped countries, but with a wealthy working force (Lewis 1954, p. 3). Lewis supported the overarching vision of classical economics but did not always agree with their judgments and approaches. Lewis' model implies a low standard of living in the short run. The savings achieved will enhance the stock of capital, resulting in the creation of income growth in the long term. Thus, Lewis' model indicates that short-run inequalities between countries should be widened in order to achieve long-run economic equality (Lewis 1956, pp. 7-22).

Lewis's theory does have a conceptual underpinning attributed to Simon Kuznets, who invented "Kuznets's curve" (Kuznets 1955, pp. 1-28). The presence of economic inequalities in the early phases of expansion was proven by empirical investigations. Initial inequalities were the biggest as labor started to switch from agricultural to industry. The distinctions tended to vanish, though, as the factors of production gathered in industrial hubs.

Walt Rostow published another economic growth theory a few years later. Rostow, like Lewis, tied economic development to capital accumulation and identified five phases of development (Rostow 1960, pp. 4-16). According to Rostow, the most challenging step for poor countries is reaching the third stage, described as "take off." Poor countries are concerned about breaking the "vicious circle" that has developed over time. Rostow advocated that it should be broken by acquiring capital. However, he acknowledged that when there weren't any possibilities to grow over the years accumulation, external assistance would be needed.

All these above theories are very important for this research paper because they are showing us how things should work if countries care about the development of manufacturing sector performance which contributes more to economic growth. The manufacturing sector should be also taken as the key-driven economic growth that uses intensive technology to rise the quality of the products through the transformation of raw materials to final products for the country to be able to compete at the international level which rise the level of the manufacturing sector on GDP.

3. Empirical Review

Several empirical studies supported the assertion of the existence of a relationship between the manufacturing sector and economic growth even though the literature evidence is mixed.

In 2014, Sheridan used cross-sectional data from 86 countries from the period 1970 to 2009 to examine the relationship between manufacturing exports and economic growth using regression tree analysis. The researcher argued that for a country to consider the manufacturing sector as a benefit for economic growth it first needs to be developed. the study revealed that manufacturing exports are positively related to economic growth in countries with higher education and manufacturing exports are negatively related to economic growth in countries with lower education (Sheridan,2014).

An empirical study conducted by Zalk (2014) seeks to address the interrelated questions of what is the role of manufacturing in boosting economic growth and employment in South Africa. more precisely manufacturing continues to be the engine of growth in South Africa. He argued that manufacturing continues to be the engine of fast economic growth in association with the creation of employment. by testing the Kaldorian hypothesis using the econometrics approach the study found that manufacturing heavily continues to play an important role in stimulating economic growth and employment creation in South Africa (zalk,2014).

Katuria and Raj (2009) analyzed the relationship between manufacturing growth and output growth in Indian states (including the informal sector) and tested the hypothesis of the engine and finally confirmed that manufacturing is working as the engine of economic growth. In an econometrical analysis of the Indian country, Chakravarty and Mitra (2009, found that manufacturing is one of the determinants of overall growth, construction, and services also turn out to be important, especially for manufacturing growth.

In 1999, Waterberg and Verspagen conducted an empirical analysis of the real growth rate of Gross domestic products and the real growth rate of the manufacturing sector to prove whether the engine of the growth in the manufacturing sector or not. They found that manufacturing is playing a key role as the engine of the economic growth in East Asia and Latin America but has no significant effort in developed economies. And recently study by Szirmai and verspagen (2010) found a significant relationship between the shares of manufacturing in GDP at the beginning of five years period and average growth rates in five years for a panel dataset of 90 countries for the period 1950-2005.

