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The 4th Industrial Revolution Effects on Industrial Production of South Africa

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ABSTRACT

This study examines how critical South Africa's response to the fourth industrial revolution industrial production. In a developing continent like Africa technological advancements have been rather slow, and adapting to those technological changes have been challenging. Since the age of artificial intelligence entered the economic market and there is an increased demand to implement more Artificial intelligence in production. This study looks at how can more fourth industrial production be employed without having an impact on markets like employment, and whether is it a given possibility with the low levels of energy generation, ICT investment, industrial production performance, ICT development, and human capital development. The endogenous growth framework frameworks evaluate the statistical significance elements of economic growth, such as investments in human capital, knowledge, and innovation. The Cobb-Douglas production functions framework shows the technological connection between two or more inputs and how much output they may produce. These results show the correlation between non-stationary time sequences over the long term and for a given time period. The six variables and total industrial production in the study revealed positive correlations between growth and human capital investments and causation. This means that growth benefits are to some degree being directed toward the improvement of the skill sector and financing. This indicates that the industrial sector supported the labour market.

Keywords: 4th Industrialisation, Industrial Production, South Africa's Economy, Economic Growth
JEL Classifications: O3, O14, O25, D24

1. INTRODUCTION

South Africa is facing the triple challenge of poverty, income inequality and unemployment because of the COVID-19 outbreak. This is despite an economy that has been unexpectedly deindustrializing. Before the epidemic, Africa was already concerned about the Fourth Industrial Revolution (4IR effect)'s and the likelihood of robot technology displacing human employment. South Africa is seeing an increase in calls for the government's intervention to boost employment and protect workers from automation. These demands were not satisfied until COVID-19. In response to the epidemic, South Africa's government implemented vital measures like a national lockdown to stop the virus from spreading. Because our work, lives and interactions have changed significantly, South Africa has had to adopt 4IR technologies. Even people who are most vulnerable to losing their jobs to automation recognize the benefits 4IR technology can provide. However, there is uncertainty with the 33.9% unemployment rate. In Cape Town, the new Intsimbi Future Production Technologies Initiative (IFPTI) was introduced by Minister of Trade and Industry Dr. Rob Davies. It was made available to the public at NTIP's Competence Center and recently furnished with the newest industrial equipment for training programs (Department of Trade, Industry and Competition of South Africa, 2021). South Africa has made plans to move further towards the fourth industrialisation. With the implication of programmes that include training in robotics, mechatronics and industrial maintenance. This initiative will allow governments and industries to cooperate with the large-scale intervention needed to repair South Africa's tools, moulds and meld (TDM) manufacturing sectors for the benefit of South Africa's manufacturing sector. The

Fourth Industrial Revolution has the potential to raise income levels globally and enhance people's quality of life. Those with financial resources and access are the largest winners from the digital age. The development of new services and products through technology has made our lives more efficient and enjoyable. Innovation is also a source of supply-side magic, which results in long-term efficiency gains and productivity improvements. You can reduce transportation and communications costs, improve logistics and global supply chains efficiency, and lower trade costs. These all open up new markets, which in turn drives economic growth. Economists Erik Brynjolfson and Andrew McAfee (2014) warn that revolutions can cause greater inequality, especially in the face of the possibility of disrupting the labour force. As automation replaces labor across the economy, the net movement of workers by machine may exacerbate the gap between capital and labor margins. On the other hand, the transfer of labor via technology may also result in a net gain in overall safe and fulfilling employment (Schwab and Sala-I-Martín, 2016). According to Economic solutions (2015) and Solow (1999) the Solow growth model also supports the importance of technology in the production process. As well as the importance of technology development for country's competition. From the model, to understand that new technology is endogenous, and technology is always developing. Technology enables constant growth and defines it as a balanced growth. This is because technology enables growth in output, capital, consumption, and population to all occur steadily. Knowing the brief significance of the Fourth Industrial Revolution comes from this. The purpose of this research is to bring to light the true impact of the fourth industrial revolution on South Africa's industrial production, especially since the industrial production effects key economic factors like output, GDP, export, consumption and employment (Sutherland, 2020). There are many arguments about if technology advancements are really benefiting us or driving more inequality for the future, and if it is an enemy for developing countries. Many may believe that can be an easily answered question, but may fail to understand the true sacrifices of accepting the fourth industrial revolution especially in the long term and its impacts for a country busy developing like South Africa with difficulty of unemployment. This is most important more than ever since entering the pandemic the world has shifted to the digital and technological way of doing things (Enaifoghe, 2021). Along with the President Ramaphosa's (2021) announcement to harness the fourth industrial revolution in early 2020. Real manufacturing output rose sharply in the first quarter of 2019 after a sharp rise in the previous three quarters. Real manufacturing GVA shrank 8.8% in the first quarter of 2019, subtracting 1.1% points from overall GDP growth (South African Reserve Bank, 2019). This shows the importance of the industrial sector's contribution to GDP. In this research, there will be a lot of comparison of existing research of the impact of the Fourth Industrial Revolution on certain industrial factors, especially in the South African market. As well as look at the economies that have more technology in manufacturing are performing. Then decide how this will drive South Africa's economy in the long run.

