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Macroeconomic determinants of value addition in the manufacturing sector in Zambia

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Abstract: Zambia is one among many African countries which has not experienced sustained high economic growth in the recent years despite having previously transitioned from stereo-typical agriculture to manufacturing. Thus, this study sets out to understand the macroeconomic drivers of manufacturing value-addition gains and estimated macro-economic determinants of value addition in the manufacturing sector in Zambia. The study adopts the secondary time series data for the period 1984 to 2021.

Manufacturing value-addition was regressed on several macroeconomic variables to help understand by how much the manufacturing value addition tends to change with others which were identified as potential drivers of output growth in the manufacturing sector. These include gross domestic product (GDP) per capita, foreign direct investment (FDI), manufacturing exports, manufacturing imports, real interest rates, money supply and population. The data was first tested for stationarity using Augmented Dickey Fuller (ADF) test. The Granger Causality test was adopted as a theoretical framework for this analysis as more than two variables were adopted for the study. The Johansen co-integration test is used to ascertain the long-run relationship between the established variables. The findings of the study show that FDI boosts Zambian manufacturing value-added that increases the GDP per capita and showed the importance of manufacturing exports in driving manufacturing value-added in Zambia. Further, the study showed that net exports are long-term drivers of output growth in the manufacturing sector showing the existence of a unique long-run relationship between manufacturing value addition and the real interest rate. The constraints of this investigation primarily stemmed from the insufficiency of data points, preventing the inclusion of additional variables like private sector credit, which the researcher found pertinent. In addition, the study's results provide robust evidence of the unique long-run relationships between Manufacturing Value Added (MVA) and Foreign Direct Investment (FDI), GDP per capita, Manufactured export (manu_export), and Real Interest Rate (RIR) in Zambia. This study revealed strong, long-term connections between factors like foreign investment and exports, and Zambia's manufacturing sector growth. These insights can guide policymakers in developing strategies to ensure the industry's sustainable development. Notably, manufactured exports show a positive long-term impact, but a short-term dip, highlighting the dynamic nature of this relationship. Overall, the study offers valuable considerations for decision-making and future policies affecting manufacturing value-added in Zambia.

Keywords: Manufacturing Value Addition, GDP per Capita, manufacturing exports, Real Interest Rate, Economic Growth.

1. Introduction

Macroeconomic considerations have a significant impact on the manufacturing sector of the economy, and they influence business performance. Social, environmental, and political situations and government rules and policies are examples of macroeconomic elements that exist outside the organization and are beyond management's control (Adidu & Olanye, 2006). The Consumer Price Index (CPI), unemployment, Gross Domestic Product (GDP), stock market index, inflation rate, exchange rate, corporation tax rate, and interest rates are all key economic elements that can have a favourable or negative impact on manufacturing enterprises' development and performance (Egbunike & Okerekeoti, 2018).

Further, Zambia has a dynamic and rapidly growing manufacturing sector that is largely driven by agro processing (food and beverages), textiles and leather subsectors, metal processing, and material production (cement, fertilizer, chemicals, explosives, among others (Zambia Development Agency (ZDA), 2019). According to the Central Statistical Office (2022) the manufacturing sector accounted for 10.5 percent of the country's GDP annual growth and accounted for only 3.8 percent of total employment. Most of the country's locally produced commodities are not exported but rather consumed domestically. This is a common phenomenon among Sub-Saharan countries. Zambia's total manufacturing sector exports averaged 2.1 percent between 2006 and 2010 (Dinha, 2013). Though this has been increasing in the recent past, there is a need to promote the exports of locally produced goods to diversify the economy and make it more robust to external shocks.

The manufacturing activities in Zambia are undertaken by the private sector with the government playing a proactive role in prompting a conducive environment for value addition in the manufacturing sector. The sector is key to the country's macroeconomic strategy for encouraging broad-based economic growth. Support this with evidence! In this regard, the Government has put in place measures to support manufacturing activities, such as the establishment of Multi-Facility Economic Zones (MFZS) and industrial parks. These are industrial areas/zones for both export and domestic-oriented industries, with the necessary support infrastructure installed, and provision of sector-specific investment incentives. The government also promotes small and medium enterprises in rural and urban areas to enhance labour-intensive light manufacturing activities in these areas.

According to the Ministry of National Development and Planning, the Zambian mining sector accounts for about 11% of the country's GDP (Uncenta, 2021). Because of this large share, policymakers have made repeated efforts to boost manufacturing value-added over the past (1984-2021) 37 years. For example, they put in place measures to support manufacturing activities, such as the establishment of the Multi-Facility Economic Zones (MFEZs) in Lusaka's South and Central provinces. This effort was set to jump-start Zambia's manufacturing value-addition sector. These zones were endowed with tax reductions and loans to establish plants and buy machinery at affordable and incentivised rated to promote the sector.

In addition to the above export zones, Industrial Parks with key support infrastructure installed were established for both export-oriented and domestic-oriented industries. The government also promoted and continues to promote Small and Medium Enterprises (SMEs) in rural and urban areas to enhance labour-intensive light manufacturing activities. Numerous tax havens offered by the Ministry of Finance to potential investors targeted at investing in manufacturing across all provinces of the nation. Most recently (year 2022), the government unveiled a proposed exemption of value-added manufacturers' exemption from import duty on raw materials that cannot be sourced locally in the proposed 2022 national budget. This will be supplemented by numerous other policy frameworks to protect the manufacturing sector threatened by potential macroeconomic shocks and instability of the global supply chain (Ministry of Commerce Trade and Industry, 2021).