In 2006, Dasgupta and Singh tested Kaldor's law in India, the research investigated the evidence of deindustrialization in emerging economies with low levels of income, unemployment growth, and fast growth in the formal sector. the research also analyzed the manufacturing growth in the formal and informal sectors of the Indian economy, they revealed that the manufacturing sector continues to be a key sector that drives the Indian economy. It was also found that the manufacturing sector improved the balance of payment. Kaldor's three laws of growth were also empirically tested south African economy by Millin and Nichola, the study adopted an econometric methodology using the ordinary least squares (OLS) to estimate linear regressions. The study found

that South Africa's economy supports the Kaldorian growth laws, therefore manufacturing was found to be a key economic growth in South Africa in the 21st century.

Bennett, Anyanwu, and Kalu (2015) investigated also the effect of industrial development on Nigeria's economic growth from 1973-2013 using OLS (ordinary least square) regression, they found that the influence of manufacturing sector performance on economic growth is not statistically significant, which means that there was no influence of manufacturing performance of the economic growth. The co-integration test results conducted on Nigerian industries indicated the long-run relationship between the two series. The results revealed that an increase in economic growth caused an increase in the manufacturing sector and more importantly growth in GDP with a high inflation rate significantly increases manufacturing activity in Nigeria (Jolayemi and Fatomilola, 2020).

Stable manufacturing growth drives a nation's economy in a positive way and sustained growth because of its significantly contributing to economic growth Penelope and Thirlwall (2013).

The manufacturing sector occupies a marginal role in the strategy, with the reasoning that industrial development cannot be realized without a competitive stock of skills, infrastructure, and financial services (MINECOFIN, 2020). In 2009, Wang analyzed the relationship between direct foreign investment in the manufacturing sector and economic growth in Asian economies using the regression model. he found that foreign direct investment in the manufacturing sector has a positive significant effect on economic growth (Wang,2009).

According to Mercan, Kizilkaya, and Okde (2015), manufacturing production boosts economic growth in Modern industrialized Countries. Su and Yao (2016) find that manufacturing expansion increases incentives for saving and technological accumulation, both of which are critical for middle-income nations' economic growth. Su and Yao (2016) concluded that manufacturing output growth is critical for economic development and productivity, particularly in middle-income countries, while Marconi, Reis, and Araújo (2016) support their findings. Olamide and Oni (2016) offered data to support the concept that manufacturing is a development engine in 28 African nations and argue that de-industrialization may be harmful to economic growth.

In 80 different nations, Cantore et al. (2017) break down the impact of the manufacturing sector on economic development into structural change and employment impacts, and they conclude that

manufacturing boosts GDP through structural change involving an increase in productivity. According to Keho (2018), economic development is boosted by industrial production in the majority of ECOWAS nations. The impact is also stronger in Nigeria and Senegal, where industrial production encourages output development in the agricultural and service sectors.

The research was done to examine the relationship between manufacturing and economic growth in many African nations between 1990 and 2017. This research offers an empirical examination of the first Kaldorian legislation. Because of the probability of endogeneity and heteroscedasticity in the data, the System-GMM model is chosen. Furthermore, because the number of cross-sectional units (37 nations) exceeds the periods, the model is appropriate for the study (28 years). There is little empirical data on the influence of manufacturing on African economic growth. Recent research by Ududechinyere, Michael, and Mbam (2018), Tsoku, Mosikari, Xaba, and Modise (2017), and Keho (2018) used time series approaches that may suffer from multicollinearity, serial correlation, and endogeneity issues.

Olamande and Oni's (2016)'s recent panel study suffers from spurious regression because the model calculated excluded control variables, which may exaggerate the influence of manufacturing on economic growth. This research includes variables about the macroeconomic environment, the foreign sector, and the government sector. Furthermore, institutional quality and human capital are considered important factors of economic growth.