1.1. Problem Statement

The government has implemented programmes to move more towards the fourth industrial revolution. The problem how can more fourth industrial production be employed without having an impact on markets like employment, and is it a given possibility with the low levels of energy generation, ICT investment, industrial production performance, ICT development, and human capital development (David, 2019). In a developing continent like Africa, technological advancements have been rather slow, and adapting to those technological changes have been challenging. Since the age of artificial intelligent entering the economic market, this will come with challenges (Manda and Ben, 2019). With manufacturing hubs like China and Taiwan that are performing so well because of artificial, intelligent it is only reasonable for other countries to join in the fourth industrialization. However, they are considering the serious impact of the Fourth Industrial Revolution on industrial production. Industrial production, which is important for economic growth because of its performance, contributes to GDP in the market, so look at the countries components and challenges. For instance the fact that South Africa is an importantly a developing country. Secondly, South Africa's unemployment rate is 35,3% in the fourth quarter (StatsSA, 2022). Third, we look at South Africa's debt of (Treasury, 2022). Keeping those in mind is therefore important to cautious strategize the move towards more fourth industrialization. Then lastly, the plan to have better performance towards the fourth industrialization, looking at this will also determine the solution to implementing more fourth industrialization. This study is quiet relevant cause other departments concerned about the effects of the fourth industrial revolution like the education department. Angie Motshekga, Minister of Basic Education, argued that the country has to keep up with the pace of learning with the global in the adoption of coding and robotic learning in public schools (Nkosi, 2022). Some parts of the countries worries about falling behind with the technology revolution in different sectors of the markets, while some are still a bit hesitates with the moves into fourth industrialization. The sensitive and hesitate sector would be the labour sector. The president announced the strategy to harnessing the fourth industrialization in the 1st month of 2020. The president highlights that the focus is on the opportunities that will come with fourth industrialization. As wells as making sure citizens are well prepared to enter this change. Also, the cautious implementing of this change, without effecting the sensitive sectors of the market like employment but also mention that re-skilling that will be most necessary. Solving this problem will help the country to be able to adopt more technology advances, which will result in more productivity. When more productivity is achieved, it will boost the contribution of industrial production in GDP, in result boost economy economic growth. When looking at other factors that industrial production effects is productivity, export, consumption and employment, so those factors will be benefit. Hence, the increase of industrial production is important because of its influences on other factors. We also learnt the importance of technology advances from the endogenous growth model (Romer, 1990) for economic growth. The possible solution is:

Increasing more fourth industrial production programs, while providing the necessary skills to produce and manage these technologies, so that jobs are not impacted.

Lessen the factors that contribute to the inequality of people, allowing many areas to have urbanization, this will make most places ready for the fourth industrialisation change as well as boost local development.

The study examined if South Africa's industrial production will be affected by the fourth industrial revolution and whether this result in increased productivity and growth. It is crucial to remember that both short-term and long-term impacts could be different. In this research, the factors that produce an effect on manufacturing when South Africa moves deeper towards the fourth industrialization are learnt. So, South Africa will be able to have economic growth through 4th industrialization with the right measures learnt in this research that are positively impact industrial production. As well as to come up with a solution to fourth industrialization solution that the government may have not consider when implementing the move deeper to more technology advances.

1.2. Research Objectives

1.2.1. Primary objective

The primary objective of this research study is to know the effects of the fourth industrial revolutions on industrial production so we can know whether to apply more fourth industrialisation in South Africa's economy for better industrial production performance.

1.2.2. Theoretical objectives

The following theoretical goals have been developed to aid in the accomplishment of the main goal:

- Analysing the variables that influence industrial output
- Analyse the impacts of Information and communication technology on fourth industrial revolution
- Analysing the impacts of technology changes in the South African economy.

1.3. Empirical Objectives

The empirical part of the study has the following goals in order to help with the primary goal's achievement:

- Establishing the direction of causality between fourth industrial revolution and industrial output in South Africa
- Determining the effects of fourth industrialisation on industrial output
- Evaluate the long run impact of 4IR on industrial output in South Africa.

2. LITERATURE REVIEW

2.1. Theories of Industrialisation

There are frequently overlapping theories when examining the production aspects of the fourth industrial revolution. According to Moavenzadeh (2015), when discussing the 4th industrial revolution in terms of industrial products, referring about production methods rather than particular goods or services that are changing. Cyber physical systems are what Moavenzadeh (2015) and French et al. (2021) alludes to when he talks about the production systems of the fourth industrial revolution. The usage of a fully networked integration of products and production processes, as well as a high level of complexity, define the fourth industrial revolution. The World Commission on Environment and Development (Keoleian and Menerey, 1994) defined the fourth industrial revolution as "meeting the needs of the present without compromising the ability of future generations to meet their own needs, so industries must pay special attention not only to the development of products and their life cycles, but also to the processes that involve their elaboration." This is what the main topic means when discussing the 4th industrial revolution. However, this is how other sources define the fourth industrialisation in production. The overall view of the fourth industrial revolution provided by this literature is clear and similar.

