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The Role of Industrialization on Employment and Economic Growth in South Africa

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ABSTRACT

Nowadays economic performance and people's well-being are driven by various factors linked to technological improvement and industrialization. South Africa is one of the countries that adopted technology and innovation to improve its economic performance and employment conditions. However, the country is still facing a growing unemployment rate and sluggish economic growth. The current study investigated the role of industrialization in heightening employment and economic growth. The autoregressive distributed lag (ARDL) and error correction model (ECM) approaches were applied to time series data from 1998 to 2019. Empirical findings indicated that industrialisation has a significant impact on South African economic growth and employment opportunities. While automotive, food and beverage, chemical and metal industries positively affect economic growth; employment growth is fuelled by high production in food and beverage, chemical, automotive and metal industries. Nonetheless, high production in clothing and chemical industries have adverse effects on economic and employment growth respectively. In the short run, employment behaviour is determined by the production of metal, food and beverages industries while changes in economic growth are driven by production in the automotive and metal industries. Grounded on findings, South African policymakers should consider pro-industrialization strategies, especially in those industries whose production is highly demanded such as metal, food and beverages. These industries enhance trade and the latter improve economic growth and create employment.

Keywords: Industrialization, Economic growth, Employment, Manufacturing, Food industry
JEL Classifications: E24, L60, L66, O47

1. INTRODUCTION

Within the contemporary era of industrialization, globalization and technological innovations, countries are racing in their development aiming to solve crucial socio-economic issues such as unemployment and sluggish economic growth (Burns et al., 2016). Economic growth and employment opportunities, in developed as well as some developing countries are largely the results of technological adoption and advanced industrialization. For instance, industrial development played a significant role and accelerated economic growth in countries such as China, Korea, Taiwan, Taiwan and Indonesia (Kniivilä, 2007). Industrialization in these countries, not only improved economic growth, it also created more job opportunities.

South Africa's economy is undergoing a serious decline and instability. For example, before the advent of COVID-19 in 2019, per capita GDP was lower than its value during the 2008 financial crisis. On the other hand, unemployment keeps rising. In August 2022, the official unemployment rate exceeded 35% while youth unemployment went beyond 50% (OECD, 2022). During that period of low economic growth and high unemployment, South Africa was also experiencing a decline in the manufacturing sector and scanty industrial performance (Stats SA, 2022). Looking at this economic situation, one may say that a close link exists between economic growth, employment and industrial performance. This paper aims to provide clarity on the relationship between industrialisation, economic growth and employment opportunities. Additionally, the study analyses to which extent employment and economic growth are affected by industrial performance.

2. LITERATURE REVIEW

2.1. Industrialisation and Economic Growth

Industrialization is one of the key drivers of economic growth and job creation in developed and developing countries alike (Matambalya, 2015). Malan (2015) and Zalk (2014) argue that industrial development entails development in the manufacturing sector and its sub-sectors. Therefore, industrial development implies the development of manufacturing industries as these two terms, industrialisation and manufacturing, are often used interchangeably. Nonetheless, a slight difference exists between the two in the sense that manufacturing is regarded as a component of industrialisation (Millin, 2003).

The existing literature presents several growth theories that may be useful to understand the link between industrialization-manufacturing, economic growth and employment (Lucas, 1988). These theories are derived from the two main economic theories namely the classical theory and Keynesian, theory. The classical theory and its branches (schools of thought) took their existence from the physiocratic theory suggesting that agricultural production was the only source of national wealth (Charbit, 2002). This implies that the classical theory acknowledged the link between labour production, employment and economic growth. However, irrespective of having ties with physiocratic theory, the classical theory flew with its wings and became a modern growth theory (Thirlwall, 2006) and admitted the role of capital in growing production rate. As such, production or output (Y) becomes a function of labour (L), capital (K) and land (T) as depicted in Equation 1 below

$$Y = f(L, K, T) \tag{1}$$

Equation 1 shows output growth (G_Y) depends on land growth (G_T), labour growth (G_L), capital and accumulation (GK) (Smith, 1904). Besides, the role of agriculture in economic development, the proponents of classical theory recognised the power of technology in growing output (Samans, et al., 2015) and agriculture was seconded by the manufacturing sector. On the other hand, the Keynesian growth theory focuses on the role of aggregate demand to enhance a country's economy. One of the models proposed by Keynes is to improve technological revolution and government investment (Dutt, 2010). Other theories linking industrialisation, employment and economic growth are briefly discussed below.