4.0. METHODOLOGY AND MAJOR FINDINGS

4.1. Empirical Methods Used in this research

This research used a quantitative research econometrics approaches and performs empirical estimations using the Augmented Dickey-fuller (ADF) test for stationary of the series. the ARDL bound test and with Error Correction Model (ECM) for testing short and long-run effects of one-time series on another were applied. And some post-estimation techniques were also tested like BG-test for autocorrelation was used to test if there is no serial or auto-correlation between the residual (u), Breusch-Pegan-Godfrey Test was performed to test if the variance of the residual (u) is constant (Homoscedasticity), Skewness/Kurtosis tests for Normality

4.2. MODEL SPECIFICATION

The researcher, examined the effect of manufacturing sector performance on economic growth using the data from 1986 to 2021. An econometric model was used to find the results in this research to verify and see the effect of the manufacturing sector on the economic growth of Rwanda. The following are the variables tested the manufacturing sector performance /output, Gross Domestic Product (GDP), Inflation(infl), an Exchange rate (Exch), total factor production (TFP).

Mathematical Model presentation

$GDP = \beta_0 + \beta_1 MANF + \beta_2 {}_E XCH + \beta_3 INFL + \beta_4 TFP$

- GDP: Gross domestic products at the current price
- MANF: Manufacturing products/outputs
- EXCH: Exchange rate
- INFL: Inflation rate
- TFP: Total factor of productivity

Econometrical model presentation

$GDP_t = \beta_0 + \beta_1 MANF_t + \beta_2 EXCH_t + \beta_3 INFL_t + \beta_4 TFP_t + \varepsilon_t$

- $\boldsymbol{\beta_0}$: is a constant intercept that shows the level of GDP when the explanatory variables are equal to zero.
- $\boldsymbol{\varepsilon_t}$: is the error term that stands for other factors which are not considered in the model but that can affect our dependent variable.
- **t:** time horizon
- $\boldsymbol{\beta_1}$, $\boldsymbol{\beta_2}$, $\boldsymbol{\beta_3}$ $\boldsymbol{\beta_4}$ **are** the parameters of the independent variable

The logarithmic functional form is also commonly used in econometrics due to its coefficients representing useful concepts that are easy to be interpreted and measure the growth rate over a long period.

$\text{Log } GDP_t = \beta_0 + \beta_{1 \log MANF_t} + \beta_{2 \log EXCH_t} + \beta_{3 NFL_t} + \beta_{4 \log TFP_t} + \varepsilon_t$

Testing hypothesis of overall objective of the study

In this part we tried to prove the effect of manufacturing sector to the economic growth of Rwanda throughout testing our Hypothesis.

H0: There is no effect of manufacturing sector performance on the economic growth of Rwanda.

H1: There is an effect of manufacturing sector performance on the economic growth of Rwanda.

If the calculated statistics are less than 5 percent (0.05), we can reject the null hypothesis, then accept the alternative one. if we reject the null hypothesis, this means that all independent variables Manufacturing, inflation, TFP, and Exchange rate are jointly influencing the dependent variable.

4.3.Data

Following many works done by other researchers, the searcher of this paper constructed a data set from internationally trusted publishers like the world bank, International monetary funds and the National Institute of statistics for both dependent and independent variables. Our data set was composed of 36 years as observation means from 1986 to 2021.

4.4.Descriptive Statistics

The table1 below provides a real picture of descriptive statistics of the variables used to examine the relationship between Manufacturing (MANF), the Exchange rate (EXCH), the Inflation rate (INFL), Total factor productivity (TFP), and Gross Domestic products (GDP) in Rwanda from1986 to 2021. The table below shows that the average GDP in 36 years was 4.53 billion Rwandan Francs per year.

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Table 1: Descriptive Statistics of variables

	Exch	GDP	Infl	TFP	MAN
Mean	467.24	4525277346	8	0.8	396810394
Medium	542.25	2477603776	5.6	0.82	303369886
Maximum	988.6248	11070356519	55.96	1.0432	1016601040
Minimun	76.4477	753636370.5	-2.419	0.34	130000002.3
Standard devi	275.305	3239323535	9.85	0.18	236090451
Skewness	0.08324	0.693159	3.346	-0.45766	0.965183
kurtosis	1.96531	1.916786	16.8	2.55	2.973392
Jarque bera	1.647432	4.693159	352	1.472872	5.590535
Probability	0.438798	0.095696	0	0.478817	0.061099
Sum sq dev	275	3.67	9.851298554	0.181725254	19

Source: Researcher s' computation using Eviews 12

Ho: There is a normal distribution in series, ie calculated values > 5% critical values.