Economists claim that changing the composition of GDP can result in long-term economic growth and higher earnings (Barr 2020, p. 110). Despite undergoing structural adjustment initiatives aimed at addressing the economic crisis that began in 1975, Zambia has not seen long-term development that spurred economic growth. However, the service sector has grown significantly, while the manufacturing sector's proportion has decreased.

Dependence on mining industries has resulted in times of boom and squalor dependent on the increase and fall of copper prices, rather than sustainable long-term prosperity. This has been compounded by unstable agricultural operations with a propensity to increase and decline during periods of busts and booms (Rodrick, 2013), causing a structural change that reduces growth. This is slow growth is attributed to Zambia's agriculture industry that remain largely labour-intensive and uses little technology.

Given the prominence that the manufacturing sector has been accorded in Zambia`s development effort, its sluggish growth in the last few years is a matter of concern. This mixed record stems from several factors including the international environment, the local policy frameworks, and the country's

macroeconomic situation. In Zambia, manufacturing output growth has occasionally been linked with the unstable macro-economic environment, the policy framework, and other variables but rarely in any detailed or explicit fashion. The unclear understanding of the country's economic performance is characterised by lack of empirical evidence that support the claims of Zambia's success and failure.
According to the World Bank (2022), Zambia's GDP growth rate was 3.3% in 2021, while the Manufacturing value added shrunk by almost 3.9%. While this can be attributed to the COVID-19 pandemic, this trend has been persistent even prior, with the pandemic compounding its effects. In 2019, Zambia's GDP was projected to grow by 3%, while the manufacturing value-added growth rate shrunk by 1% (African Development Bank Group, 2023).
The whole process of determination, the relative contribution of the factors, and their magnitudes are not quite known and hence, the information gap that needs to be filled. The present analysis is an attempt to estimate the macroeconomic determinants of value addition in the manufacturing sector in Zambia. An understanding of such factors is important to promote faster growth of the sector.
Understanding what influences the growth of this cardinal industry and how it is affected by those variables is fundamental to developing impactful policies that boost Zambia's economic performance while also alleviating the effects of macroeconomic underperformance. Understanding its influencing factors will give the federal government a better grasp of policy reform that will reverberate throughout Zambia's varying industries. This policy reformation will see growth in real sectors, contributing positively to Zambia's goal of overall long-term growth in all sectors.
Additionally, this study provides empirical support for informed decision-making for individuals and organizations looking to invest in the manufacturing industry. This will allow for more efficient planning and will encourage more long-term FDI and domestic investment.

Overall Objective

The analysis attempts to estimate the macroeconomic determinants of value addition in the manufacturing sector in Zambia using the trend analysis.

Specific Objectives

To accomplish the overall objective of this research, the researcher explored the following specific objectives as its basis:

a) To assess the nexus that exist between foreign direct investment and manufacturing value-added in Zambia.
b) To examine the link between GDPs per capita and manufacturing sector value-addition performance in Zambia
c) To assess the gaps and draw emerging learning grounded on the theoretical framework to inform FDI that will spur economic growth in Zambia.

2. Materials and Methods

Using time series data from the World Bank, Bank of Zambia, and World Development Indicators, the study used a quantitative research design to investigate the macroeconomic drivers of value addition in Zambia's manufacturing sector. The researcher used the annual secondary time series data spanning from 1984 to 2021. The manufacturing value added, foreign direct investment, broad money, employment in the sector, GDP per capita, population, import and export of manufactured goods, inflation, and real interest rate were all covered by this data. Time series is a series of observations, observed over a period of time on an interval or at fixed time points (Rao, 2022).

The Econometric Model

Econometric models are based on economic theories that assume optimizing behaviour on the part of economic agents. These models where founded by Ragnar Frisch, he pioneered econometrics, which applies mathematical models and statistical methods to economic data, and coined many other economics terms (Chipman, 1999., pp. 58–108: Britannica, 2024). Econometric models are constructed from economic data with the aid of the techniques of statistical inference (Slade & Weiner, 1993). The review of theoretical and empirical literature proposed will prompt the selection of variables and justify the econometric model and methods used. In view of this, macro-economic determinants of value addition in the manufacturing sector will be modelled using the Foreign Direct Investment, Broad money, Employment in the industry, GDP per capita, Population, export of manufactures, import of manufactures, Inflation and Real Interest rate based on the literature.

$$lnMVA_i = \beta_0 + \beta_1(fdi)_i + \beta_2\ ln(M\ )_i + \beta_3(inf\ )_i + \beta_4\ln\ (gdppc)_i + \beta_5(riri + \beta_6 ln(m\_exp\ )_i + \beta_7 ln(m\_imp\ )_i + \varepsilon_t \quad \ldots 1$$

The model used in this study is a variant of the model by Adebisi and Olawale (2018, P. 246-258) who used the vector error correction model (VECM) techniques to analyse the macroeconomic determinants of growth on the manufacturing output in Nigeria.

$$\Delta y_t = \sigma + \sum_{i=1}^{k-1} \gamma_i \Delta y_{t-i} + \sum_{j=1}^{k-1} \eta_j \Delta X_{t-j} + \sum_{m=1}^{k-1} \xi_m \Delta R_{t-m} + \lambda ECT_{t-1} + \mu_t \dots .2$$

Where

$k - 1$ = the lag length is reduced by 1

γ, η_j, ξ_m =short run dynamic coefficient of the mode's adjustment long-run equilibrium

λ=speed of adjustment parameter with negative sign

ECT_{t-1}=the error correction term is lagged valued of the residuals obtained from the cointegrating regression of the dependent variable on the regressors. Contains long-run information derived from the long-run cointegrating relationship.

μ_t=residuals (stochastic error terms often called impulse or innovations or shock.