2.2. Introduction

This literature review's goal is to examine earlier studies on the production performance of the fourth industrial revolution. The literature offered is most pertinent to the study because it explains and identifies the performance of the fourth industrial revolution in South Africa's production sector and how it contributed to the sector's expansion. However, some of the literature does not concentrate largely on the factors affecting industrial production, and some does not concentrate directly on the South African market. The results of these investigations, however, can support the core topic.

Title	Author	Publication date	Findings
The 4th industrial revolution: reshaping the future of production	John Moavenzadeh	2015	The Chinese government has devised comprehensive national programs to modernize and reform the industrial sector as a top national priority.
A framework to test South Africa's readiness for the fourth industrial revolution	Olutoyin O. Olaitan Moshood Issah Ntombovuyo Wayi	May 18, 2021	The paper presented the 4IR readiness framework for government to measure and then plan its reaction to the introduction of 4IR technologies in the country based on findings from the literature analysis.
The fourth industrial revolution in South African manufacturing and connectivity: case studies of automotive and mining equipment manufacturing, along with transportation and ICT infrastructure and services	Rachel Alexander	September 2021	A significant result is that producers' prospects for innovation are influenced by the characteristics of the lead firms in each scenario.
Addressing the Impact of Fourth Industrial Revolution on South African Manufacturing Small and Medium Enterprises (SMEs)	John Mugambwa Serumaga-Zake and John Andrew van der Poll	October 22, 2021	The connection between SME elements, or any application area, in the 4IR.

Source: Compiled by the authors.

2.3. Empirical Studies Related to ICT/4IR and Industrial Production

The fourth industrial revolution effects on industrial production

2.3.1. Manufacturer's adopting the 4th industrial revolution system

South African businesses have several opportunities for implementing innovations due to the variety of new 4IR technologies that are accessible and being developed internationally. The majority of developing nations have shown a considerable improvement in the adoption and use of information and communication technologies (ICT) (Calvalho et al., 2018). The decision to embrace 4IR was made by businesses primarily to boost their competitiveness. Key concerns included enhancing effectiveness and quality; alexander provided this conclusion (2021). The way the fourth industrial revolution is applied to the production sector is crucial. How it is applied is essential since it affects performance, and the industry needs to change to keep up with the changes (Lorenz et al., 2019). Moavenzadeh (2015) lists the challenges that may arise when applying the 4IR in industrial production. The difficulties noted should be taken into consideration because, when properly implemented, they can decide how successful industrialization is. It is critical to consider the state of the economy being discussed because the performance of an economy can have an impact on all of these issues. The report also demonstrates how China's industrial sector effectively adopted technological production after overcoming these difficulties.

A market like China, nevertheless, is more developed and cannot rival South Africa's. An Alexander (2021) study demonstrates how manufacturing in South Africa has specifically adapted to the adoption of the fourth industrial revolution. Alexander's figures show that the manufacturing value added to the GDP fell sharply between the early 1990s and the early 2010s, but that since 2013 the decrease has slowed and the level has remained steady at around 12%. When compared to other sectors, manufacturing, engineering and technology, and trade had the highest concentration of innovative activity from 2014 to 2016. Although often at a gradual pace (CeSTII, 2020), Alexander (2021) sees the adoption of 4IR technologies and systems growing in South African manufacturing. The use of advanced analytics in South Africa is evaluated by Deonarain (2019). According to Deonarain (2019), the automation and automotive industries have the highest levels of adoption, with other industries lagging behind. The extensive deployment of 4IR systems has been most noticeable in the automotive production industry. On the other hand, Olaitan (2021) offers a variety of techniques that can assess whether the Fourth Industrial Revolution is ready for implementation. Tasks, technology, and fitness are these. Task requirements inside an organization are referred to as task characteristics. When talking about technology characteristics, features like communication assistance, process architecture, and information processing.

2.3.2. Nexus between Industrial revolution and industrial output

Moavenzadeh (2015) points out how little technology usage in comparison to other nations that generate more. This may not be the case as much in 2022, though Hong Kong, on the other hand, is not a fair comparison given the resources it has, but it is meant to demonstrate that the use of more technology has improved things sufficiently. Despite the fact that South Africa's high-technology exports rose from US$500 million in 1992 to US$2,5 billion by 2018, according to additional data, they only accounted for 4,9% of all merchandise exports in 2019, moving the nation to the 92nd spot out of 148 nations and economies (NACI, 2020; World Bank, 2021). According to the World Bank's 2021 report, 65.6% of Hong Kong's total merchandise exports were high-tech. Notably, due to the markets' low levels of competition and generally weak standards, South Africa's exporting to the rest of Africa frequently consist of products that are already available on the market and do not require significant innovation (Cunningham, 2018a). Deonarain (2019), who examined the use of advanced robots and discovered that it was not widely used in industry, has a similar perspective to Alexander (2021). Most robotics are designed to automate simple tasks and do not use-sophisticated technologies. Some automakers, nevertheless, employ techniques that are more sophisticated. Although 3D printing is not widely used in South African manufacturing, there is a high degree of knowledge, and its primary applications now are for testing and prototypes (Deonarain, 2019). This might be one of the elements influencing how well the fourth industrialization is performing in terms of industrial production. In addition to their differences, these sources compare the usage of technology in manufacturing between two different nations.