2.1.1. Kaldorian theory of economic growth

Another growth theory is the Kaldorian theory of economic growth introduced in 1957 to elucidate the link between economic growth and the industrial or manufacturing sector's production (Lugina et al., 2022). The Kaldorian theory is inductive and built on three fundamental laws. The first law suggests that a strong relationship exists between industrial production and economic growth. That relationship is expressed as follows:

$$g_{GDP} = a_1 + b_1 + g_m \tag{2}$$

Where g_{GDP} denotes total output, and g_m denotes manufacturing or industrial output. In his theory, Kaldor argues that manufacturing or industrial output growth influences the output growth in non-manufacturing sectors. The growth model indicated in equation 2, suggests that increasing return to scale determines the future outputs and total finished goods determine the industry's total exports (Lugina et al., 2022). The second law of the Kaldorian theory is known as Verdoorn's law. This law contends that a close interdependence exists between productivity growth and output growth. In other words, an increase in labour productivity results in output growth while causing a decline in production cost and selling price yet increasing total exports and revenue (Libanio, 2006). The third and last law consists of the two-sector (industrial and non-agricultural sector) model. This law emphasises a direct link between manufacturing and non-manufacturing sectors. In the initial stage, the industrial or manufacturing sector requires some inputs from the agricultural sector and in the latter stage it requires inputs from the service sector. However, it is important to note that as the non-industrial sector's resources are shifted to the industrial sector, the average productivity declines in the former while increasing in the latter sector (Ibbih and Gaiya, 2013).

2.1.2. Big push theory

Another theory that explains the relationship between industrial economic issues and how they could be solved. During difficult times, manufacturing products in developing countries were facing challenges owing to insufficient and inadequate low demand within their domestic markets due to low income, and high inequality. Additionally, manufacturing exports from these countries were facing various constraints such as high competition from developed countries and high tariffs. To solve the aforementioned issues, Rosenstein-Rodan (1943) introduced a new theory known as the big push theory. The theory argues that, for a country or firm to succeed in its industrialisation, there is a minimum level of resources required to sustain itself (Rosenstein-Rodan, 1943). Without this minimal capacity, the country or firm will always depend on others and will not achieve a satisfactory level of industrialisation. To enhance industrialisation which in results will improve production and economic growth, a country needs to ensure growth in per capita income and enhance aggregate demand (Wang, 2015). Therefore, industrialisation will positively impact economic growth if government policies are meant to move the economy from a "bad" to a "good" equilibrium (Sauer et al., 2003).

2.1.3. Empirical literature

From several researchers and scholars in various regions and economies, the relationship between industrialisation and economic growth was scrutinised. This section discusses some of their findings. Assessing the impact of industrialisation on economic growth in 37 African countries, Moyo and Jeke (2019) found that industrialisation positively influences economic growth within the selected countries. These results were supported by the Olamade and Oni (2016) study findings suggesting that industrialisation is the engine of economic growth within 28 African countries. Similarly, the findings of Opoku and Yan (2019) revealed that not only does industrialisation increase the economic growth of African countries, but it also plays an important role in African countries' trade openness. The role of industrialisation is not limited to African countries. The study of Kapoor (2015) revealed that industrialisation and manufacturing output growth remain major sources of economic growth in India. A study conducted by Szirmai and Verspagen (2015) indicated that a positive relationship between industrialisation is eminent in developing as well as it is in developed countries. Nonetheless, the positive relationship between industrialisation is not common to all countries. Analysing the association between economic growth and industrialisation within 171 countries, Saba and Ngepah (2022) found an inverse relationship between the two variables. This implies that the role of industrialisation on economic growth should not be generalised as each industry has its particularities. Some industries may have a positive effect while others have a negative impact within the same economy (Moholwa, 2017).