According to Rasheed (2010) the vector error correction model (VECM) can be used to analyse macroeconomic growth determinants on manufacturing output. Hence. the model for this study was specified as:

$$\Delta LMVA_t = \beta_0 + \beta_1 \Delta LMVA_{t-1} + \beta_2 \Delta FDI_{t-1} + \beta_3 \Delta GDPPC_{t-1} + \beta_4 \Delta M_{t-1} + \beta_5 \Delta RIR_{t-1} + \beta_6 \Delta INF_{t-1} + \beta_7 \Delta POP_{t-1} + \beta_8 \Delta MANU\ EXPORT_{t-1} + \beta_9 \Delta MANU\ IMPORT_{t-1} + \lambda ECT_{t-1} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots 3$$

Data Processing and Analysis

This study used Stata to organize the data and carry out economic modelling to achieve the objective of this study. The analysis begun by carrying out a univariate analysis of the variables to analyse the data by use of descriptive statistics. The study then proceeded to estimate the model and did the standard diagnostic tests which include the test for spatial autocorrelation and heteroscedasticity within the model by use of the Breusch-Pagan Godfrey test respective.

Data Sources and The Econometric Technique

The World Bank (WB) and World Development Indicators (WDIs) are reputable sources of economic and development data serving as reliable source of valuable data for economic analysis and development research. The data sources used by the WB and the WDI are diverse and include national statistical agencies, international organisations, and other reputable sources. A study by Okoli and Agu. (2015) published in the International Journal of Economics, Commerce and Management analysed the use of data sources in development research. The study highlighted the World Bank as one of the primary sources of development data, emphasizing its importance in empirical research and policy analysis.

This research utilised secondary data from the WB, Bank of Zambia and WDIs. The annually secondary time series data from 1984 to 2021 were used in this study from WB and WDIs.

Stationarity Test

Economic modelling using time series data attempt to quantify the historical relationships amongst variables of interest, which is used to forecast the future. However, it must be noted that in the instances where economic fundamentals change significantly, then the historical relationships may not precisely be used for forecasting the future without the great caution. Hence, it is important that time series variables follow at least a stochastic process and satisfies the condition of stationarity.

Non-stationary series refers to the times series data that have means and variances that are not statistically constant overtime. This implies that non-stationary series have a varying means and variances at different points in time. If a series is differenced p times to become stationary, then it is said to be integrated of order p, denoted I(p). In the study, the Augmented Dickey Fuller and Phillips Perron tests were used to determine the stationarity condition of the four variables of interest under the null hypothesis that there is a unit root in the series. The Phillips Perron tests are tests that are used to determine if a variable has a unit root. These two tests were used because they satisfy the conditions under this study.

Testing for Lag Structure

One of the challenges in specifying an optimal lag length (ρ) for a model is that if the chosen lag length is too small, it is possible the model may be mis-specified due to the omission of relevant variables and if too large, it is possible the number of degrees of freedom may be lost. In other words, a model with relatively large number of lags is most likely to produce residuals that approach the white noise process but might not be parsimonious. On the other hand, a model with smaller lag lengths is more likely to be parsimonious but might not produce residuals that are random enough to approach a white noise process. White noise process is a time series model which is weakly stationary with no pattern, just random variation (noise), and all frequencies are equally represented (white), sending and receiving signals on noisy channels (process) is known as white noise process. In time series analysis, a sequence of independent identically distributed (IID), normal random variables with mean zero and variance σ 2 is known as Gaussian white noise (Moffat and Akpan, 2019). A process is called a white noise process if it is a sequence of uncorrelated random variables from a fixed distribution with constant mean, usually assumed to be zero, constant variance (Moffat and Akpan, 2019).

The above problem implies that there will be need to select an optimal lag length ρ which mitigate for the two extreme situations. The most used criterion in literature to select the optimal lag lengths that produces errors that approach a white noise process, subject to the constraint that the smallest number of lag terms will be selected are the Schwartz Bayesian Information Criteria (SIC) and the Akaike Information Criteria (AIC).

Further, the Schwartz Bayesian Information Criterion (SBC) and Akaike Information Criterion (AIC) are statistical model selection methods in econometrics. They help researchers choose the best-fitting model for analysis from several candidates. The SBC penalizes models with a larger number of parameters. It aims to balance model complexity (number of parameters) and goodness-of-fit (data explanation). SBC prefers models with fewer parameters to avoid overfitting (Nkono and Uko, 2016).

Also, the SBC prefers models that explain data well with a manageable number of parameters, especially if you are considering many macroeconomic determinants. Avoiding overfitting your data set can improve generalizability and prevent misleading results.

Adding on, the AIC penalises models with more parameters, much like the SBC does. But compared to SBC, the punishment imposed by AIC is less severe. This implies that if a model provides a noticeably better fit to the data, the AIC may prefer models with a few extra parameters. If a researcher is unsure about the number of pertinent macroeconomic determinants in advance, the AIC may be a viable choice. If a few extra parameters really enhance the model fit, they may be able to evaluate models with a little less severe penalty by AIC (Nkono and Uko, 2016). This can be useful for investigating various theoretical connections and possibly locating significant elements that a more stringent model selection method would overlook. These approaches along with others were employed to determine the optimal lag length of variables for this study.

Diagnostic Tests

As Kraemer and Sonnberger (2012) assert that conventional regression output needs to be supplemented by several specification tests before interpretation and discussion. A series of tests were done in this study before interpretation and drawing conclusions. These included testing the residuals for normality, homoscedasticity, and autocorrelation.

The test for residuals for normality is a test that determines whether the regression model's residuals, or errors, have a normal distribution. For many statistical tests used in regression analysis, including confidence interval estimation and hypothesis testing, normality is an essential presumption. Results that deviate from normal can be unpredictable.