H1: There is no normal distribution in the series, i.e calculated values <5% critical values

Rule: if the calculated values are less than the critical value of 5%, we reject the null hypothesis

As shown in the table above: GDP is normally distributed because its probability is greater than 5% is (0.095696>5%), similar to the Exchange rate where the 0.438798 is greater than 5%, Manufacturing is also normally distributed with **0.061099** which is greater than 5%, the same to the TFP, it is normally distributed with 0.478817> 5%. This is good news for us to be able to process with other estimation tools because our data are normally distributed

4.5.Lags selection

It is important in the time series regression to select the lag length before conducting the unit roots test. The best techniques for the selection of the lags are information criterion (Akaike Information Criterion: AIC and Bayes Information Criterion: BIC) in lag selection.

Table 2: lag selection

lag	Log L	LR	FPE	AIC	SC	HQ
0	-1684.468	NA	2.02e+38	102.3920	102.6188	102.4683
1	-1511.655	282.7830*	2.66e+34*	93.43372*	94.79419*	93.89148*

*Indicate lag order selected by the criterion
Source: researcher's computation using Eviews 12

LR: sequential modified LR test statistic (each test at 5%level)
FPF: final prediction error
AIC: Akaike information criterion
SC: schwarz information criterion
HQ: Hannan-Quinn information criterion

To determine the number of the lags to be used, the researcher looked at the Akaike information criterion for the lags that has the least value. As indicated in the table AIC has 93.43372 at lag (1) which is also the least value for the column AIC. So, the researcher must consider one 1 lag.

4.6. Testing the unit root

The best statistical way of testing a unit root in time series data is to use the Augmented Dickey-Fuller (ADF) method. The **researcher tested the Unit root as follows:**

Ho: The time series variable has a unit root, it is non-stationary

H1: The time series variable has no unit root, it is stationary

Rule: If the p-value<0.05, we reject the Ho

Note: The Researcher s tested stationarity for each variable that appears in the model.

After testing, the Researcher s based on z(t) values compared statistics with critical values using significance levels (1%,5%, and 10%). Note researcher used the Ts=Test Statistic of Z(t) and *Tc*=Critical Value of Z(t). **Rule: If** $|Ts| > |Tc|$ **we reject H0,**

Table 3:Augmented Dickey-Fuller (ADF) Unit Root Test Results

Variable	At Level			First Difference			Order of Integration
	T/ADF Statistic	Critical Values	P-value	T/ADF Statistic	Critical Values	P-value	
GDP	-1.1485	-4.244, -3.544, -3.205	0.9056	-5.705	-4.252***,-3.548**,-3.207*	0.0002	I(1) at a 1% significance level
MANF	-0.969	-4.244, -3.544, -3.205	0.9355	-6.754	-4.252***,-3.548**,-3.207*	0	I(1) at a 1% significance level
EXCH	-2.253	-4.253, -3.548, -3.207	0.4696	-4.313	-4.252***,-3.548**,-3.207*	0.0086	I(1) at a 1% significance level
INFL	-3.82	-3.633***,-2.948**, -2.613*	0.0062	-	-	-	I(0) at 1% significance level
TFP	-2.765	-4.263, -3.553, -3.209	0.2193	-5.503	-4.273*** -3.558** -3.212*	0.0005	I(1) at 1% significance level

(***),(**) & (*) represent critical value at 1%, 5% & 10%

Source: Researcher s' computation using EViews 12

It is clearly indicated in the above table that only the Inflation (INFL) rate is stationary at levels whereas, Gross Domestic Product (GDP), Manufacturing products/outputs (MANF), the Exchange rate (EXCH), and Total factor of productivity (TFP) are not stationary at levels for ADF test but they all became stationary after taking their first difference at 1% level of significance.

