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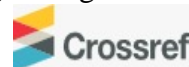
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Abstract

Purpose: It is well documented that the manufacturing industry plays a vital role in a country's economic growth and progress. This study benchmarks the endogenous growth paradigm in order to assess the productivity drivers that may affect the output growth of the manufacturing sector in East African Community member states. The empirical model covering the years 2000–2020 was constructed using panel data.

Methodology: The study adopts a longitudinal research design and tables used to present summary estimates. Analysis has been achieved using stata statistical package version 17.0. A D-GMM estimator was employed to estimate the underlying empirical model.

Findings: Foreign direct investments, inflation, trade openness, and lending interest rates were shown to be the most influential variables in the rise of manufacturing sector production among EAC member states out of a large sample of productivity indicators analyzed in the study.

Recommendations: The results show that EAC countries can boost their manufacturing output by attracting more FDI, keeping inflation low, boosting cross-border trade, and enacting policies to lower the costs associated with credit access. Unique in this study is the analysis, first of its kind, of the productivity drivers of the growth in manufacturing sector output in the East African Community member states within the general framework of endogenous growth theory.

Keywords: *Productivity Factors, Manufacturing Sector Output, D-GMM, EAC Member States.*

1.0 INTRODUCTION

Manufacturing's contribution to national economies has been extensively documented (Kayodeo, Ibenta, & Owoputi, 2020; Mbah & Okoli, 2020), and this fact is generally accepted. According to Aiginger and Rodrik's (2020) research, there is widespread agreement that the manufacturing sector is essential to national economic progress. The manufacturing industry is vital to the economy because it adds value to products and inputs from other industries. Mbah and Okoli (2020) argue that this may lead to the creation of both forward and backward links, which in turn can hasten economic expansion. The manufacturing sector is widely acknowledged as a major contributor to economic growth across all countries, as stated by the African Development Bank (2021). Growing the manufacturing sector may help emerging countries fight poverty and raise living standards, according to the 2018 East African Economic Outlook study. Many developing and emerging countries, according to PWC's 2017 study, are working toward industrial development while maintaining low inflation rates.

The expansion of national economies is mostly attributable to the manufacturing sector. The East African Community (EAC) member nations' industrial sector development has slowed, the African Development Bank said in 2021, leading to a drop in export earnings and investment activity. The value contributed by the manufacturing sector in East African Community (EAC) member states has been between 8 and 12 percent of total GDP, as stated in the East African Economic Outlook of 2021. It seems like the EAC member countries might devote more resources to developing their industrial infrastructure. Manufacturing growth rates in the East African Community (EAC) may not be adequate to successfully eliminate poverty and allow these states to catch up to other industrialized countries, according to the East African Economic Outlook (2021). Some researchers have hypothesized that the East African Community nations' industrial sectors may benefit from further development, which would raise their GDP share. According to Herman's research (2020), the economies of the EAC member nations would greatly benefit if they invested in and prioritized the manufacturing sector. Utilizing economies of scale, developing strong backward and forward connections, encouraging high employment rates, speeding up productivity, and boosting technology adoption are just some of the advantages.

Given the importance of the manufacturing sector to national growth and development, understanding what motivates it is crucial. Numerous writers have penned works that examine the factors that have fueled the expansion of the industrial industry. East African nations have received comparatively less academic attention than their West African and Asian counterparts. This study uses panel data for the years 2000–2020 to evaluate the endogenous growth paradigm's emphasis on productivity factors, with the goal of identifying the most important productivity variables that significantly affect the expansion of manufacturing sector output within the EAC community member states.

The remaining sections of this analysis are as follows: Subsequent subsections include a condensed literature assessment of the accepted growth theories, an empirical literature review of studies with similar aims, a research methodological overview, the presentation of study results, and a discussion of these findings.

2.0 LITERATURE REVIEW

Theoretical Literature on the Theories of Growth in Output

The study is motivated by two well-known growth theories, specifically endogenous and exogenous. The growth theories are useful in identifying important growth determinants to include in various models under consideration, alongside empirical investigation. Exogenous growth theory suggests that economic development is driven by the accumulation of various factors, such as physical capital, labor, and population growth. This theory operates under the assumption of constant returns to scale and conditional convergence, as first proposed by Solow in 1956. According to the current theory, growth is believed to be driven by a steady pace of technological progress, which is considered to be exogenous. The exogenous growth theory suggests that technological advancements are considered to be exogenous, which means that they are determined outside of the growth model and are not directly involved in the growth process. The authors recognize the significant contribution of human capital, labor force, and population growth in promoting economic development, as outlined in the theoretical framework presented by Mankiw, Romer, and Weil (1992). The experts highlight that the growth of the manufacturing sector is a crucial factor in driving economic development.

The introduction of endogenous growth theory is often attributed to the works of Romer (1986) and Lucas (1988). Endogenous growth models are a diverse set of theoretical frameworks that shed light on the mechanisms of economic growth by highlighting the significance of technological advancements and innovation (Onyimadu, 2015). As per Grandy's (1999) perspective, the endogenous growth theory suggests that sustained development is governed by the production process, rather than external factors. According to Onyango and Were (2015), the endogenous growth paradigm suggests that economic development can be improved by implementing policies that promote capital formation, openness, foreign direct investment, competition, innovation, and change. As per Grossman and Helpman's (1991) research, advocates of endogenous growth theory suggest that there is a positive correlation between an improvement in productivity and overall production. It is widely believed that the rise in productivity can be attributed to an increase in innovation and investment in human capital. The study combines elements from two different theoretical frameworks to examine their influence on the growth of the manufacturing sector, based on two hypotheses being considered.