2.2. Industrialization and Employment

Production and employment growth are the two main factors of economic growth and the latter, in return, is also the source of employment growth. Since the core aim of industrialization is to improve production, it is assumed that many industries operating within a specific country underpin employment opportunities (UNIDO, 2013). However, some research argues that if industrialization is linked to technological production some of the existing jobs will be destroyed and the country will experience a growing unemployment rate (Collins and Ryan, 2007). It is important to note that unemployment generally refers to the absence of jobs for those who are able and willing to work. However, industrialization does not necessarily destroy jobs it rather creates new jobs that require new skills. In this regard, structural unemployment is the only form of unemployment that can dominate during industrialization while workers are still acquiring the required skills for available jobs. Additionally, if any job loss should result in industrialization and technological growth, only low-skilled will be affected for a short period and various industries require different types of skills (Nattrass and Seekings, 2015; Ramaswamy, 2018 Braxton and Taska, 2023). Several types of research were conducted to determine the relationship between employment and industrialization and their findings revealed that the latter positively impacts the former (Hooi, 2016; Muzindutsi, 2014; Tsoku, et al., 2017; Williams, et al., 2014).

3. DATA AND METHODOLOGY

3.1. Data Description

To achieve the main objective of the paper, researchers collected and analyzed secondary time series data. Owing to the availability of data, 84 observations were employed, this implies that the analyzed data period starts from 1998 to 2019. Another factor that influenced the sample selection was the presence of COVID 19 which impacted both the industry's performance and economic growth which in the end tempered the employment level. Used that was sourced from the South African Reserve Bank (SARB) the Statistics South Africa (Stats SA). To stabilize the variance of collected data, ensure a better comparison between variables and ease the finding interpretation, all used series were transformed into natural logarithms. Table 1 represents the study variables and their descriptions.

3.1.1. Summary statistic of data

A better way to understand the data description, data outliers and spot variable patterns is to perform a descriptive analysis. Table 2 provides the summary statistics of employed variables. As indicated by the results below, contrary to other industries, high production is achieved in the clothing industry when the average economic growth and employment are high. However, over the analysed period, the clothing industry experienced high production volatility compared to other industries within the manufacturing sector as indicated by the standard deviation

Table 1: Data presentation and source

Acronym	Variable name	Description	Measurement	Source
GDP	Economic growth	Gross domestic product used as a proxy for economic growth	Index (2010=100)	SARB
EMP	Employment	Total non-agricultural employment used as a proxy for total employment	Index (2000=100)	SARB
FBP	Food and beverage production	The food and beverage sector's production volume	Index (2010=100)	Stats SA
CLP	Clothing production	Clothing sector's production volume	Index (2010=100)	Stats SA
CHP	Chemical production	The chemical sector's production volume	Index (2010=100)	Stats SA
MEP	Metal production	The metal sector's production volume	Index (2010=100)	Stats SA
AUTP	Automotive production	Automotive sector's production volume	Index (2010=100)	Stats SA

Table 2: Estimated descriptive statistics results

	GDP	EMP	AUTP	CHP	CLP	FBP	MEP
Mean	2513099	108.196	98.720	95.945	115.477	91.452	106.516
Max	3079882	117.000	123.367	114.400	144.300	114.600	127.967
Mini	1831698	98.000	63.200	74.233	92.300	71.567	91.933
Std. Dev.	423986.8	6.388	15.670	11.045	15.922	14.305	9.522
Skewness	−0.20569	−0.236	−0.476	−0.388	−0.134	0.123	0.662
Kurtosis	1.601	1.403	2.292	2.129	1.398	1.581	2.685
Jarque-Bera	6.819	8.901	4.517	4.365	8.467	6.649	5.943
Probability	0.033	0.012	0.105	0.113	0.015	0.036	0.051

values. The results in Table 2 indicated also that, besides metal, food and beverage productions, total production in each industry experiences a negative skewness. Additionally, kurtosis values are <3 implying that the data is platykurtic and not normally distributed as also confirmed by the Jarque-Bera probability values.