2.3.3. Long run impacts of the 4IR in production

Since analysing the results and performance of the fourth industrialization, its long-term consequences on production are a crucial component of our research. Additionally, platforms for managing, analysing, and reporting on these various data sources are being created. Only recently has South Africa worked with the 4IR. It is now slow growing, and not many companies are utilizing the 4IR in production processes, as Alexander (2021) points out. In a study Serumaga-Zake and van der Poll (2021), the author focuses on small and medium-sized businesses (SMEs) in a developing economy. The study took into account the demands and difficulties faced by SMEs in comparison to larger organizations with more developed infrastructures and substantial financial support. It allows the view the performance of businesses that are a part of the fourth industrialization thanks to this literature, which is quite beneficial.

2.3.4. Effects of the 4IR on South Africa's manufacturing output

The overall effectiveness and impact of the government's initiatives to advance the fourth industrial revolution have come under scrutiny. According to Alexander (2021), South Africa experiences the ICT industry's issues in a variety of ways. One problem is that firms' ability to compete may be hampered by the generally high costs of telecommunications and internet services. Entrepreneurs may particularly struggle with high data prices (Boyes et al., 2018). High data costs could also be a hindrance to the development of digital labour and goods marketplaces (Analytics Genesis, 2019). This is significant since it is focused especially on the South African economy and contains crucial information. The source also includes a list of factors contributing to manufacturing problems. Poor consumer and business confidence, administrative costs that are higher than inflation, high rail freight and port fees, an ineffective infrastructure, growing import levels, low demand, low competitiveness, and little economic development are a few of these (DTI, 2018; PC4IR, 2020). The source further emphasizes that the distribution of this advantage varies depending on the size of the firm, with micro- and small businesses experiencing the greatest effects. Three obstacles to promoting the growth of local suppliers were identified by the World Bank (2018a), and Alexander's research offers this vital insight to consider. First, South Africa's production levels are insufficiently high to make some components of local production profitable. Second, there are not enough resources-money, people, or otherwise-to spend to supplier training. According to Alexander (2021), South Africa has a number of obstacles when implementing 4IR technologies in their enterprises because of these issues. Having the money to implement changes is another factor that highlights important limitations for many firms. Some businesses prefer to keep their data confidential, but doing so can make it more difficult to implement new technology. Manage the expenses of various resources in a strategic way to protect them and get rid of anticompetitive businesses. Other sources that were used have also brought up these issues. The short-turn nature of these difficulties should be taken into account, though. Since the transition to 4IR in South Africa has only recently started and there are still many unexplored long-term patterns, the outcomes cannot be predicted by short-term effects.

2.3.5. Difference in developing and developed countries

It is crucial to recognize the type of nation comparison when considering these sources because the opportunities and difficulties for the fourth industrial revolution will vary. According to Alexander (2021), South African providers must compete with producers of the same goods on a global scale. Highlights the fact that, between 2018 and 2019, imports of original equipment components by the seven OEMs in South Africa climbed by 9.2% (Lamprecht, 2020). Pressure to reduce production costs is brought on by this circumstance. Standardized product specifications restrict chances for product innovation, but component suppliers can and may be under pressure to innovate their processes and organizations. Process innovations, including growing automation, are especially crucial since they can reduce manufacturing costs and make South African businesses more competitive internationally. Global lead companies occasionally assist suppliers in creating and implementing process innovations. A representative of a multinational lead company with a South African branch discussed managing the supply base. This gives the impression that South needs to embrace the 4IR differently than other countries in light of these issues. Many less developed nations have experienced industrialization without accompanying growth in other spheres of the economy and society. The repercussions of the downturn in heavy industry and other sectors are being felt by developed countries that were formerly thought to be sailing easily on a track of sustained expansion.