A Review of Empirical Literature on the Relationship between Productivity Variables and Output Growth

Egbuche, Chukwuka, Achugbu, and Leonard (2020) investigated the impact of financial deepening on Nigerian manufacturing sector output from 1981 to 2018. The information came from the Central Bank of Nigeria's (CBN) 2018 Statistical Bulletin. The dependent variable was output performance in the manufacturing sector, whereas the independent variables were money supply as a percentage of GDP and private sector credit as a percentage of GDP. The variable stationarity was determined using the unit root test, the long run equilibrium connection was determined using the co-integration technique, and the rate of adjustment was determined using the Error Correction Model (ECM). This research employed these approaches in addition to serial correlation, heteroscedasticity, and a normalcy test. The data was analyzed using Ordinary Least Squares (OLS). According to the model, financial deepening has a significant positive influence on the performance of the manufacturing sector.

The study conducted by Nwabuisi, Oke-Bello, Oyewole, Toriola, Folami, and Afolabi (2020) explored the relationship between domestic credit and the efficiency of Nigeria's manufacturing sector. An econometric model was developed retrospectively, utilizing industrial production as the dependent variable and domestic credit, rate of interest, and foreign exchange rate as explanatory variables. The annual series of time data from the Nigerian Central Bank Statistical Bulletin from 1981 to 2017 was evaluated using the dynamic OLS technique. The manufacturing sector in Nigeria experienced significant improvements in efficiency due to domestic credit and interest rates, although the exchange rate had a notable adverse effect. The research indicates that Nigeria's manufacturing sector performance is positively impacted by domestic finance.

Adaramola and Dada (2020) investigated the impact of inflation on Nigerian economic development from 1980 to 2018. The ARDL method lag was applied to the variables real GDP, inflation rate, interest rate, currency value, degree of economic transparency, money supply, and government final consumption expenditures from 1980 to 2018. Inflation and the actual exchange rate had a significant negative influence on economic growth, whereas interest rates and money supply had a significant positive impact. Other inflation projections have no impact on Nigeria's economic development. The investigation of causality found bidirectional links between the interest rate, the rate of exchange, government consumption expenditures, and GDP.

The study conducted by Obamuyi, Edun, and Kayode (2012) examined the relationship between bank lending, economic development, and Nigerian industrial output. The data spanning from 1973 to 2009 were analyzed using cointegration and vector error correction model (VECM) techniques. The study's findings suggest that the utilization of industrial capacity and bank lending rates may have had a negative impact on Nigerian manufacturing output. It appears that the country faced challenges in establishing a correlation between industrial output and economic development.

Egoro and Obah (2017) conducted a study aimed at assessing the effects of trade liberalization on the Nigerian economy, with a specific emphasis on the manufacturing sector, during the period spanning from 1981 to 2015. The economic growth model was formulated by taking into account various international trade possibilities, including non-oil imports, oil supply, non-oil exports, and oil exports. The CBN statistics bulletin was utilized as a supplementary data source. This study employed a range of regression estimation techniques and E-view version 9 software to examine the impact of global trade on the Nigerian economy. Empirical data suggests that the process of trade liberalization has provided significant benefits to the industrial sector of Nigeria.

Afolabi, Laseinde, Oluwafemi, Atolagbe, and Oluwafemi (2019) conducted a study utilizing ARDL and cointegration techniques to analyze the relationship between manufacturing sectors and foreign direct investment over a period of 36 years. The study found that the dependent variables had a strong correlation with manufacturing sector indicators, explaining 97% of the variation. The independent variables considered in the study were foreign direct investment, inflation rate, government expenditure, and money supply. The study suggested that it may be beneficial for the federal government to consider increasing the amount of foreign direct investment available to the manufacturing sector. This could potentially lead to improvements in efficiency, as well as positively impact Nigeria's GDP and job creation.

Babasanya, Maku, and Amaefule (2020) conducted a comprehensive study over a period of 35 years (1985-2019) to investigate the impact of labor force and national savings on the production

of the manufacturing sector in Nigeria. The information was obtained from various sources including the Central Bank of Nigeria (CBN), National Bureau of Statistics, and World Development Index (WDI), all of which provided data from 2017. The Vector Error Correction Model (VECM) was utilized for the purpose of data analysis. According to the VECM findings, it was observed that national savings and labor force had a significant impact on manufacturing production in the long run. However, it was also noted that exchange rate and inflation had a negative influence on the same. According to this research, it appears that the growth and sustainability of the manufacturing industry is influenced by various factors, including national savings, the industrial labor force, inflation, and currency rates.

Olarewaju, Ogundipe, Adekol, and Adeleye (2021) conducted a study to explore the relationship between human capital and manufacturing output in Nigerian industrial businesses, in order to shed light on the sporadic development of Nigeria's manufacturing sector. This investigation was grounded in the theoretical framework of physical capital theory. The study utilized Spearman Correlation to examine the effects of physical capital on manufacturing value-added in Nigerian industries, using micro data from the World Bank Enterprise Survey (2014). The data suggests that additional education and training beyond high school can have a positive impact on manufacturing production, albeit a modest one. As a result, recommendations were put forward to enhance the quality of physical capital through collaborations between the public and private sectors, training programs, research initiatives, and establishing a conducive business environment for industrial sectors with fair and efficient institutions.

The study conducted by Joshua, Wubon, Arastus, and Owolabi (2021) explored the impact of capital (Foreign Direct Investments inflows) and labor (domestic labor) on the production of Nigeria's industrial sector. The selection of ARDL for this investigation was influenced by the mixed order of integration derived from the unit root test. Based on the research, it appears that capital had a significant impact on the output of the industrial sector in Nigeria, while labor had a positive but less significant effect on performance.

Most of the related studies to the correct study have mainly utilized time series data and thus have considered singly-country analysis. In addition, the existing studies do not much attention to the endogeneity concerns which are inherent in growth functions. Moreover, none of the studies has been done on the East African Member states. This study therefore contributes to existing literature by analyzing panel data on the East African member states and implementing a D-GMM estimator which addresses Endogeneity bias, in order to assess the key drivers of the manufacturing sector output growth among the East African member states for the period 2000-2020.