3.1.2. Pairwise correlation

Another step that assists in determining the basic relationship between variables or series is correlation analysis. The value of the correlation coefficient fluctuates between −1 and +1, the latter suggesting a positive perfect correlation and the former implying a positive perfect correlation. The zero value of the correlation coefficient indicates the absence of correlation between two variables. As indicated in Table 3, a correlation movement exists between the dependent variables and explanatory variables. A strong and positive correlation exists between AUTP, LCHP, LCLP, LFBP and both independent variables (LGDP and LEMP). A weak and negative correlation exists between LGDP, LEMP and LCLP. In other words, performance in clothing production might have a converse movement with employment and economic growth while production growth in automobile, beverage and food, chemistry and metal may be the cause of economic growth.

3.2. Model Specification

The study aims to assess the responsiveness of non-agricultural employment and economic growth towards industrialization growth (measured using total production in each of the analyzed industries). This implies a single and linear equation. The adequate model to analyze this type of relationship is the autoregressive distributed lag (ARDL) model (Brooks, 2014). The following are the basic models that determine the relationship between economic growth, employment and industrialisation.

$$LGDP_t = f(LFBP + CLP + CHP + ME + AUTP)_t \tag{3}$$

$$LEMP_t = f(LFBP + CLP + CHP + ME + AUTP)_t \tag{4}$$

$LGDP_t$ denotes the natural log of GDP; *LFBP* denotes the natural log of *FBP*; *LCLP* denotes the natural log of *LCLP*; *LCHP* denotes the natural log of *CHP*; *LMEP* denotes the natural log of *MEP*; *LAUTP* denotes the natural log of *LAUTP* and *t* denotes the sample period. Given that the main objective of the study is to assess the long-run and short-run effects of independent variables on the dependent variables, the subsequent models were constructed and employed to assess the aforementioned relationships.

$$\begin{aligned}\Delta LGDP_t &= \propto_0 + \sum\nolimits_{i=1}^{k} \beta_i \Delta LGDP_{t-i} + \sum\nolimits_{i=0}^{k} \delta_i \Delta LCLP_{t-i} \\ &+ \sum\nolimits_{i=1}^{k} \psi_i LCHP_{t-i} + \sum\nolimits_{i=1}^{k} \varphi_i \Delta LFBP_{t-i} + \sum\nolimits_{i=1}^{k} \gamma_i \Delta LMEP_{t-i} \\ &+ \sum\nolimits_{i=1}^{k} \vartheta_i \Delta LAUTP_{t-i} + \lambda_1 LGDP_{t-1} + \lambda_2 LCLP_{t-1} + \lambda_3 LCHP_{t-1} \\ &+ \lambda_4 FBP_{t-1} + \lambda_5 LMEP_{t-1} + \lambda_6 LAUTP_{t-1} + e_t\end{aligned} \tag{5}$$

$$\begin{aligned}\Delta LEMP_t &= \propto_0 + \sum\nolimits_{i=1}^{k} \beta_i \Delta LEMP_{t-i} + \sum\nolimits_{i=0}^{k} \delta_i \Delta LCLP_{t-i} \\ &+ \sum\nolimits_{i=1}^{k} \psi_i LCHP_{t-i} + \sum\nolimits_{i=1}^{k} \varphi_i \Delta LFBP_{t-i} + \sum\nolimits_{i=1}^{k} \gamma_i \Delta LMEP_{t-i} \\ &+ \sum\nolimits_{i=1}^{k} \vartheta_i \Delta LAUTP_{t-i} + \lambda_1 EMP_{t-1} + \lambda_2 LCLP_{t-1} + \lambda_3 LCHP_{t-1} \\ &+ \lambda_4 FBP_{t-1} + \lambda_5 LMEP_{t-1} + \lambda_6 LAUTP_{t-1} + e_t\end{aligned} \tag{6}$$

In equations 4 and 6, the short-run coefficients are denoted by $\square_i$, δ_i, ψ_i, φ_i, γ_i and ϑ_i while the long-run coefficients are presented by λ_1 to λ_6, the error term or white noise is denoted by e_t.

It is important to note that the cointegration between variables is analysed using the bound test. The conclusion is made based on the comparison between the calculated F-value (from the test) and the critical values of upper and lower bounds available in the Pesaran et al. (2001) table. The null hypothesis for cointegration suggests that the value of each of the long-run coefficients is zero (H_0: $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = 0$) and the alternative hypothesis suggests that they are different from zero (H_1: $\lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq 0$). Therefore, a long-run relationship exists between analysed variables if any of the upper bounds values are lower than the calculated F-value, other otherwise variables do not cointegrate or the results are inconclusive. The presence of cointegration necessitates the short-run relationship analysis and termination of the error correction model (ECM). For the current paper, equations 7 and 8 were used to assess both ECM and short-run dynamics.