2.4. Gaps in Literature

The fourth industrial revolution's performance in the industrial sector and its real causes are not well understood. These sources provide insight into what is happening within the 4IR in production as well as the obstacles that are confronted. There are many potential difficulties, but there is not really a clear indicator of the difficulties the organization is facing. Even while there may be additional difficulties, not all organizations will face them. Although Moavenzadeh (2015) provides a great overview of 4IR in manufacturing, including all of the problems, solutions, and implementation strategies, it is not fully taken into account due to the market disparities between China and South Africa. Olaitan (2021) provides guidelines for assessing 4IR preparedness and use in South Africa, although there are not many results for immediate performance or for the long run. The most recent statistics on the adoption of 4IR and all the causes leading to it are provided by Alexander (2021). While Serumaga-Zake and van der Poll (2021), research focuses on the effects of 4IR on South African businesses, a component of the study that uses this information to measure cause focuses on manufacturing businesses. These sources provide information on the country's situation, how slowly 4IR is being implemented, and the immediate challenges, but they do not really elaborate on how well 4IR performs with production in South Africa, especially in light of the recent changes brought on by the pandemic and its long-term effects based on those changes. This study will evaluate the direct impact of the fourth industrial revolution on South Africa's industrial production since the Presidents Ramaphosa summit to harness the fourth industrial revolution in 2019. Taking into account economic obstacles and the economy slipping into a recession (StatsSA, 2020), and how that effects ICT and electricity generation as factors of the fourth industrialisation. Whether or not the fourth industrial revolution is succeeding in light of the present difficulties.

3. METHODOLOGY

3.1. Research Method and Data Sources

3.1.1. Study design

3.1.1.1. Theoretical framework

There were many methods and techniques used in order to reach both the theoretical and empirical goals of the research. Many econometric and inferential methods can be used to describe the data. For describing and profiling technological effects, descriptive characteristics, productivity and output outcomes of firms, manufacturers and companies, descriptive statistics were used. Cobb-Douglas production functions framework and Endogenous Growth model are the models used. According to endogenous theory, economic growth is more often the result of internal factors than external ones (Stiglingh, 2015), argues that higher productivity can directly be linked to greater innovation and increased expenditures in human resources by both governments and private sectors. Cobb-Douglas production functions simulate how input and output factors are related. It is used to forecast technological advancement in manufacturing systems and to calculate input-output rates to achieve efficient production (Inomics, 2020).

This study implemented a quantitative research approach by means of secondary data. The data is generated from the World Bank database. The use of E-views was used to further provide evident and support to my research. The study used recent data because the effects may differ if looked at before the global pandemic, further the study wanted to provide a solution for the present. So, data sources from 30 years, 1990 to 2021 was used. Data about Investment in ICT, power generation in South Africa, industrial production contribution to GDP, employment levels in industrial production, industry growth, secondary school enrolment and Gross fixed capital formation, from the World Bank data base.

3.1.2. Econometric method and model specification

3.1.2.1. Estimation techniques

Estimation techniques using the following determination the used models was ARDL, VAR OR VECM to determine the results.

3.1.2.2. Data measurement and descriptions

Determinations of production

$$Q = f(\mathrm{l,k})$$

Endogenous growth model

$$Q = AL^{\propto} K^{B}$$

$$In\ Q = InA + \propto InL + BInK + u$$

Adding other important variables as mentioned by empirical studies.

$$InQ = InA + \propto InL + BInK + IuE + InICT$$

INDT= Industrial production

EMP= Employment

CAP= Physical capital

ELEC= Electricity

ICT= Industrial revolution (ICT development)

HCD= Human capital development.

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. Principal Component, Correlation Matrix and Descriptive Statistics Result

4.1.1. Analysis

Before reporting on the various estimation methods employed in this study's findings, first need to create the Industrial production variable and six variables. The significant collinearity in the industrial output indicators in Table 1 required the use principal component analysis to create the Industrial production variable. In Table 1, components with >1 eigenvalue were kept, as well as those with absolutes >0.40 (Saba and David, 2020). The criterion was met and the Industrial variable was made using the eigenvalues of the first components. Therefore, ignored numbers 3, 4, 5, 6 and 6 as their eigenvalues were not relevant to the model.

The descriptive statistics results are presented in Table 2. The data distribution's symmetry is assessed by skewness. A data set with a negative skewness has a larger tail on the left side of the distribution, as shown in LNELEC, LNEMP, LNHCD, and LNICT. Positive kurtosis (as seen in all variables) means that

Table 1: Principal component and correlation matrix results

Sample: 1990-2021						
Included observations: 32						
Computed using: Ordinary correlations						
Extracting 6 of 6 possible components						
Eigenvalues (Sum=6, Average=1)						
Number	**Value**	**Difference**	**Proportion**	**Cumulative Value**	**Cumulative Proportion**	
1	4.455730	3.389233	0.7426	4.455730	0.7426	
2	1.166497	0.769393	0.1777	5.522227	0.9204	
3	0.297104	0.166324	0.0495	5.819331	0.9699	
4	0.130780	0.089297	0.0218	5.950111	0.9917	
5	0.041483	0.033077	0.0069	5.991594	0.9986	
6	0.008406		0.0014	6.000000	1.0000	
Eigenvectors (loadings)						
Variable	**PC 1**	**PC 2**	**PC 3**	**PC 4**	**PC 5**	**PC 6**
LNINDT	0.453392	0.074606	-0.451798	0.304593	0.191264	-0.674825
LNCAP	0.455824	0.117415	-0.383602	0.288177	0.098031	0.733915
LNELEC	0.440536	-0.134620	0.562187	-0.166687	0.666058	0.018254
LNEMP	-0.392774	-0.471315	0.083445	0.733908	0.276723	0.037827
LNHCD	0.445122	-0.093685	0.496774	0.365778	-0.639460	-0.060028
LNICT	-0.200458	0.855342	0.280938	0.352104	0.157131	-0.024744
Ordinary correlations						
	LNINDT	**LNCAP**	**LNELEC**	**LNEMP**	**LNHCD**	**LNICT**
LNINDT	1.000000					
LNCAP	0.989780	1.000000				
LNELEC	0.802334	0.810350	1.000000			
LNEMP	-0.810966	-0.837247	-0.697722	1.000000		
LNHCD	0.834932	0.846521	0.944507	-0.691850	1.000000	
LNICT	-0.359205	-0.318290	-0.472698	-0.036566	-0.488860	1.000000