3.0 METHODOLOGY

Data

The study utilizes panel data from secondary sources. The information was sourced from the World Bank development indicators (WBI), with the latest update being in June 2022.

Research Approach and Research Design

The study adopts a quantitative research approach and the longitudinal research design for analysis. Data was analyzed using stata statistical package 7.0 MP-parallel Edition. Summary estimates were presented using tables.

Model Specification

Borrowing from the growth accounting in which output can derive from inputs as well as technological change, we first express the growth model as a Constant Returns to Scale (CRS) Hicks-neutral Solow-style neoclassical production function of the form:

$$Y(t) = AF[K(t)L(t)] \quad (1);$$

Where A represents the productivity parameter, which, in the neoclassical growth model, is assumed to be exogenous. $K(t)$ and $L(t)$ are the capital and labour inputs respectively which are subject to change over time.

We introduce an error term, u in equation (1) and write a non-linear Cobb-Douglas type production function the context of the neoclassical production thought as:

$$Y(t) = A[K(t)]^{\beta_1}[L(t)]^{\beta_2}e^u; 0 < \beta_1, \beta_2 < 1 \quad (2);$$

Where e is the Euler's constant.

This study however adopts the thoughts of the endogenous growth and treats technology progress as a core determinant of long run economic growths. Thus we re-write (2) such that parameter A varies with time.

$$Y(t) = A(t)[K(t)]^{\beta_1}[L(t)]^{\beta_2}e^u; 0 < \beta_1, \beta_2 < 1 \quad (3)$$

Taking natural logarithms in (3), we obtain a linearized output function as:

$$\ln Y(t) = \ln A(t) + \beta_1 \ln K(t) + \beta_2 \ln L(t) + u; 0 < \beta_1, \beta_2 < 1 \quad (4)$$

Our analysis focuses on identifying the key determinants of productivity by utilizing empirical literature, while treating the capital and labour inputs as control variables. The equation (5) highlights the significant productivity variables that are of interest for analysis.

$$\ln A(t) = f(\text{Inf}, \text{domcred}, \text{tradeopen}, \text{findeep}, \text{lrates}, \text{fdi}) \quad (5);$$

Variables in question include: The variables in question are as follows: Inf denotes the inflation rate, domcred represents the amount of domestic credit extended to the private sector, tradeopen signifies the degree of trade openness, findeep pertains to the level of financial deepening, lrates denotes the interest rate for lending, and fdi represents the amount of foreign direct investment.

The empirical model is formulated as a log-linear dynamic panel model, taking into account equation (4) and equation (5).

$$\ln \text{msy}_{i,t} = \alpha \ln \text{msy}_{i,t-1} + \beta_1 \ln \text{gk}_{i,t} + \beta_2 \ln \text{lf}_{i,t} + \beta_3 \text{domcred}_{i,t} + \beta_4 \text{fdi}_{i,t} + \beta_5 \text{inf}_{i,t} + \beta_6 \text{tradeopen}_{i,t} + \beta_7 \text{lrates}_{i,t} + \beta_8 \text{findeep}_{i,t} + \mu_i + \gamma_t + \epsilon_{i,t} \quad (6)$$

The cross-section dimension, denoted by i , is defined by the individual countries being studied, while the time dimension, denoted by t , is defined by the time span of 2000-2020. The variable $\ln \text{msy}_t$ represents the natural logarithm of the current period value of the manufacturing sector output, while $\ln \text{msy}_{t-1}$ represents the natural logarithm of the one-period lag of the manufacturing sector output. Additionally, $\ln \text{gk}$ is the natural logarithm of gross capital formation, which has been used as a proxy for capital stock, and $\ln \text{lf}$ is the natural logarithm of the labor force, which has been used as a proxy for the labor stock. The variables being discussed include domcred , fdi , inf , tradeopen , lrates , and findeep . Additionally, there are three other factors

to consider: μ_i , γ_t , and $\epsilon_{i,t}$. These variables are used to capture various economic factors and their effects on γ_i , across the individual countries being studied.

Diagnostic Checks

The study performs pre-estimation diagnostic checks to evaluate data behavior and post-estimation diagnostic checks to evaluate the validity and/or robustness of the estimates. The initial three diagnostic checks listed below are conducted prior to estimation, while the remaining checks are performed after estimation as part of the diagnostic process.

(i) A check for multicollinearity has been performed to evaluate the degree of linear associations among the predictor variables. This has been done by examining the sizes and significance of the correlation coefficients between the independent variables in the empirical model. According to Rendón (2012), when the pairwise correlation coefficients between explanatory variables exceed ± 0.8 , it may suggest the presence of severe multicollinearity. This could potentially lead to larger standard errors in the coefficients of the linear regression model, which may affect the efficiency of the estimates.

(ii) Stationarity tests/ unit root tests. These have been conducted to assess the order of integration of the variables in the panel model. This test is necessary condition for subsequent tests such as cointegration test but also the order of integration of the model variables is a yardstick of the choice of the correct estimation procedure. Noting that our panel data is not strongly balanced and that it has a time dimension greater than that is than the cross-section dimension (i.e. $T > n$), the study employs the Fisher-type (Choi, 2001) panel unit root test which is appropriate under such panel data conditions.

(iii) A test for cointegration using panel data. The purpose of this study was to examine whether there exist long-term equilibrium relationships among the variables in the empirical model. The utilization of test outcomes aids in the selection process between cointegration estimation methodologies and non-cointegration estimation methodologies. The present research utilizes the Johansen-Fisher cointegration test methodology for panel data, which is suitable for multiple linear regressions and can also handle variables that exhibit integration of varying orders (Maddala and Wu, 1999).

(iv) The topic under consideration is the Wald tests of simple and composite linear hypotheses. The purpose of this examination is to ascertain the statistical significance of the entire regression. The examination is carried out under the assumption that the estimated regression's model coefficients are collectively equivalent to zero, which is known as the null hypothesis. If this is the case, the entire model would be deemed insignificant. The rejection of the null hypothesis in this research is contingent upon the Wald chi-square statistic's estimated probability value being less than or equal to the predetermined significance level of 0.05.