Table 3: Correlation analysis

Variables	LGDP	LEMP	AUTP	LCHP	LCLP	LFBP	LMEP
LGDP	1.000						
P-value	-----						
LEMP	-----	1.000					
P-value	-----	-----					
AUTP	0.714	0.666	1.000				
P-value	0.000***	0.000***	-----				
LCHP	0.744	0.871	0.768	1.000			
P-value	0.000***	0.000***	0.000***	-----			
LCLP	−0.882	−0.804	−0.467	−0.771	1.000		
P-value	0.000***	0.000***	0.000***	0.000***	-----		
LFBP	0.872	0.741	0.611	0.892	−0.916	1.000	
P-value	0.000***	0.000***	0.000***	0.000***	0.000***	-----	
LMEP	0.027	0.021	0.567	0.000***	0.320	−0.144	1.000
P-value	0.818	0.759	0.000***	0.173	0.005***	0.213	-----

Note: *** Rejection of the null hypothesis for no correlation at a 1% significance level

$$\Delta LGDP_t = \propto_0 + \sum_{i=1}^{k} \beta_i \Delta LGDP_{t-i} + \sum_{i=0}^{k} \delta_i \Delta LCLP_{t-i} + \sum_{i=1}^{k} \psi_i LCHP_{t-i} + \sum_{i=1}^{k} \varphi_i \Delta LFBP_{t-i} + \sum_{i=1}^{k} \gamma_i \Delta LMEP_{t-i} + \sum_{i=1}^{k} \vartheta_i \Delta LAUTP_{t-i} + \pi ECT_{t-1} + e_t \quad (7)$$

$$\Delta LEMP_t = \propto_0 + \sum_{i=1}^{k} \beta_i \Delta LEMP_{t-i} + \sum_{i=0}^{k} \delta_i \Delta LCLP_{t-i} + \sum_{i=1}^{k} \psi_i LCHP_{t-i} + \sum_{i=1}^{k} \varphi_i \Delta LFBP_{t-i} + \sum_{i=1}^{k} \gamma_i \Delta LMEP_{t-i} + \sum_{i=1}^{k} \vartheta_i \Delta LAUTP_{t-i} + \pi ECT_{t-1} + e_t \quad (8)$$

In both equations 7 and 8, the π is the coefficient of ECM used to measure the speed of adjustment from the short-term dynamics to long-run equilibrium. This coefficient should be negative and statistically significant over the sample period. It is important to note that before any econometric assessment, the unit root test was performed to determine the variables' integration order and the adequacy of selected models.

4. REGRESSION RESULTS AND INTERPRETATION

4.1. Unit Root

Solid results from the econometric analysis are subjected to the type of used data. Nonstationary data produces spurious results while a combination of stationary data and adequate model selection results in robust outcomes. In the current paper, the augmented Dickey-Fuller (ADF) unit root was conducted to demine the series integration order. Table 4 displays the ADF unit root results and suggests that the study series are a mixture of I(0) and I(1) as LCHP and LFBP are stationary at levels while LGDP, LEMP, LCLP, LMEP, LAUTP are stationary after the first difference. Therefore, The ADL is the appropriate approach for cointegration analysis.

4.2. Bounds Testing

The first step that precedes the analysis of the long-run impact of independent variables on the dependent variables is to assess the presence of cointegration. Bounds tests were performed to determine whether cointegration exists between independent variables (employment and economic growth) and industrial performance. As indicated in Table 5, the calculated F-value (6.66) for Model I exceeds the value of the tabulated upper bound critical value (4.65) at a 1% level of significance. Similarly, the calculated F-value (5.86) for Model II exceeds the upper bound critical value (4.68) and is larger than the upper bound critical value (4.68) at a 1% significant level. Accordingly, a cointegration exists between, economic growth, employment and production levels in food and beverage, clothing, chemical, metal and automotive industries.