The widely used test for normalcy is the Shapiro-Wilk test (Shapiro & Wilk, 1965). To determine the probability of detecting the data under normalcy, it computes a p-value by comparing the observed residual distribution to a theoretical normal distribution.

Adding on, the assumption known as homoscedasticity states that the residuals' variance remains constant for all values of the independent variables. To put it another way, the residuals' "spread" should be constant across the data. Regression models with non-reliable standard errors and inefficient estimates can result from homoscedasticity, sometimes referred to as heteroscedasticity, being violated.

One often used test for homoscedasticity is the Breusch-Pagan test (Breusch & Pagan, 1979). The squared residuals and the independent variables are compared for statistical significance. The presence of heteroscedasticity is indicated if a substantial association is found.

Furthermore, the serial dependence between the residuals at various time lags (observations) is referred to as autocorrelation. Put more simply, it determines whether the inaccuracies from one observation are associated with the inaccuracies from earlier observations. Unreliable standard errors and skewed estimations of the regression coefficients might result from autocorrelation.

For first-order autocorrelation, the Durbin-Watson test (Durbin & Watson, 1950) is a popular test. It determines whether there is a statistically significant association between the lagged residuals (errors from the prior observation) and the residuals. Nonetheless, the Durbin-Watson test has its limitations. For a more comprehensive evaluation of autocorrelation at various delays, one may consider using alternative tests such as the Breusch-Godfrey LM test (Breusch, 1978).

Also, a test was carried out on coefficient in various models for their significance. Lastly, the Ramsey's Reset test and Stability tests for stability test were done. Ramsey's Reset Test (Ramsey, 1968) is a broad specification error test, in contrast to the earlier tests that concentrate on particular assumptions. It looks for non-linear correlations or pertinent variables that have been left out that could be influencing the residuals. The squares of the model's fitted values are added as regressors to the test. It indicates that there may have been misspecification in the model, such as missing variables or non-linear correlations, if these extra factors are statistically significant.

Granger Causality Test

Granger (1988) developed the concept of Granger Causality to describe the relationship between two variables. That is, whereas correlation indicates co-movement, Granger causality relays the predictive power of one time series for forecasting another time series variable. Variable X is said to Granger cause variable Y if the past of X advances the individual periods ahead of predictions of variable Y over and above the information included in the past of X. A multivariate Granger Causality test was suggested for this analysis as more than two variables were adopted for the study.

The Unit-Root Test for Stationarity

This is pre-estimation test that is done to ensure that the variance, mean, and covariance remain constant no matter the point of observation of the variable. Stationarity tests are conducted in isolation on each individual variable. For this study, the Augmented Dickey-Fuller (ADF) unit root test was conducted on each individual variable to ensure their Stationarity. To ascertain whether a variable has a unit root in time series analysis, the ADF test is a unit root test that is utilised. A non-stationary variable is one that does not exhibit a distinct trend (growing or decreasing) over time, but rather one whose past values can be used to forecast future values (Rodrik, 2013). Regression analysis might yield misleading results due to spurious regressions caused by non-stationary variables.

The ADF test for unit roots is used in the presence of unit roots in time series samples. The presence of unit roots hinders the assumption of Stationarity, meaning the model cannot make accurate predictions. Non-stationary data tends to produce unreliable, spurious results, leading to poor forecasting due to unstable track record due to unstable conditions.

The Johansen Co-Integration Test

The Johansen co-integration test formulated in 1988 by Søren Johansen and published as "Statistical analysis of cointegration vectors" (Johansen 1988), was used to ascertain the long-run relationship between the established variables. Nkono and Uko (2016), stated that it estimates the trace and maximal statistics eigenvalues, and the eigenvectors. The trace test and the maximal eigenvalue are used to determine the number of co-integrating vectors. In this case, an Ordinary Least Squares method cannot be used to determine data if the model is found to have a long-run relationship. The test is also important when determining if an Error Correction Model is necessary for the model.

Further, to find cointegration between variables, we can use the Johansen test. In short, cointegration indicates that, over the long term, independent variables are nonetheless related to one another and tend to move towards a stable equilibrium connection, despite the fact that individual variables may show trends or variations over time, meaning they are not stationary (Gujarati et al., 2012). To explain changes in value addition (manufacturing production), the researcher in this study used several macroeconomic variables. Long-term relationships between these variables and value addition may exist even though their annual trends may differ.

Moreover, to ascertain whether cointegration between value addition and macroeconomic factors occurs, a researcher can employ the Johansen test. In the long run, these variables may move together to impact value addition in Zambia even if there is no evidence of cointegration between them due to their distinct patterns.

The Autocorrelation Test

Autocorrelation is a measure of the degree of correlation between the values of the same variables across different observation in data (Gujurati, 2008). The presence of autocorrelation is a sign of dependent observations, risking the study yielding spurious results. To test for autocorrelation, the study used the Lagrange Multiplier test, whose null hypothesis assumes no autocorrelation at lag order (Barr, 2020).

The Eigenvalue Stability Condition

This condition measures the stability of the model, which implies Stationarity and that it will not diverge to infinity in the long run (Gujurati, Porter, & Gunasekar, 2012). The study adopted the eigenvalue stability condition for the examination of model stability. This condition is also used to test for structural breaks because unstable models are also prone to structural breaks. For any investigation, eigenvalue stability must be guaranteed. Unreliable and deceptive outcomes can be generated by an unstable model. Within an acceptable timescale, a researcher can be sure that the predictions made by their model are relevant by independently testing the stability requirement (Oduola et al., 2021). Analysing the long-term connections between macroeconomic factors and value addition requires this. Thus, this criterion has been used for the current investigation.