(v) The test for serial correlation in the residuals. The inefficiency of regression coefficients is a consequence of the existence of serial correlation within the residuals. The research employs the Arellano-Bond (Arellano & Bond, 1991) test for serial correlation of first and second order, AR (1) and AR (2) respectively, on the first-differenced residuals subsequent to the regression estimation. When testing for the absence of serial correlation of order p , the null hypothesis is deemed invalid if the probability value of the Z-statistic derived from the test is less than or equal to the predetermined significance level of 0.05.

(vii) Normality of the residuals test. Residual non normality makes standard errors of regression coefficients unreliable which makes inferences uncertain. This study implements the Jarque-Bera (JB) normality test to assess whether the predicted residuals are normally distributed or not. The JB tests the null hypothesis of normally distributed residuals. In this study, the null hypothesis is rejected if the probability value of the chi-square statistic produced from the JB test is less or equal to the significance level of 0.05.

(viii) The present study employs the Sargan test to examine the overidentifying restrictions, which evaluates the collective soundness of the instruments employed in the D-GMM estimation. The null hypothesis posits that the instruments utilized are jointly valid. The rejection of the null hypothesis is contingent upon the chi-square probability value being reported as less than or equal to the predetermined significance level of 0.05 in this particular study.

(ix) The Hausman specification test is a statistical tool utilized in econometrics to ascertain the suitability of either the random effects model or the fixed effects model for a specific dataset. The study utilizes a Hausman specification test to determine whether there exists a systematic variation in the coefficients between the instrumental variable (IV) estimator, specifically the D-GMM, and the ordinary least squares (OLS) estimator. This is carried out based on the premise that there is no systematic variation in the coefficients between the corresponding estimates obtained from the two estimators. When the reported chi-square probability value is equal to or less than the predetermined significance level of 0.05, it is considered that the null hypothesis has been rejected. In the event that the null hypothesis is rejected, it would imply the presence of a systematic variance in coefficients, thereby indicating that the estimator of the independent variable is a more desirable model.

4.0 FINDINGS

This section provides an exposition, analysis, and discourse of the outcomes derived from the examination of the data. Initially, the primary descriptive statistics pertaining to the model variables in their original units are presented. Subsequently, a correlation matrix of the independent variables is displayed, followed by an exposition of the stationarity tests conducted on all model variables. This is followed by the cointegration test, and ultimately, the regression estimates are presented. The diagnostic test outcomes subsequent to estimation are succinctly outlined and exhibited alongside the regression estimates in a unified table.

Descriptive Statistics to Analyze All Variables in the Model

The study variables are utilized to calculate descriptive statistics in their original units, which are then consolidated for the panel of five countries under examination. Table 1 presents a summary of the primary descriptive statistics of interest in the current investigation, including the mean, standard deviation, minimum, and maximum values.

Table 1: Key Descriptive Statistics on Study Variables (All Countries in the Panel)

Variable	Mean	Std. Dev.	Min.	Max.
Manufacturing Sector Output, Value added (MSY)(Current US\$)	2.38E+09	2.36+09	8.66E+07	7.92E+09
Gross Capital Formation (GCF) (Current US\$)	5.69E+09	6.43E+09	2.42E+07	2.56E+10
Labour force, total (LBF) (count)	1.20e+07	7436246	2700000	2.80e+07
Domestic Credit to private sector by banks (DOMCRED) (% of GDP)	16.11527	7.572301	0.0074246	36.64775
Foreign Direct Investment, net inflows (FDI) (% of GDP)	2.020219	1.6479	-0.0013049	6.65660
Inflation, GDP deflator (INF) (annual %)	8.271441	9.971017	-5.230474	85.35327
Trade openness (TRADEOPEN) (current account balance as a% of GDP)	-6.536008	4.061637	-16.0907	0.88845
Lending interest rate (LRATE) (%) Financial deepening(FINDEEP)(M ₂ /GDP)	17.03394	2.859849	11.9958	26.16010
	262.2414	210.9095	24.27797	962.0181

Source: Author's Compilation

The descriptive statistics in Table 1 indicate that for all the five EAC countries studied, on average, the manufacturing sector contributed \$2.38 billion to their total GDP over the study period 2000-2020, with a minimum contribution of approximately \$86.6 million and the maximum contribution of approximately \$7.9 billion. Analysis of raw data reveals that the minimum contribution of the manufacturing sector output to total GDP was recorded in Burundi in the year 2003 while the maximum was recorded in Kenya in the year 2019. The descriptive statistics indicate gross fixed capital formation for all the five EAC member countries averaged \$5.69 billion over the study period 2000-2020 with a minimum of approximately \$24. 2 million which was recorded in Burundi in the year 2000 according to raw data analysis and the maximum of approximately \$25. 6 billion which was recorded in Tanzania in the year 2020.

Over the course of the study period, the average labor force across the five member states of the East African community was found to be 12 million individuals. Notably, the lowest labor force was observed in Burundi in the year 2000, with a recorded minimum of 2.7 million individuals. Conversely, the highest labor force was observed in Tanzania in the year 2020, with a recorded maximum of 28 million individuals. Over the study period, the mean value of domestic credit to the private sector by banks as a percentage of GDP for the five EACs was approximately 16 percent. The minimum value, which was registered in Tanzania in 2005, was approximately 0.007 percent, while the maximum value, which was registered in Kenya in 2015, was approximately 36.6 percent. Over the course of the study period, the five member states of the East African Community experienced an average of approximately 2 percent in FDI (net inflows) as a percentage of GDP. Burundi recorded the lowest percentage at approximately -0.001 percent in 2001, while Uganda recorded the highest percentage at approximately 6.7 percent in 2007. Over the course of the study period, the mean inflation rate (as measured by the GDP deflator) among the five member states of the East African community was approximately 8.3 percent. The lowest recorded inflation rate was approximately -5.2 percent, observed in Rwanda in 2002, while the