Source: Compiled by the authors

Table 2: Descriptive Statistics Result

	LNINDT	LNCAP	LNELEC	LNEMP	LNHCD	LNICT
Mean	10.84223	10.59782	1.844075	1.40719	6.610836	8.212362
Median	10.85491	10.65048	1.90768	1.417358	6.642128	8.310564
Maximum	10.91575	10.79545	1.933993	1.457882	6.690625	8.593877
Minimum	10.74184	10.31567	1.450609	1.31534	6.394574	7.176091
Std. Dev.	0.063917	0.173715	0.128359	0.039157	0.078013	0.33793
Skewness	-0.240415	-0.27143	-1.72806	-0.568320	-1.600835	-1.255351
Kurtosis	1.447811	1.471702	4.977260	2.284691	4.575899	4.18051
Jarque-Bera	3.520651	3.507189	21.13909	2.404820	16.97558	10.26298
Probability	0.171989	0.17315	0.000026	0.300469	0.000206	0.005908
Sum	346.9514	339.1301	59.01039	45.03007	211.5467	262.7956
Sum Sq. Dev.	0.126649	0.935486	0.510755	0.047533	0.188665	3.540098
Observations	32	32	32	32	32	32

Source: Compiled by the authors.

Table 3: Panel data results

Series	Model	ADF	PP
Entire sample			
LNINDT	None	0.9400	0.93396
	Constant	0.6744	0.6745
	Constant and trend	0.9581	0.9524
LNCAP	None	0.9505	0.9517
	Constant	0.4198	0.6791
	Constant and trend	0.9952	0.9721
LNELEC	None	0.6761	0.9751
	Constant	0.0001	0.0001
	Constant and trend	0.0006	0.0000
LNEMP	None	0.0001	0.0009
	Constant	1.0000	0.9999
	Constant and trend	0.9764	0.9893
LNHCD	None	0.8979	0.9496
	Constant	0.0123	0.0082
	Constant and trend	0.9731	0.9225
LNICT	None	0.6230	0.6260
	Constant	0.6486	0.5202
	Constant and trend	0.9345	0.9139
D (LNINDT)	None	0.0000	0.0000
	Constant	0.0002	0.0002
	Constant and trend	0.0006	0.0006
D (LNCAP)	None	0.0032	0.0033
	Constant	0.0188	0.0195
	Constant and trend	0.0370	0.0423
D (LNELEC)	None	0.0003	0.0001
	Constant	0.0268	0.0003
	Constant and trend	0.0000	0.0000
D (LNEMP)	None	0.5960	0.1028
	Constant	0.0270	0.0270
	Constant and trend	0.0072	0.0250
D (LNHCD)	None	0.0000	0.0000
	Constant	0.0008	0.0010
	Constant and trend	0.0002	0.0000
D (LNICT)	None	0.0002	0.0002
	Constant	0.0044	0.0045
	Constant and trend	0.0114	0.0114

Null: Unit root (assumes common unit root process): Null: Unit root (assumes individual unit root process): Im, Pesaran and Shin (W-stat). Source: Author's computations*P<0.1, **P<0.05, and ***P<0.01 are significance level, respectively. Source: Compiled by the authors

the distribution has heavier tails and more pronounced peaks than a normal distribution. The p-value linked to the Jarque-Bera statistic shows the likelihood of getting a similar statistic if the data was normally distributed. If the p-value is low, it means there is strong evidence suggesting that the data is not normally distributed. Based on their higher p-values, LNINDT and LNCAP data does not seem to differ greatly from a normal distribution. However, for three variables (LNELEC, LNHCD, and LNICT), the low p-values indicate that these variables are significantly different from a normal distribution. The p-value for LNEMP is quite high, which means that it is not significantly different from being normally distributed.

Table 4: Panel cointegration result

Unrestricted cointegration rank test (trace)				
Hypothesized No. of CE (s)	Eigenvalue	Trace Statistic	0.05 Critical value	Pro.**
None*	0.943574	207.5589	117.7082	0.0000
At most 1*	0.865900	121.3144	88.80380	0.0000
At most 2	0.555188	61.03942	63.87610	0.0847
At most 3	0.476268	36.73632	42.91525	0.1807
At most 4	0.281268	17.33308	25.87211	0.3905
At most 5	0.219252	7.425085	12.51798	0.3023
Trace test indicates 2 cointegrating eqn (s) at the 0.05 level				

*denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) P-values
Source: Compiled by the authors.