3. Results and Discussion

Descriptive Analysis

The descriptive analysis below shows the descriptive statistics output of all the variables studied in this paper, clearly showing the minimum, maximum, means, standard deviations and other statistical information. To get a better understanding of the distribution of the variables of interest to this study, other key statistics are also presented in table 4.1.

Table 1: Summary of descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Ske	kur
Log MVA	37	20.57684	0.634567	19.6146	21.4652	-0.27565	1.505815
GDP per capita	37	830.7853	538.7159	232.539	1878.35	0.578777	1.741014
Population	37	1.16E+07	3340426	6900000	1.80E+07	0.385004	1.982596
Broad money	37	20.97722	5.08515	13.56	32.85	0.848334	2.815291
Manu_export	37	7.275556	5.635046	0.15	16.79	0.003098	1.615393
Manu__import	37	72.685	5.29259	61.64	80.05	-0.61222	2.190947
Real interest rate	37	-0.22611	17.27129	-41.79	23.67	-0.89186	2.851391
Foreigndirect_inv	37	-6.0708	6.6108	-2.4809	1.4808	-1.4445	4.368631
Inflation	37	36.53694	44.56552	0.000	183.31	2.028286	6.323534

Source: Authors Computation, 2024

From table 1, the results showed that the averages as well as the variability in the data differ across variables. This considerable variation in all the variables translates into more efficient estimates. All variables had positive values except Foreign Direct Investment and Real Interest Rate which contained some negative values as seen by their minimum values. In addition, the skewness and kurtosis measures showed that most of the variables were not normally distributed in their levels. Thus, a transformation of the variables using the logarithmic transformation was done to improve their normality. The log transformation is often used to reduce the skewness of positively skewed variables. It can also be applied to variables with positive values.
The data show fluctuations in the variability among several variables as well as average values. This variety implies that every variable makes a unique contribution to the analysis and could influence value addition in Zambia in a different way. Further, the only two variables with negative values are real interest rate and foreign direct investment (FDI). This implies that on general, these variables have a favourable impact on adding value. These factors may occasionally have a negative impact, as indicated by the negative numbers for FDI and the Real Interest Rate.

Table 2: The results of Augmented Dickey and Phillips-perron

Test	Augmented Dickey-Fuller test			Phillips-Perron test statistic		
Variable	Level	1st Diff.	Lag	Level	1st Diff.	Bandwidth
			(SIC based)			
Log MVA	-1.22	-4.606***	0	-1.392	-4.629***	3
GDP per capita	-1.039	-4.982***	0	-1.142	-4.471***	3
Population	-0.368	-11.081***	0	2.479	-10.648***	3
Broad money	-1.958	-6.627***	0	-1.927	-6.527***	3
Manu_export	-1.818	-6.651***	0	-1.289	-6.24***	3
Manu__import	-2.61	-7.203***	0	-2.582	-7.265***	3
Real interest rate	-1.677	-6.798***	0	-1.844	-7.093***	3
Foreign direct_inv	-2.462	-6.664***	0	-2.528	-6.705***	3
Inflation	-2.194	-6.337***	0	-2.194	-6.337***	3

*Note: The asterisks *, ** and *** imply level of significance at 10%, 5% and 1% levels respectively.*
Source: Authors Computation, 2024

In table 2, all variables were non-stationary (had a unit root). After taking the first difference, the variables were stationary (without a unit root) at 5% significance. Each variable's Augmented Dicky-Fuller and Phillips-Perron test statistics are supplied before and after the first difference. The unit root null hypothesis (non-stationarity) cannot be rejected with a negative test statistic. Rejecting the null hypothesis implies series stationary. By using differencing to detect and correct non-stationarity, the researcher made sure their regression analysis was based on more trustworthy data. This enhanced

the validity of the hypothesised correlations between value addition in Zambia and macroeconomic variables.
The null hypothesis is rejected when test statistics have *** symbols next to them. GDP per capita, Broad money, Real interest rate, Foreign direct investment, and Inflation should be somewhat stationary. The stationarity of various economic metrics shows no consistent changes over time.
The negative test statistics and significant *** symbols suggest that these variables are stationary or become stationary after differencing. This shows that economic forces, policies, or factors impacting these variables are largely steady over the investigated time.

To determine the relationship between foreign direct investment and manufacturing value-added in Zambia

Table 3: The Johansen Co-Integration Test

maximum rank	parms	LL	eigenvalue	**trace** statistic	**critical(5%)** value
none	9	-2022.015	.	195.1402	192.89
At most1	26	-1986.1398	0.87127	123.3897*	156
At most2	41	-1966.2425	0.67922	83.5952	124.24
At most3	54	-1951.912	0.55908	54.9342	94.15
At most4	65	-1939.5102	0.50771	30.1304	68.52
At most5	74	-1931.8319	0.35516	14.7739	47.21
At most6	81	-1927.9691	0.19807	7.0484	29.68
At most7	86	-1925.5518	0.12902	2.2136	15.41
At most8	89	-1924.4769	0.05957	0.064	3.76