This indicated that they are all integrated at I (1) except for one variable ie (inflation). And no variable is integrated at I (2) or beyond which is good news for the searcher to use the **Autoregressive distributed Lag (ARDL)** approach to co-integration for the regression analysis.

ARDL approach to co-integration is more suitable to analyze the data than others like Johansen's co-integration approach.

4.6. Testing the short and long-run effect of independent variables on GDP

Estimation of ARDL Long Run Bounds Test

The Researcher s estimated the equation by employing the OLS approach and also conducted the Wald Test or F-Test for determining the joint significance of the coefficients of lagged variables for the purpose of examining the existence of long-run relationships among variables.

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Hypothesis setting:

H0: No co-integration/Long run relationship among the variables,

Ha: There is co-integration among the variables.

The F-statistics were then compared with the critical values **(upper and lower bound).** If the F-statistic is to be found above the upper critical value, the H0 of no co-integration can be rejected, which indicates that a long-run relationship exists among the variables. Conversely, if F-statistic is found to be smaller than the lower critical value, the H0 cannot be rejected implying no co-integration among the variables. However, if the F-statistic lies between lower and upper critical values, the test is inconclusive

Table 4**: Estimation of ARDL Long Run and Bounds Test**

F-Stat	Critical Value	I(0)	I(1)	P-Value	Outcome

5.542414**	1% significance level (***)	4.4	5.72	0.0000	Inconclusive
	5% significance level (**)	3.47	4.57		Co-integration
	10% significance level (*)	3.03	4.06		Co-integration

Source: Researcher's computation using Eviews 12

The results indicated that the calculated F-statistics at 1% significant level was found to be in between I (0) and I (1) ie 5.542414 is in between of 4.4 and 5.72 respectively, which means that the test is inclusive. At 5% significance leve**l** F statistic was found to be **5.542414,** which is greater than the critical value of **4.57,** and hence the rejection of the null hypothesis of no co-integration**.** The results revealed that there is an existing of long-run relationship among variables. The results found in this study are somehow similar to the results found in the research conducted by Su and Yao on middle-income economies, using long-run Granger causality tests, cross-sectional regression, and panel regression demonstrating that the expansion of the manufacturing sector feeds the expansion of other sectors and affect positively economic growth. These data have also proven to the researchers that there is a long-run relationship among the variables tested (Su and Yao (2017).

Estimation of the long-run effect of the independent variables on the economic growth

The estimation of a Long Run Equation Using the ARDL Model in this research helped the Researcher s to know whether the variables are significant or not, in the long run, using a long-run equation formed.

Table 5**: Estimated Long-Run Coefficients Using ARDL Model**

Variable	**Coefficient**	**T-Value**	**P-Value**
LOGMANF	0.343119	1.263697	0.2225
LOGEXCH	-0.542598	-1.583816	0.1306
LOGTFP	1.443493**	2.859981	0.0104
INFL	0.021032*	-1.751493	0.0969

(***),(**) & (*) represent critical value at 1%, 5% & 10%

Maximum dependent lags (2), Maximum regressors lags (2)

Source: Researcher s' computation using Eviews 12

As indicated in the above table, the inflation (INFL) rate is not significant at the 10% level and has a positive effect on the long run-on GDP which is true because we used nominal GDP instead of real GDP. The following are the interpretations basing the results: 1% increase in inflation, leads to a 2.12% increase in GDP, ceteris paribus. The total factor of productivity (TFP) has also a positive effect in long-run on Gross Domestic Product (GDP) where a 1% increase in TFP, leads to a 1.4% increase in GDP, ceteris paribus. On the other hand, in Manufacturing products/outputs (MANF), the Exchange rate (EXCH) is not statistically significant in the long run.

Comparing this paper with other ones conducted in other countries, the results showed that, it is different from the ones found by Jolayemi and Fatomilola after performing a co-integration test on Nigerian industries indicating the long-run relationship between the series. The results revealed that in Nigeria an increase of 1.8% in economic growth is caused by an increase of 1% in the manufacturing sector and more importantly growth in GDP with a high inflation rate significantly increases manufacturing activity in Nigeria (, 2020).