Table 4: Unit root and stationary test results

Variable	Level		1st difference		Decision
	Intercept	Trends	Intercept	Trends	
LGDP	0.2780	0.9911	0.0008***	-----	I (1)
LEMP	0.8727	0.5737	0.0000***	-----	I (1)
LCHP	0.3033	0.0373**	-----	-----	I (0)
LCLP	0.7543	0.5554	0.0000***	-----	I (1)
LFBP	0.9460	0.0289**	-----	-----	I (0)
LMEP	0.2987	0.6001	0.0000***	-----	I (1)
LAUTP	0.0607	0.1016	0.0001***		I (1)

*** denotes the rejection of the null hypothesis at 1% and 5% significance levels respectively

4.3. Long-run Effects of Industrial Production on Economic Growth

As indicated in Table 5, a cointegrating relationship exists between economic growth and South African industrial production. This implies that the long-term production improvement within the South African dominant industries induces long-term economic growth. However, the results in Table 5 do not elucidate to which extent economic growth is impacted by industrial production growth. The long-run coefficients that determine the effect of independent variables on economic growth are presented in Equation 9 below.

$$LGDP = 9.8543 + 0.1765LCHP - 0.2818LCLP + 0.3701LFBP + 0.5280LMEP + 0.2964LAUTP \quad (9)$$

The long-run coefficients in equation 9 suggest that production growth, which is the indicator of industrial better performance, leads to economic growth. Therefore, a 1% increase in the volume of chemical production causes economic growth to increase by 0.1765L while a 1% increase in food and beverages leads to a 0.3701 increase in economic growth. Additionally, while a 1% increase in metal production results in a 0.5280 increase in economic growth, the latter rises by 0.2964 in response to a 1%

Table 5: Bound test results

Significance levels	Model I Calculated F-value: 9.03		Model II Calculated F-value: 5.86	
	I (0) Bounds	I (1) Bounds	I (0) Bounds	I (1) Bounds
10%	2.26	3.35	2.26	3.35
5%	2.62	3.79	2.62	3.79
1%	3.41	4.65	3.41	4.68

Table 6: Error correction model and short-run dynamics

Economic growth model				
Variable	Coefficient	Std. error	t-statistic	Prob.
D (LCHP)	0.012246	0.013796	0.887657	0.3779
D (LCLP)	−0.019552	0.013070	−1.495934	0.1394
D (LFBP)	0.025676	0.016799	1.528427	0.1311
D (LMEP)	0.036628	0.012474	2.936297	0.0045***
D (LAUTP)	0.020563	0.007232	2.843213	0.0059***
ECT(-1)	−0.069373	0.020580	−3.370929	0.0012***
Employment model				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (LCHP)	−0.014161	0.017482	−0.810050	0.4207
D (LCLP)	0.011215	0.013755	0.815354	0.4177
D (LFBP)	0.044086	0.026167	1.684774	0.0966*
D (LMEP)	0.033266	0.017507	1.900128	0.0617*
D (LAUTP)	0.013105	0.010144	1.291934	0.2008
ECT(-1)	−0.085569	0.032657	−2.620217	0.0108**

***, * denote the significance level at 1% and 10% respectively

Table 7: Residual diagnostic and model robustness checks

Test	Probability values		Inference
	Model I	Model II	
Normality	0.1443	0.0917	The estimated model's residuals are normally distributed
Serial correlation	0.0711	0.7559	The estimated model is free of serial correlation
Heteroscedasticity	0.8843	0.9500	The estimated model is homoscedastic
Stability	0.0965	0.2948	The estimated model's parameters are stable

increase in the automotive industry's production volume. The general view is that enhancing industrialisation, specifically increasing production in manufacturing industries contributes to the South African economy performance. It is not surprising that the metal, food and beverages industries occupy the first rank in enhancing South African economic growth, as metal is one of the major exports of South Africa while food and beverages dominate domestic aggregate demand.

Nonetheless, all selected industries do not have a positive impact on economic growth as a 1% increase in total production of the clothing industry causes economic growth to decline by 28.18%. The negative effect of the clothing industry towards economic growth might be assisted by a high inflow of cheap clothing products from other countries such as India and China (Ndalana, 2016; Thamm, 2017). Another, explanation of this inverse relationship might be that the South African industry is not highly competitive in both quality and price. This implies that increasing production might be associated with high production cause which results in high selling prices and a decline in selling volume.