**Trace statistic test indicates 1 cointegrating eqn(s) at the 0.05 level*
Source: Authors Computation, 2024

The results from the Johansen Co-Integration Test, in table 3 revealed that the null hypothesis of no cointegrating vector between Manufacturing Value Added (MVA) and Foreign Direct Investment (FDI) was rejected at the 5% level of significance. The trace test statistics, with a lag of 2, indicated 1 cointegrating relationship, leading to the conclusion of a unique long-run relationship between MVA and variables including FDI.
These findings coincide with Chandran and Krishnan (2008), and Sjöholm (2017) who examined the long-term relationship between FDI and MVA, its effects on manufacturing output, and developing countries like Malaysia and Indonesia. These parallels emphasise the necessity of understanding FDI's long-term effects on manufacturing value-added in diverse economic circumstances.
The study shows that MVA and FDI in Zambia have a long-term relationship by using the Johansen cointegration test. This implies that value creation in the manufacturing sector is significantly influenced by foreign direct investment. The results add to our knowledge of the macroeconomic factors that influence value addition in Zambia and emphasizes the need of taking FDI's long-term consequences into account in this situation.
According to Guajarati (2004), two variables are said to be co-integrated if they exhibit a long run relationship. Furthermore, Dickey et al (1991) said that Co-integration assert that at least one linear combinations of the time-series variables are stationary even though they appear to be individually non-stationary according. This prompted Granger and Newbold (1974) to report that a possible presence of co-integration had to be considered when one is selecting a method to test existence of the relationship between two variables.
Furthermore, the statistics obtained in table 3 shows that there is at least one cointegrating vector between GDP per capita and manufacturing value-added in Zambia. For the trace test, the statistics surpasses the critical value only when the rank is "At most 1," suggesting that there is one cointegrating vector. This means that there is a unique long-term link between GDP per capita and manufacturing value-added in Zambia.
From the generated results, the null hypothesis related to the absence of a cointegrating vector between MVA and GDP per capita was rejected at the 5% level of significance. The trace test statistics with a lag of 2 showed 1 cointegrating relationship, supporting the conclusion of a unique long-run relationship between MVA and GDP per capita.

3.2.1 Vector Error Correction Mechanism (VECM)

The VECM outcomes of the Long and Short-run period are presented in table 4.2.1. The long run relationship is determined through the significance of the lagged error-correction term from the VECM results figure.

Table 4 Normalized Cointegrating Coefficients: 1 Cointegrating Equation(s)

Variable	Coefficients	standard Error	Z	P>Z	[95% confi. Interval]	
LMVA	1					
Foreigndirect_inv	-1.35E-10	5.39E-11	-2.5	0.012**	-2.410	-2.9411
GDP per capita	-0.0014552	0.0001333	-10.92	0.000***	-0.0017163	-0.00119
Broad money	0.0112463	0.006808	1.65	0.099*	-0.0020971	0.02459
Real interest rate	0.0052539	0.002775	1.89	0.058*	-0.000185	0.010693
Inflation	-0.0108608	0.0010232	-10.61	0.000***	-0.0128661	-0.00886
Population	-2.52E-08	2.48E-08	-1.02	0.309	-7.39E-08	2.34E-08
Manu export	-0.0080197	0.0073233	-1.1	0.273	-0.0223731	0.006334
Manu import	-0.0172649	0.007068	-2.44	0.015**	-0.0311179	-0.00341

*Note; * p < 0.1, **p < 0.05 and ***p < 0.01,*
Source: Authors Computation, 2024

Form table 4, the coefficient for Foreign Direct Investment is -1.35E-10, with a standard error of 5.39E-11. This means that for a one-unit increase in Foreign Direct Investment, the predicted change in the dependent variable (Manufacturing Value Added, LMVA) is -1.35E-10, holding other variables constant. The Z-score for Foreign Direct Investment is -2.5, and the related p-value is 0.012, marked as '**', indicating statistical significance at the 5% level. This shows a modest level of confidence in the association between Foreign Direct Investment and the dependent variable.

Adding on, Equation 3. this illustrates that Foreign Direct Investment (FDI), together with other parameters such as GDP per capita, inflation rate, population, exports of manufactures (MANU EXPORT), and import substitution, has a positive long-run connection with Manufacturing Value Addition (MVA) in Zambia. The study indicated that in the long run, a rise in FDI will lead to a higher change in manufacturing value addition. The 95% confidence interval for the coefficient of Foreign Direct Investment spans from -2.410 to -2.9411. This interval provides a range of numbers within which we can be 95% convinced that the genuine coefficient lies.

Further, the research reveals that if FDI grows by a percentage point, manufacturing value added as a proportion of GDP will raise by 1.35 percentage points, and this finding is statistically significant at the 5% significance level. This finding is consistent with prior investigations by Chandran and Krishnan (2008), Okoli and Agu (2015), Sjöholm (2017), and Azolibe (2020) who however, contradict the finding of Oduola et al. (2021).

Further, from table 4, the coefficient for GDP per capita is -0.0014552, with a standard error of 0.0001333. This means that for a one-unit rise in GDP per capita, the estimated change in the dependent variable is -0.0014552, holding other variables constant. The Z-score for GDP per capita is -10.92, and the related p-value is 0.000, denoted as '***', indicating extremely high statistical significance at any conventional significance level. This shows a high level of confidence in the association between GDP per capita and the dependent variable.

The 95% confidence interval for the coefficient of GDP per capita spans from -0.0017163 to -0.00119. This interval provides a range of numbers within which we can be 95% convinced that the genuine coefficient lies.

The study examined the relationship between GDP per capita (GDPPC) and manufacturing value-added in Zambia. It found that per capita income has a positive impact on manufacturing value added as a percentage of GDP. However, this impact is inelastic, meaning that a greater change in per capita income leads to a lesser change in manufacturing output in the long run. Distinctively, a one percentage point rise in per capita income will cause manufacturing value added as a percentage of GDP to increase by 0.1 percentage points, and this finding is statistically significant at the 5% level of significance.

This finding is consistent with the findings of Odhiambo (1991). The increase in per capita income implies increased demand, especially for manufactured goods, which were previously unaffordable or considered luxuries. This tendency stimulates manufacturing in the country. Additionally, increases in per capita income can stimulate capital accumulation and labour productivity through education and training, further enhancing the level of output in the manufacturing sector.