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No of CE (s)	Eigenvalue	Max-eigen Statistic	0.05 Critical value	Prob.**
None*	0.943574	86.24450	44.49720	0.0000
At most 1*	0.865900	60.27500	38.33101	0.0000
At most 2	0.555188	24.30309	32.11832	0.3289
At most 3	0.476268	19.40324	25.82321	0.2790
At most 4	0.281268	9.907997	19.38704	0.6287
At most 5	0.219252	7.425085	12.51798	0.3023
Max-eigenvalue test indicates 2 cointegrating eqn (s) at the 0.05 level				

*denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) P-values
Source: Compiled by the authors

4.2. Panel Unit Root Result Analysis

The findings of the panel unit root for the entire sample and the six factors are shown in Table 3. The panel unit root results for the entire sample and each of the six parameters are displayed in Table 3. The second-generation panel unit root test's reliability was guaranteed. Results of first-generation panel-unit root tests, including the ADF and Phillips-Perron tests (Peter C. B. Phillips and Pierre Perron), are shown in Table 3. The null hypothesis of non-stationarity (H0) is rejected when $P < 5\%$. Therefore, variables of order I (1) were integrated. A panel-cointegration test was suggested to determine the variables' long-term relationship with

Table 5: Vector auto regression estimates

Vector auto regression estimates						
Sample (adjusted): 1992 2021						
Included observations: 30 after adjustments						
Standard errors in ( ) and t-statistics in [ ]						
	LNINDT	**LNCAP**	**LNELEC**	**LNEMP**	**LNHCD**	**LNICT**
LNINDT(-1)	0.473690	0.248492	0.095924	0.166264	−0.282226	−0.261472
	(0.34286)	(0.52017)	(0.33733)	(0.14426)	(0.35946)	(3.51089)
	[1.38160]	[0.47772]	[0.28436]	[1.15257]	[−0.78514]	[−0.07447]
LNINDT(−2)	−0.675429	−1.134765	0.304452	−0.215227	−0.971558	−3.699664
	(0.50282)	(0.76286)	(0.49472)	(0.21156)	(0.52717)	(5.14897)
	[−1.34328]	[−1.48751]	[0.61540]	[−1.01733]	[−1.84296]	[−0.71852]
LNCAP(−1)	−0.049919	0.949895	−0.026560	−0.035100	0.649064	0.612400
	(0.24099)	(0.36563)	(0.23711)	(0.10140)	(0.25267)	(2.46783)
	[−0.20714]	[2.59798]	[−0.11202]	[−0.34616]	[2.56886]	[0.24815]
LNCAP(−2)	0.321885	0.057558	−0.122358	0.041899	−0.180095	1.187283
	(0.16380)	(0.24852)	(0.16117)	(0.06892)	(0.17174)	(1.67739)
	[1.96505]	[0.23161]	[−0.75921]	[0.60793]	[−1.04867]	[0.70782]
LNELEC(−1)	−0.005390	0.397919	0.086329	−0.023751	0.483793	−1.400083
	(0.16509)	(0.25047)	(0.16243)	(0.06946)	(0.17309)	(1.69059)
	[−0.03265]	[1.58866]	[0.53147]	[−0.34192]	[2.79504]	[−0.82816]
LNELEC(−2)	0.031786	−0.297873	0.634938	−0.013260	0.209205	−0.102114
	(0.13945)	(0.21157)	(0.13721)	(0.05867)	(0.14621)	(1.42803)
	[0.22793]	[−1.40789]	[4.62761]	[−0.22600]	[1.43088]	[−0.07151]
LNEMP(−1)	0.781498	−0.065967	−0.402620	1.110910	0.414195	−1.192474
	(0.62650)	(0.95050)	(0.61640)	(0.26360)	(0.65684)	(6.41541)
	[1.24741]	[−0.06940]	[−0.65318]	[4.21444]	[0.63059]	[−0.18588]
LNEMP(−2)	−1.428850	−1.206486	0.550444	−0.125643	−0.841202	−1.017381
	(0.72031)	(1.09282)	(0.70870)	(0.30307)	(0.75519)	(7.37606)
	[−1.98367]	[−1.10401]	[0.77670]	[−0.41457]	[−1.11389]	[−0.13793]
LNHCD(−1)	0.091604	0.165047	0.109790	0.043154	0.233785	0.568334
	(0.13485)	(0.20459)	(0.13267)	(0.05674)	(0.14138)	(1.38086)
	[0.67931]	[0.80674]	[0.82752]	[0.76060]	[1.65361]	[0.41158]
LNHCD(−2)	−0.132174	−0.250152	−0.056554	0.011286	−0.563813	0.016378
	(0.12634)	(0.19168)	(0.12431)	(0.05316)	(0.13246)	(1.29376)
	[−1.04616]	[−1.30504]	[−0.45496]	[0.21231]	[−4.25647]	[0.01266]
LNICT(−1)	−0.018556	−0.009282	0.011063	−0.000419	0.020315	0.930127
	(0.02267)	(0.03440)	(0.02231)	(0.00954)	(0.02377)	(0.23219)
	[−0.81838]	[−0.26982]	[0.49591]	[−0.04388]	[0.85456]	[4.00588]
LNICT(−2)	−0.037054	−0.078932	−0.000975	−0.001639	−0.001665	−0.178429
	(0.02594)	(0.03936)	(0.02553)	(0.01092)	(0.02720)	(0.26566)
	[−1.42828]	[−2.00538]	[−0.03821]	[−0.15014]	[−0.06120]	[−0.67163]
C	11.74609	12.43187	−2.868858	0.200486	16.59068	27.94071
	(5.41156)	(8.21022)	(5.32436)	(2.27690)	(5.67364)	(55.4153)
	[2.17055]	[1.51419]	[−0.53882]	[0.08805]	[2.92417]	[0.50421]
R-squared	0.969480	0.990439	0.986526	0.985874	0.971691	0.891000
Adj. R-squared	0.947936	0.983690	0.977014	0.975902	0.951708	0.814059
Sum sq. resids	0.003375	0.007768	0.003267	0.000597	0.003710	0.353877
S.E. equation	0.014089	0.021376	0.013862	0.005928	0.014772	0.144279
F-statistic	45.00085	146.7565	103.7204	98.86867	48.62574	11.58028
Log likelihood	93.82141	81.31615	94.30880	119.7931	92.40263	24.03188
Akaike AIC	−5.388094	−4.554410	−5.420587	−7.119540	−5.293508	−0.735459
Schwarz SC	−4.780908	−3.947224	−4.813401	−6.512354	−4.686323	−0.128273
Mean dependent	10.84800	10.61379	1.867568	1.403886	6.621747	8.187644
SD. dependent	0.061749	0.167380	0.091434	0.038188	0.067219	0.334591
Determinant resid covariance (dof adj.)		1.48E-22				
Determinant resid covariance		4.90E-24				
Log likelihood		549.6963				
Akaike information criterion		−31.44642				
Schwarz criterion		−27.80331				
Number of coefficients		78				