highest recorded inflation rate was approximately 85.4 percent, observed in Uganda in 2009. On average, trade openness, as measured by the current account balance as a percentage of GDP, was around -6.5%. The lowest value of approximately -16% was observed in Burundi in 2008, while the highest value of approximately 0.89% was recorded in Kenya in 2003. Over the course of the study period, the five East African countries exhibited an average lending interest rate of roughly 17 percent. Notably, Kenya recorded the lowest lending interest rate of approximately 12 percent in 2020, while Uganda registered the highest lending interest rate of approximately 26.1 percent in 2012. Table 1 presents the descriptive statistics of the financial deepening variable (M2/GDP) for the five EACs during the study period. The average financial deepening value was \$262. The minimum financial deepening value was observed in Kenya in 2007, with a value of \$24. The maximum financial deepening value was recorded in Burundi in 2020, with a value of approximately \$262.

Multicollinearity Checks

The current study entails conducting a preliminary diagnostic procedure of multicollinearity assessment prior to estimation. The process involves the computation of a correlation matrix comprising the pairwise correlation coefficients among the independent variables in the empirical model. The production of the correlation matrix is based on the use of transformed variables, when appropriate, in the empirical model. Table 2 displays the correlation matrix.

Table 2: A Correlation Matrix of the Explanatory Variables (Correlation Coefficients, Figures in Parentheses Are Probability Values)

Explanatory Variable	1	2	3	4	5	6	7	8
Natural logarithm of gross capital formation (LNGCF)	1							
Natural logarithm of labour force (LNLBF)	0.9321*** (0.0000)	1						
Domestic Credit to private sector (DOMCRED)	0.1588 (0.1057)	0.1217 (0.2163)	1					
Foreign Direct Investment (FDI)	0.4296*** (0.0000)	0.3574*** (0.2163)	-0.4181*** (0.0000)	1				
Inflation (INF)	-0.0935 (0.3429)	-0.0872 (0.3762)	-0.0597 (0.5454)	-0.0296 (0.7646)	1			
Trade openness (TRADEOPEN)	0.1397 (0.1817)	0.3359*** (0.0010)	-0.1089 (0.2987)	-0.0402 (0.7018)	0.0077 (0.9415)	1		
Lending interest rate(LRATE)	0.0862 (0.3818)	0.0443 (0.6536)	-0.3802*** (0.0001)	0.3565*** (0.0002)	-0.0281 (0.7757)	0.2515** (0.0150)	1	
Financial deepening(FINDEEP)	0.0321 (0.7448)	0.0295 (0.7649)	-0.3341*** (0.0005)	0.1997* (0.0411)	-0.1011 (0.3050)	-0.2154* (0.0382)	0.2652*** (0.0063)	1

Source: Author's Compilation

1= Natural logarithm of gross capital formation; 2= Natural logarithm of labour force; 3= Domestic Credit to private sector; 4= Foreign Direct Investment; 5=Inflation; 6= Trade openness; 7= Lending interest rate; Financial deepening. *, ** &*** denote significance at 10%, 5% and 1% levels respectively.

Table 2 presents the estimated pairwise correlation coefficients among the explanatory variables in the model being analyzed. Most of the coefficients are situated within the desirable range, except for the variables LNGCF and LNLBF. The correlation coefficient between these two variables is 0.9321, which is statistically significant. The results indicate a significant level of collinearity among the independent variables of the natural logarithm of gross capital formation and the natural logarithm of the labor force. The results indicate that the inclusion of both explanatory variables may lead to redundancy in the model, which can cause an increase in multicollinearity levels during the regression analysis. The research revealed that the gross capital formation variable demonstrated a more robust positive association with the dependent variable in comparison to the labor force variable. Consequently, the ultimate empirical model utilized for analysis did not incorporate the labor force variable.

Unit Root Tests on All Model Variables

Given that our panel data has time dimension greater than cross-section dimension and it is not strongly balanced, we implement the Fisher-type (Choi, 2001) panel unit root test procedure on model variables which is appropriate under such conditions. Table 3 shows a summary of panel unit root tests on all model variables.

Table 3: Unit Root Test Results on All Model Variables

(Figures in parentheses are probability values of the corresponding estimated statistics)

Variable Name	Estimated Statistic (Variable in Levels)				Estimated Statistic (Variable in first difference)				Integ · Order
	P:	Z:	L:	Pm:	P:	Z:	L:	Pm:	
LNMSY	5.3221 (0.8687)	0.9945 (0.8400)	0.9207 (0.8176)	-1.0460 (0.8522)	29.4462* ** (0.0011)	- 3.4254* ** (0.0003)	- 3.5647* ** (0.0006)	4.3483*** (0.0000)	I (1)
LNGCF	9.0002 (0.5321)	-0.3086 (0.3788)	-0.2918 (0.3863)	-0.2236 (0.5885)	29.9281* ** (0.0009)	3.4719* ** (0.0003)	3.6250* ** (0.0005)	4.4561*** (0.0000)	I (1)
DOMCRED	8.9193 (0.5398)	0.4142 (0.6606)	0.5420 (0.7040)	-0.2416 (0.5955)	56.2442* ** (0.0000)	- 5.8304* ** (0.0000)	- 7.0438* ** (0.0000)	10.3405*** (0.0000)	I (1)
FDI	17.8134* (0.0582)	- 1.7015* * (0.0444)	1.7041* * (0.0495)	1.7471 (0.0403)	-	-	-	-	I (0)
INF	38.7215* ** (0.0000)	- 3.7365* ** (0.0001)	- 4.5131* ** (0.0000)	6.4223* ** (0.0000)	-	-	-	-	I (0)
TRADEOPEN	50.71810 (0.8384)	0.5557 (0.7108)	0.5077 (0.6923)	-0.9575 (0.8308)	40.8373* ** (0.0000)	- 4.5236* ** (0.0000)	- 5.0521* ** (0.0000)	6.8954*** (0.0000)	I (1)
LRATE	30.6792* ** (0.0007)	- 2.5418* ** (0.0055)	- 3.2985* ** (0.0013)	4.6240* ** (0.0000)	-	-	-	-	I (0)
FINDEEP	00.9383 (0.9999)	3.5413 (0.9998)	3.9355 (0.9997)	-2.0263 (0.9786)	31.6674* ** (0.0000)	- 2.4042* ** (0.0000)	- 3.1251* ** (0.0000)	4.8450*** (0.0000)	I (1)

Source: Author's Compilation

P=Inverse Chi-square statistic; Z: Inverse normal statistic; L=Inverse Logit t-statistic; Pm=Modified Inverse Chi-square statistic. *, ** &*** indicate significance at 10%, 5% and 1% levels respectively.