3.2.2 Short Run Analysis

Table 5: The Result of Error Correction Model for Short Run analysis

Variable	Coefficients	standard Error	Z	P>Z	[95% confi.Interval]	
ECT t-1	-0.449668	0.2357556	-1.86	0.062*	-0.9017405	0.022405
D(LMVA) (-1).	0.8908162	0.2371711	3.76	0.000***	0.4259694	1.355663
D (foreign direct inv) (-1).	7.2311	7.76E-11	0.93	0.352	-7.99E-11	2.24E-10
D (GDP per capita) (-1).	-0.0009061	0.0003477	-2.61	0.009**	-0.0015875	-0.00022
D (Broad money) (-1).	0.0180199	0.0154327	1.17	0.243	-0.0122277	0.048268
D (Real interest rate) (-1).	-0.0189439	0.0047595	-3.98	0.000***	-0.0282725	-0.00962
D (Inflation rate) (-1).	-0.005977	0.0016354	-3.65	0.000***	-0.0091822	-0.00277
D (Population size) (-1).	-1.3707	1.25E-07	-1.09	0.276	-3.83E-07	1.09E-07
D (manu-export) (-1).	-0.0389696	0.0184885	-2.11	0.035**	-0.0752064	-0.00273
D (manu-import) (-1).	-0.0334897	0.0130086	-2.57	0.01**	-0.0589861	-0.00799
_trend	-0.0128691	0.0047924	-2.69	0.007***	-0.022262	-0.00348
_cons	0.2317466	0.0855881	2.71	0.007***	0.0639969	0.399496

*Note; * p < 0.1, **p < 0.05 and ***p < 0.01,*
Source: Authors Computation, 2024

The Result of Error Correction Model for Short Run analysis equation 4.1 is shown below.

$$\Delta LMVA_t = 0.232 - 0.01trend + 0.891\Delta LMVA_{t-1} + 7.231\Delta FDI_{t-1} - 0.001\Delta GDPPC_{t-1} + 0.018\Delta M_{t-1} - 0.019\Delta RIR_{t-1} - 0.006\Delta INF_{t-1} - 1.3707\Delta POP_{t-1} - 0.039\Delta MANU\ EXPORT_{t-1} - 0.033\Delta MANU\ IMPORT_{t-1} - 0.450ECT_{t-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots equation\ 4.2$$

The coefficient for the first-differenced Foreign Direct Investment is 7.2311, with a standard error of 7.76E-11. This shows that given a one-unit change in the lagged first-differenced Foreign Direct Investment, the predicted change in the dependant variable is 7.2311, holding other variables constant. The Z-score for the first-differenced Foreign Direct Investment is 0.93, and the related p-value is 0.352, suggesting that the coefficient is not statistically significant at conventional levels.
The Vector Error Correction Model (VECM) analysis revealed that the estimation of the error correction term (ECTt-1) had a negative sign and was statistically significant. The coefficient of the adjustment term was also statistically significant at the 10% level, with a negative coefficient of -0.450. This negative

coefficient indicates that the model is stable and reverts to equilibrium after a shock, with a convergence speed of 4.5%.

The result proves the existence of a problem in the long-run equilibrium correlation among the explanatory variables within Zambia, indicating a deviation from equilibrium. The value of adjustment suggests a relatively high-speed of adjustment to long-run equilibrium, implying that short-run shocks or disturbances in the Manufacturing value addition would quickly move the economy towards the long-run equilibrium. This highlights the importance of considering cointegrating relationships among variables to avoid misspecification in the underlying dynamic structure.

Similarly, the findings from the study by Azolibe (2020) on the role of foreign direct investment (FDI) on manufacturing sector growth in the Middle East and North African area reveal a favourable impact of both inbound and outward FDI on manufacturing sector growth. This suggests that FDI drives manufacturing sector growth in Middle East and North African areas over the long term.

Additionally, Ray's (2012) study on the causes of total factor productivity development in Indian manufacturing industries suggests that explicit trade variables and macroeconomic factors have a considerable impact on total factor productivity growth. Indian policymakers should allow imports to boost institutional and technological progress and total factor productivity (TFP).

From table 5, the coefficient for the first-differenced GDP per capita (D (GDP per capita) (-1)) is -0.0009061, with a standard error of 0.0003477. The Z-score is -2.61, and the related p-value is 0.009, marked as '**', indicating statistical significance at the 1% level. This means that a one-unit change in the lagged first-differenced GDP per capita is related with a change of -0.0009061 in the MVA, leaving other variables constant. The negative coefficient suggests an inverse link between first-differenced GDP per capita and the MVA. The 95% confidence interval for the coefficient of first-differenced GDP per capita runs from -0.0015875 to -0.00022. This interval provides a range of numbers within which we can be 95% convinced that the genuine coefficient lies.

Further, the VECM analysis indicated that the past years GDP per capita had a negative and significant impact on the current manufacturing value added as a percentage of GDP. The impact is inelastic, with a percentage point increase in the past years per capita income causing manufacturing value added as a percentage of GDP to decrease by 0.1 percentage point. This suggests that GDP per capita has a dampening effect on manufacturing value-added in the short run.

The results from the VECM analysis, which indicate a negative and significant impact of past years' GDP per capita on the current manufacturing value added as a percentage of GDP, are similar to the findings of Rasheed (2010) and Charles-Anyaogu (2012). Rasheed (2010) investigated the productivity in the Nigerian manufacturing sub-sector using co-integration and an error correction model. The study indicated the presence of a long-run equilibrium relationship index for manufacturing production, determinants of productivity, economic growth, interest rate spread, and bank credit to the manufacturing sub-sector, among other factors. This aligns with the study's VECM analysis, which also explores the relationship between GDP per capita and manufacturing value added.