After conducting their research, on middle-income economies, using long-run Granger causality tests, cross-sectional regression, and panel regression, Su and Yao have also confirmed that the expansion of the manufacturing sector feeds the expansion of other sectors. These data have also proven to the researcher s that manufacturing is, the key driver of economic growth among in other variables (Su and Yao (2017). Based on al, the Researcher s would recommend Rwanda to improve the performance of the manufacturing sector which will lead us to have a positive relationship in the long run

Estimation of the short-run effect among the variables

Using the ARDL Model, the searcher estimated the equation to verify if there is a short run between the independent variable and the dependent. the following are the results got from EViews 12

Table 6: Estimated Short-Run Coefficients Using ARDL Model

Variable	Coefficient	T-Value	P-Value
LogMANF	0.267396***	4.617405	0.0002

LogMANF(-1)	-0.143166***	-2.976881	0.0081
LogEXCH	-0.219580	-1.473844	0.1578
LogEXCH(-1)	-0.547404***	-4.372250	0.0004
LogTFP	1.392421***	13.28614	0.0000
INFL	0.000704	0.373987	0.7128
INFL(-1)	-0.002722**	-2.175825	0.0431
ECM (-1)	-0.455784***	-5.819820	0.0000

(***), (**) & (*) represent critical values at 1%, 5% & 10%, ECM: Error Correction Model.

Source: Researcher s' computation using Eviews 12

As indicated in **table 6**, the results from the estimation of the Short Run Equation Using the ARDL Model are showing that the estimated lagged error correction term ECM (-1) is -0.455784 which is highly significant at a 1% level of significance and negative **(ranges between zero and one)** as was expected having probability values less than 1% which is 0.0000. These results show that almost 45.6% of the discrepancy between the long run and short run is corrected within a year.

The results have also indicated that the lagged variables of Manufacturing products/outputs (MANF) Exchange rate (EXCH) and Inflation have a negative effect on GDP in the short run.

The researcher has also found that in the short run, Manufacturing products/outputs (MANF) and Total factor of productivity (TFP) have also a positive effect on Gross Domestic Product (GDP) where a 1% increase in MANF leads to a 0.27% increase in GDP and a1% increase in TFP it leads to 1.39% increase in GDP respectively. On the other hand, EXCH and INFL have no effect on GDP in the short run because they are not statistically significant.

Having a short-run relationship between Manufacturing sector performance and GDP was maybe caused by the improvement made in the manufacturing sector a few years ago. The result found is also different from the one found by Bennett, Anyanwu, and Kalu in 2015 after the investigation conducted on the effect of industrial development on Nigeria's economic growth from 1973-2013 using OLS (ordinary least square) regression, they found that the influence of manufacturing sector performance on economic growth is not statistically significant, which means that there was no influence of manufacturing performance on economic growth in Nigeria. However, the empirical results of the research conducted by Karami in European countries revealed that the relationship between manufacturing output and GDP was significantly positive. An increase of 6 % in the manufacturing sector led to an increase of 1% in economic growth.

Comparing this study to the other one conducted by Faraji in 2011, on the relationship between inflation and GDP in Tanzania. The results showed that there was a negative relationship between inflation and economic growth in the Tanzania economy during the period of the study, as has been shown in Rwanda with lag 1.

5.0. Post-estimation techniques

5.1. Autocorrelation test

The researcher tested Serial correlation by using the Breusch-Godfrey test to verify whether the value of u in any period is correlated with its preceding value (or values. Here we have the rule of testing autocorrelation: If the p-value is less than 5%, we reject Ho

Hypothesis testing and interpretation

H0: No serial correlation
H1: Serial correlation

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	0.718510	Prob. F(2,17)	0.5017
Obs*R-squared	2.494146	Prob. Chi-Square(2)	0.2873

The table above shows that P-value is 0.2873 which is great than 0.05, therefore we fail to reject the null hypothesis (Ho: No serial correlation). This means that there is no correlation between residuals.