Table 3 presents the outcomes of the unit root test, indicating that the four statistics obtained from the Fisher unit root test dismiss the null hypothesis of non-stationarity for the variables LNMSY, LNGCF, DOMCRED, TRADEOPEN, and FINDEEP when analyzed in levels. However, these same four test statistics do not dismiss the null hypothesis of non-stationarity for these variables when analyzed in their first difference at a 5 percent level of significance. The aforementioned variables, namely LNMSY, LNGCF, DOMCRED, TRADEOPEN, and FINDEEP, exhibit integration of order one, I (1). Conversely, as presented in Table 3, the outcomes of the unit root test indicate that the four estimated statistics derived from the Fisher unit root test do not refute the null hypothesis that the variables FDI, INF, and LRATE are stationary in levels at a significance level of 5 percent. The aforementioned statement implies that the variables FDI, INF,

and LRATE exhibit an integration order of zero, denoted as $I(0)$. The outcomes of the panel unit root test suggest that the levels of integration of the variables in the empirical model are varied.

Cointegration Test Results

This study implements the Johansen-Fisher cointegration test which is appropriate when variables in the model have mixed orders of integration. Indeed, the unit root test results indicated that the model variables are integrated of different orders. Table 4 shows a summary of the cointegration test results.

Table 4: The Johansen-Fisher Cointegration Test Results (The Test Assumes a Linear Deterministic Trend)

Hypothesized No. of CE(s)	Fisher Stat. ^a (from trace test)	Prob.	Fisher Stat. ^a (from max-eigen test)	Prob.
None	4.159	0.6552	4.159	0.6552
At most 1	4.159	0.6552	4.159	0.6552
At most 2	4.159	0.6552	4.159	0.6552
At most 3	0.012	0.9899	55.26***	0.0000
At most 4	0.012	0.9899	55.26***	0.0000
At most 5	55.26***	0.0000	55.26***	0.0000
At most 6	37.14***	0.0000	32.78***	0.0000
At most 7	15.27**	0.0183	15.27**	0.0183

Source: Author's Compilation

^aProbabilities are computed using asymptotic Chi-square distribution. *, ** & *** denote significance at 10%, 5% and 1% levels respectively.

The results of the Johansen-Fisher cointegration test, as displayed in Table 4, demonstrate that the null hypothesis of "at most 5" cointegrating equations is rejected at a 5 percent level of significance based on the Fisher statistics obtained from the trace test. The results of the cointegration analysis suggest that there are at least five cointegrating equations present in the empirical model, indicating the presence of cointegration among the variables included in the model. The analyzed panel model demonstrates enduring equilibrium relationships.

The primary objective of this study was not to examine the short-term and long-term relationships in the model, but rather to utilize an instrumental variable (IV) estimator to mitigate endogeneity bias in the analyzed model. The identification of cointegration within our model provides assurance against the potential for spurious estimates, even in the absence of variable differencing during the estimation process. Instead of utilizing cointegration regression estimation methods like panel vector error correction (PVECM), dynamic OLS (DOLS), or fully modified OLS (FMOLS), the study employs the Arellano and Bond (1991) first differenced generalized method of moments (D-GMM) estimator. This estimator employs instrumental variables and accounts for unobserved country-specific effects, measurement error, and endogeneity of regressors. The D-GMM method was selected for our study due to the potential endogeneity of the gross capital formation variable. Empirical research has reported this variable to be an endogenous regressor in a growth function, as evidenced by studies conducted by Ongo and Vukenkeng (2014), Nweke, Odo, and Anoke

(2017), Onwiodiokit and Otolorin (2021), among others. Additionally, foreign direct investment is believed to have a simultaneity relationship with manufacturing sector output.

Regression Estimates

The study implemented the first difference D-GMM estimator to remove the individual country specific unobserved effect and the endogeneity bias arising of the variables “LNGCF” and “FDI” which are suspected to be endogenous explanatory variables in the regression. In the D-GMM estimation of the empirical model, the explanatory variable “LNLBF” is excluded because it was found to be highly linearly correlated with “LNGCF”. Table 5 shows the summary of the regression estimates together with the post-estimation diagnostic test results.

Table 5: The Regression Estimates from D-GMM Estimation

Dependent variable: Natural logarithm of manufacturing sector output (LNMSY)			
Independent variable	Coef.	Std. Err.	Prob.
One-period lagged natural logarithm of manufacturing sector output (LNMSY)t-1	0.8697***	0.031039	0.000
Natural logarithm of gross capital formation (LNGCF)	0.1140***	0.019778	0.000
Domestic Credit to private sector by banks (DOMCRED) (% of GDP)	-0.0004	0.0030657	0.897
Foreign Direct Investment, net inflows (FDI) (% of GDP)	0.0111**	0.004999	0.026
Inflation, GDP deflator (INF) (annual %)	-0.0125***	0.0015476	0.000
Trade openness (TRADEOPEN) (current account balance as a% of GDP)	0.0086***	0.001607	0.000
Lending interest rate (LRATE) (%)	-0.0051**	0.002390	0.032
Financial deepening(FINDEEP)(M2/GDP)	0.0001	0.000117	0.271
Constant	0.3200	0.543378	0.556