4.4. Long-run effects of Industrial Production on Employment Levels

Since the effect of the production performance of selected industries on economic growth is determined, it is important to assess the responsiveness of employment level. Changes in employment as a response to long-run fluctuation in industrial volume are displayed in Equation 10 below.

$$LEMP = 4.8543 - 0.1655LCHP + 0.1311LCLP + 0.5152LFBP + 0.3888\,LMEP + 0.1532LAUTP \quad (10)$$

Industrial production growth is not important only for economic growth but also for employment. As displayed in Equation 10, except for chemical production, production growth in all selected industries enhances employment in South Africa. Thus, while a 1% increase in clothing production results in a 0.1311% increase in employment level, the latter grows by 0.5152 as a response to a 1% increase in food and beverage production. Additionally, the country experiences 0.3888 and 0.1532% increases in employment level owing to a 1% increase in total production from metal and automobile industries respectively. In contrast to these industries (clothing, food and beverages, metal and automobile) production growth in the chemical industry causes a decline in total employment. Henceforth, a 1% increase in chemical production leads to a 0.1655% decline in employment level. This implies that production in the chemical industry is linked to machinery or capital-intensive instead of labour-intensive. Similar to its impact on economic growth, the food and beverage industry remains a key employment factor in South Africa. The main reason for this industry's economic and employment growth is that the industry employs people with various skills be it low-skilled, semi-skilled and high-skilled workers.

4.5. Error Correction Model and Short-run Dynamics

The error correction model was performed to ensure that changes experienced in the short-run are adjusted for the long-run equilibrium. Results in Table 6 indicate that the error terms for both models are negative and significant. In other words, the model's short-run shocks are adjusted each quarter for long-run equilibrium. Nonetheless, it takes more time for economic models to respond to short-term changes than the time required for the employment model to revert to long-term equilibrium.

Contrary to long-term results suggesting that total production from all selected variables is statistically significant to cause long-term changes in economic growth and employment, only a few industries' productions can impact economic growth and employment behaviours. While short-term changes in economic growth result from metal and automobile production industries, short-term changes in employment are caused by metal, food and beverages production. These results imply short-term economic growth depends on industries that are linked with exports while short-term employment is led by industries that are associated with domestic consumption.

4.6. Residual Diagnostic and Model Robustness Checks

Results from residual diagnostic tests determine the validity and reliability of analytical findings. Therefore, in this study, we performed different residual tests to ensure that the study's analytical results were reliable. Results in Table 7 indicate that residuals of the estimated models are normally distributed, serially uncorrelated and homoscedastic. In addition, the stability test results suggest the existence of stability in the models' parameters. From these results, it can be concluded that the study's analytical findings are accurate and reliable.

5. CONCLUSION

Motivated by the poor performance of the economy and growing unemployment rate, the study analysed the effect of industrialisation (industrial production growth), economic growth and employment in South Africa. As the aim was to test a one-way relationship, the ARDL model was employed to determine the impact of industrial performance on economic growth and employment in both the long run and short run. The analytical section comprised two models namely the economic growth model and the employment model. On one hand, the analytical results indicated that the long-run positive changes in four industries (automotive, chemical, food and beverage, and metal) lead to a better and positive performance of economic growth, while high production in the clothing industry inversely impacts economic growth. In the short run, economic growth is only driven by production in the automotive and metal industries. On the other, the analytical results indicated that, the long-run positive changes in four industries (automotive, clothing, food and beverage, and metal) performance leads to improvement in non-agricultural employment. In other words, an increase in these sectors' production is associated with employment opportunities. However, it was revealed that production in the chemical industry causes a decline in demand for labour. In the short-run, only two industries (metal, food and beverages) are statistically significant to increase employment level and create job opportunities.

Given the importance of manufacturing industries on the economy and employment in South Africa, governments and policymakers should consider creating a conducive environment that can enhance industries' performance and thereafter increase both economic growth and employment. This is possible through the provision of sustainable and sufficient electricity, subsidising new entrepreneurs and investment in innovation and technology.

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