5.2. Heteroscedastic testing

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	1.823156	Prob. F(4,29)	0.1514
Obs*R-squared	6.831945	Prob. Chi-Square(4)	0.1450
Scaled explained SS	9.134781	Prob. Chi-Square(4)	0.0578

The results in the table above show that, the result of the Obs. R square calculated is 0.1450 which is greater than 0.05, therefore we failed to reject the null hypothesis (Ho: Homoskedasticity). This means that there is no problem of heteroscedasticity in the series

6. Summary of Key findings

The main objective of this research was to find out the effects of the manufacturing sector performance and other macroeconomic stability factors on the economic growth of Rwanda either in long run or in the short run. The following are the results from the regression

6.1. Effects of Independent variables on GDP in the Long run

The Researcher s was surprised by some results after performing the test. For instance, the manufacturing sector performance inflation rate and Exchange rate are not statistically significant in the long run which means that p- values of them ar**e 0.2225, 0.096, and 0.1309 respectively**, which are greater than critical values of **5%,** this led to the rejection of null hypothesis saying that there is a long run relation between these mentioned variables and GDP.

On another hand, the total factor of productivity (TFP) has also a positive effect in the long run on the Gross Domestic Product (GDP) where an increase of 1% in TFP, leads to a 1.4% increase in GDP.

6.2. Effects of Independent variables on GDP in the short run

In this research, it was noticed that, in the short run, Manufacturing products/outputs and Total factor of productivity have a positive effect on Gross Domestic Product where a 1% increase in MANF leads to a 0.27% increase in GDP and a1% increase in TFP it leads to 1.39% increase in GDP.

And also, the estimation of the short Run Equation Using the ARDL Model showed that the estimated lagged error correction term ECM (-1) is -0.455784 which is highly significant at a 1% level of significance and negative **(ranges between zero and one)** as was expected having probability values less than 1% which is 0.0000. These results show that almost 45.6% of the discrepancy between the long run and short run is corrected within a year.

7.0. Conclusion,

Based on the general objectives of this research and the results from the E-view, the Researcher can conclude that there is a short-run relationship between manufacturing sector performance on the economic growth of Rwanda and also there is a long-run relationship between the total factor of productivity and Gross Domestic Product (GDP), where a 1% increase in TFP, leads to a 1.4% increase in GDP, ceteris paribus. And also, the Total factor of productivity (TFP) has a positive effect in the long run on Gross Domestic Product (GDP) where a 1% increase in TFP, leads to a 1.4% increase in GDP.

8.0. Recommendations

After finding the results from data regressed from 1986 up to 2022, a Researcher brings here the following recommendations and suggested topics for future research.

- The Government of Rwanda should increase budget allocation in the manufacturing sector in way of rising its contribution to GDP.
- There is a need of revising some policies that limit some startups of foreigners who want to invest in Rwanda for the first time. i.e., there are no subsidies as it is applied to the locals.
- The government of Rwanda is recommended to reduce the issue of balance of payment by increasing made in Rwanda's export to accelerate economic growth.
- The Government of Rwanda is recommended to increase the number of local experts that work in the manufacturing sector so as to increase the revenues from that output as well as increase the standards of living of the citizens.
- Reducing the cost of transportation and energy for manufacturing firms is a good way of encouraging them to increase their production through tax exemption for raw materials.
- Improve also the financial sector, for facilitating the expansion of the manufacturing firms to the small and medium owners.
- Ensuring and sustaining the security of the people and their goods is a good thing that attracts some investors.
- Invest in research and development to bring new ideas to boards that intend to raise the country's economic growth of Rwanda.

- To promote market competitiveness, a specific action to prevent the import of inexpensive counterfeits should be implemented and enforced across all categories of imported goods.

- Ensure price stability in the market. This is required to maintain the expense of machinery/equipment and intermediate inputs within control.

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