Instrumentization

Instrumented variables: Lngcf, fdi

GMM-type Instruments for 1st difference eq.: Lnmsyt-1, domcred t-1, Inft-1, tradeopen t-1, Lrate t-1,findeep t-1,

Standard Instruments for 1st difference eq.: Δ domcred, Δ Inft-1, Δ tradeopen, Δ Lrate, Δ findeep

Instruments for level equation: constant

Post-estimation Diagnostics

Wald Chi-sq. test for Ho: All slope coefficients are simultaneously zero: $p > \chi\text{-sq.} = 0.000$

Arellano-Bond test for Ho: No AR(1) in first difference errors: $p > Z = 0.0845$

Arellano-Bond test for Ho: No AR(2) in first difference errors: $p > Z = 0.1321$

Jarque-Bera normality of residuals test for Ho: Normally distributed residuals: $p > \chi\text{-sq.} = 0.0840$

Sargan test of overidentifying restrictions for Ho: instruments are jointly valid: $p > \chi\text{-sq.} = 0.5020$

The Hausman specification test for Ho: The difference in coefficients between the D-GMM estimator and the OLS is not systematic: $p > \chi\text{-sq.} = 0.0000$

Source: Authors Compilation after D-GMM Estimation

& * indicate significance at 5% and 1% levels respectively.

Diagnostic Test Results

The statistical significance of the model is supported by the rejection of the null hypothesis, as indicated by the Wald Chi-square statistic with a p-value below the predetermined alpha level of 0.05. This implies that the entire model exhibits statistical significance. The p-values of the estimated Z-statistics obtained from the Arellano-Bond test for AR (1) and AR (2) fail to reject the null hypothesis of no first and second order serial correlation, as they exceed the predetermined significance level of 0.05.

Discussion of the Regression Estimates: The Effect of Productivity Factors on Growth in Manufacturing Sector Output

The Effect of Foreign Direct Investment on the Manufacturing Sector Growth in the EAC Member Countries

As per the regression estimates outlined in Table 5, it can be observed that the partial slope coefficient for the foreign direct investment variable displays a positive trend and is statistically significant at the 5 percent level (Coef. = 0.0111, $p < 0.05$). The results suggest that the manufacturing sector output growth in East African Community member countries is significantly positively influenced by foreign direct investment. The results indicate that the manufacturing sector output of East African Community member states can be increased by attracting more foreign direct investments. Several scholarly investigations have documented the positive influence of foreign direct investment on the expansion of the manufacturing industry. Several researchers have conducted studies on this topic, including Duramany-Lakkoh et al. (2021), Opoku and Boachie (2020), Azolibe (2020), Obi-Nwosu and Ibenta (2019), and Idoko and Taiga (2018). The findings of the current study are inconsistent with the research carried out by Samantha and Liu (2018), which demonstrated an insignificant influence of foreign direct investment (FDI) on industrial growth in Sri Lanka. The research conducted by Masron and Hassan (2016) suggests that the positive externalities resulting from foreign direct investment (FDI) in different sectors of Malaysian manufacturing subsectors cannot be guaranteed. Furthermore, the research conducted by Afamefuna and colleagues (2019) revealed a lack of significant long-term association between foreign direct investment (FDI) and the growth of manufacturing sector output in Nigeria.

Impact of Inflation on the Growth of the Manufacturing Sector in the East African Community (Eac) Member Countries

The results of this study suggest that the inflation variable has a statistically significant negative partial slope coefficient (Coef. = -0.0125; $p < 0.05$). It is our contention that the aforementioned outcome is theoretically feasible. The escalation of prices has been linked to adverse impacts on the expansion of output, as it can distort business plans, disrupt the flow of investments, and undermine the fundamental value of currency (Hodge, 2006; Amata et al., 2016). The present study's results are consistent with those reported by various authors in the empirical literature pertaining to the relevant subject matter, including Oduor et al. (2021), Chaudhry (2021), Bans-Akutey et al. (2016), Judith and Chijindu (2016), Shabbaz et al. (2019), Adaramola and Dada (2020), Babasanya et al. (2020), and Sade et al. (2021). Ali and Ibrahim (2018) reported a finding that differs from our study on the causal impact of inflation on industrial output growth. Their research discovered a positive correlation between inflation and growth in the manufacturing sector among Malaysian manufacturing companies.

Impact of Trade Openness on the Growth of the Manufacturing Sector in the Member Countries of the East African Community (EAC)

The findings of this investigation, as presented in Tables 5, reveal that the model's estimates demonstrate a noteworthy and affirmative partial slope coefficient on the trade openness variable (Coef. = 0.0086; $p < 0.05$). The findings indicate that trade openness serves as a significant predictor for the growth of manufacturing sector output in the member states of the East Africa community. The findings suggest that heightened involvement in global trade can potentially bolster the manufacturing sector output growth of member states within the East African community. The augmentation of cross-border trade, specifically through amplified exports, has the potential to serve as a substantial catalyst for the expansion of the manufacturing sector in the member states of the East African community. The existing empirical literature presents varying results regarding the causality between trade openness and the growth of output in the manufacturing sector. Our research aligns with the results of other relevant studies, such as those conducted by Shahbaz et al. (2019), Khobai and Moyo (2021), and Pan et al. (2019), among others. Sade et al. (2021) have reported certain findings indicating that there exists no causal relationship between trade openness and the growth of the manufacturing sector in a sample of 12 West African countries. Several authors have reported findings that contradict our own on the subject of study. For example, Su, Nguyen, and Christophe (2019) have reported differing results. A study was conducted by Fongang, Kamdem, and Tambo in 2017 to investigate the correlation between trade openness and the expansion of manufacturing sector output across multiple nations. Their findings revealed varying results.