Source: Compiled by the authors

one another. These elements have substantial effects on industrial output. It is crucial to include these in data as a result. It is possible to evaluate both correlation and causation. Summary: According to the findings of the first-generation panel unit roots testing, the majority of the variables were integrated of order I (1). Because the $P < 0.05$, the null hypothesis is rejected, and serial correlation is therefore assumed to exist. The null hypothesis posits that the data are homoscedastic. However, the result's $P < 0.05$ enables us to reject the null hypothesis and supports our original analysis that this data set exhibits heteroscedasticity.

4.3. Panel Cointegration Result Analysis

Results of the Johansen Fisher test for cointegration are displayed in Table 4. The Fisher-Trace or Fisher-maximum Eigenvalue tests were combined with panel series data to produce the results of Table 4 using vector auto regression (VAR). H0: Means there isn't a cointegrating equation, and H1: H0 isn't accurate. If the probability value is ≤0.05, reject the null hypothesis. If the Trace or Max-Eigen statistic exceeds the 0.05 threshold value, the null hypothesis will be rejected. The cointegration 2 was validated by the eigenvalue tests' maximum and trace statistics. Two Cointegrating eqn are shown by the trace test. This is the long-term, or for a certain time period, correlation between non-stationary data. One may draw conclusions about the long-term equilibrium relationship between industrial production and each of the six variables. The null hypothesis that there is no cointegrating equation is rejected at the 5% level based on the results obtained. Therefore, it may be said that the six variables have a long-term relationship.

4.4. Panel VAR Result Analysis

The table below shows the results of panel-VAR. Table 5. These findings suggest that ICT investment and human capital development need to be increased. The total industrial production and six variables show positive correlations between growth and human capital investments and causation. This means that the growth gains are to some extent being properly channelled towards the improvement of the skill sector and finance. This indicates that the industrial sector supported the labour market.

5. CONCLUSION

The expected outcomes was to see the change in the increased performance of fourth industrial revolution would influence dependent variables, and should I expect a positive relationship between the variables. How to better apply the increased use of fourth industrial revolution. If technology is significant to industrial output than the conclusion can means it does affect industrial production but wanted to how much it influences. The problem is determine how well 4IR performs with industrial production in South Africa, especially in light of the recent changes brought on by the pandemic and its long- term effects based on those changes, with sensitive markets like the employment sector. The results of total industrial production for the entire sample and the six variables reveal that growth is positively significant to human capital investment and causation. This indicates that growth benefits are to some degree being directed towards the improvement of the skill sector and finance. This suggests that the industrial sector supports the labour sector. The recommendations to reach more 4th industrial revolution is to invest in Education and Training. Your existing team members need training to take advantage of new technologies, which means increasing investement in human capital development and investment.

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