Relationship between Financial Deepening and the Growth of the Manufacturing Sector in Member Countries of the East African Community (EAC)

The findings of this study, as presented in Table 5, indicate that the financial deepening variable does not have a significant impact on the growth of the manufacturing sector in the member states of the East Africa community. The statistical analysis reveals that the financial deepening variable's estimated partial slope coefficient has a probability value exceeding the predetermined significance level of 0.05 (Coefficient = 0.0001, $p > 0.05$). The findings of our study indicate that financial deepening does not possess the capacity to elucidate fluctuations in the growth of manufacturing sector output across the member nations of East Africa. Despite the positive sign on the estimated coefficient of the financial dependent variable, its lack of significance results in a deviation from the conclusions of previous studies on the subject. For instance, Asaleye, Adama, and Ogunjobi (2018), Kayodeo, Ibenta, and Owoputi (2020), and Ademola and Marshal (2018) found a significant and positive impact of financial deepening on industrial growth. Previous studies have reported a reciprocal relationship between financial deepening and growth in the manufacturing sector. This is exemplified by the research conducted by Mbah and Okoli (2020).

The Effect of Lending Interest Rates on the Manufacturing Sector Growth in the EAC Member Countries

The findings of our study suggest that there exists a significant and negative causal relationship between the lending interest rate and the growth of manufacturing sector output within the member countries of the East African Community. The presence of a statistically significant negative sign on the estimated partial slope coefficient of the lending interest rate variable, as shown in Table (Coef. = -0.0051, $p < 0.05$), indicates that the aforementioned variable has a significant impact on the outcome. It is our contention that the aforementioned estimation holds theoretical validity, as interest rates serve as a metric for the expense incurred in procuring capital for investment purposes. Elevated lending interest rates are indicative of augmented borrowing expenses, resulting in a reduction of investments intended for the purpose of expanding production. Several scholars in the field have documented the adverse impact of lending interest rates on the expansion of the manufacturing industry. Notable examples include the research conducted by Akpan, Yilkudi, and Opiah (2016), Sakanko and Maria (2017), and Thomas and Olaitan (2020), among others.

The Effect of Domestic Credit on the Manufacturing Sector Growth in the EAC Member Countries

The findings of the study indicate that the model's outcomes, as displayed in Table 5, demonstrated a partial slope coefficient on the domestic credit variable that exhibited both negative and statistically insignificant values (Coef. = -0.0004, $p > 0.05$). The absence of statistical significance in the estimates suggests that the domestic credit variable lacks the ability to influence the growth of manufacturing sector output in the countries that are part of the East African community. The observation of an unanticipated negative sign in the estimation is significant. There is a contention that the emergence of a negative sign could be attributed to the structural relationships that exist between lending interest rates and the growth of manufacturing sector output. Prior studies have demonstrated a noteworthy adverse causal impact of loan interest rates on the expansion of manufacturing sector production, as well as on the domestic credit extended to the private sector by commercial banking institutions. The lending interest rate functions as a channel for facilitating private sector credit. A rise in interest rates could have a negative effect on the amount of credit provided to the private sector through loan disbursements. Thus, it can be inferred that domestic credit may serve as an intermediary variable in facilitating the growth of the manufacturing sector's production. Nevertheless, it does not function as a direct determinant, as demonstrated by the negative value of its estimated coefficient, which is also considered statistically insignificant. The findings of our investigation exhibit incongruity with the outcomes reported by some researchers in analogous studies. The findings of the current study contradict the assertions made by Nwabuisi et al. (2020) regarding the considerable favorable influence of domestic credit on the efficacy of Nigeria's manufacturing industry. Additionally, the results are inconsistent with the research conducted by Muchingami, Monametsi, and Paradza (2017), which established a positive association between commercial bank loans and Zimbabwe's manufacturing production.

Our investigation has produced significant results that merit further examination, in conjunction with the influence of productivity-related variables. According to the results of the study, it can be inferred that the partial slope coefficient estimated at a 5 percent level for the natural logarithm of gross fixed capital formation is positive and statistically significant. The aforementioned observation suggests that there exists a noteworthy favorable influence of gross capital formation on the expansion of manufacturing sector yield in countries that are members of the East African Community. The variable "gross capital fixed capital formation" has been frequently utilized as a substitute for private sector investments in various instances of applied research. The study's results suggest that enhancing private sector investment and augmenting foreign direct investment can enhance the manufacturing sector's output in the East African Community's member states

5.0 CONCLUSION AND RECOMMENDATIONS

Conclusion

The objective of this research was to examine the primary productivity factors that could potentially augment the expansion of the manufacturing industry's output in the EAC member states during the period of investigation spanning from 2000 to 2020. The examination is conducted using the endogenous growth theory framework. This research examined the impact of six distinct productivity factors, specifically foreign direct investment, inflation, trade openness, financial deepening, lending interest rates, and domestic credit to the private sector by banks. The study examined various productivity variables and found that foreign direct investment, inflation, trade openness, and lending interest rates are the most significant factors that impact the growth of manufacturing sector output within the member states of the EAC. The study found that there was no significant impact of financial deepening and domestic credit to the private sector by banks on the growth of manufacturing sector output in the member states of the EAC. The findings of our research demonstrate that the increase in manufacturing sector output among member states of the East African community can be effectively examined through the lens of the endogenous growth theory. This suggests that the theory holds significant value in the context of empirical growth studies.

Policy Implications

Results from this study point to four key policy implications: (i) East African community member countries can enhance on their manufacturing sector output capacity by attracting more foreign direct investors, (ii) It is prudent for the East African community member countries to maintain low levels of inflation in order to create a conducive environment for the manufacturing sector to thrive, (iii) Increased cross-border trade for instance through removing tariff barriers by the member countries and putting in place initiatives to create exports business hubs in foreign nations by the member countries seems a lucrative policy option for increased manufacturing sector growth within the East African community member countries, and (iv) Enacting policies to reduce costs of accessing credit may be a prudent policy variable in favour of manufacturing sector growth within the East African community member countries.

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