Similarly, Charles-Anyaogu (2012) evaluated the performance of monetary policy on the industrial sector in Nigeria using econometrics test methodologies. The study's results suggested that factors such as money supply, firm loan rate, income tax rate, inflation rate, and exchange rate have substantial effects on the performance of the manufacturing sector. This is consistent with the study's VECM analysis results, which underlines the impact of GDP per capita on manufacturing value added.

Table 6 Long and short run Elasticities

equations	**Foreign Direct Investment**	**GDP per Capita**	**Broad Money**	**Inflation Rate**	**Real Interest Rate**	**Import Substitution**	**Manufactured Export**
long run	1.350*	0.001*	-0.011*	0.011*	-0.005*	0.017*	0.008
short run	7.2311	-0.001*	0.018*	-0.006*	-0.019*	-0.033*	-0.039*

**. statistically significant.*

Source: Authors Computation, 2024

Form table 6, the elasticity of FDI is 1.350*, indicating a positive relationship with the dependent variable in the long run. The short-run coefficient for FDI is 7.2311, suggesting a substantial impact on the dependent variable in the short term.

The results indicated that a 1% increase in foreign direct investment (FDI) leads to a substantial increase of 1.350% in manufacturing value added in Zambia. This suggests a positive and significant relationship between FDI and manufacturing value-added, highlighting the potential impact of foreign investment on the growth of the manufacturing sector in Zambia. The findings underscore the importance of attracting and facilitating foreign direct investment to enhance the value-added contribution of the manufacturing industry to the Zambian economy.

These findings are similar to the findings for Okoli and Agu (2015) who in their research equally found the existence of a positive relationship between FDI and manufacturing value added. These findings further suggest a substantial increase in manufacturing value added in Zambia due to FDI, while Okoli and Agu (2015) studied the impact of FDI flow on the performance of manufacturing firms in Nigeria, using manufacturing value added as a measure of performance.
Further, the findings underline the positive and large impact of FDI on manufacturing value added in Zambia, demonstrating the potential impact of foreign investment on the expansion of the manufacturing sector. In contrast, Oduola et al. (2021) revealed that foreign direct investment exerts a negative and significant impact on industrialization in a panel of 43 Sub-Saharan African nations.
Adding on, the elasticity of GDP per Capita is 0.001*, indicating a positive relationship with the dependent variable in the long run. The short-run coefficient for GDP per Capita is -0.001*, suggesting a negative relationship with the dependent variable in the short term.
In the long run, a 1% increase in GDP per capita leads to a modest 0.1% increase in manufacturing value added in Zambia. This indicates a relatively small positive impact of GDP per capita on manufacturing value-added over the long term. However, in the short run, a 1% increase in per capita income leads to a 0.1% decrease in manufacturing value added. This suggests a short-term dampening effect of per capita income on manufacturing value-added, highlighting the complex dynamics between economic growth and the manufacturing sector in Zambia.
The elasticity of GDP per Capita being 0.001* in the long run, indicating a positive relationship with the dependent variable, aligns with the findings of Azolibe (2020), which indicated a positive influence of inward and outward FDI on the manufacturing sector's growth in the Middle East and North African region. Similarly, the negative short-run coefficient for GDP per Capita suggests a negative relationship with the dependent variable in the short term, which resonates with the study by Ray (2012) that determined the determinants of total factor productivity growth in selected manufacturing industries in India.
In the long run, a 1% rise in GDP per capita corresponds to a tiny 0.1% gain in manufacturing value added in Zambia, demonstrating a relatively little positive influence of GDP per capita on manufacturing value-added over the long term. This is consistent with the findings of Azolibe (2020), which showed the positive influence of FDI on the manufacturing sector's growth in the MENA region.

Diagnostic Checks Results
This section deals with econometric techniques of finding out whether the model adopted is a reasonable fit for the data. The following diagnostic tests were performed to confirm that our model tracked the data well over the sample period.
The diagnostic and stability tests are responsible for checking whether a model is correctly specified along with the goodness off fitness. The tests results depend on statistical values. The model was tested for normality test, heteroscedasticity test, autocorrelation test; AR roots graphs, as well as impulse response and variance decomposition analysis. The interpretation of the tests is considered on the following criteria when probability value is less than ($p<0.05$), we reject the null hypothesis and when the probability value is more than ($p>0.05$), we accept the null hypothesis. The good conditions of the model were tested in four different main techniques.
To start with, Jarque-Bera normality test was tested. This was followed by heteroscedasticity tested utilizing White's test with no cross terms and autocorrelation tested using Breusch-Godfrey test. Finally, AR Roots graph was tested to check if the model is stable or not. In Table 4.4.1 below, a summary of the diagnostic and stability tests outcomes of regression model is presented followed by providing more information on each test.
Table 7 Summary of the Diagnostic Tests

Test	**Null Hypothesis**	**T-Statistic**	**P-Value**	**Conclusion**
Jarque-Bera	There is normal distribution	18.659	0.54408	The residuals are normally distributed.
Breusch-Godfrey	No serial correlation	113.3643	0.16713	There is no serial correlation.
Estat vce	No serious multicollinearity	Correlation matrix	0.8121	Multicollinearity is not serious since all coefficients of the correlation coefficient are below 0.85
AR Roots Graphs	Stable model	$\sum_{r=1}^{n} a_1 < 1$		The model is stable.

Source: Authors Computation, 2024

Normality tests were done by applying the Jarque-Bera (JB) test. This test is applied to assess if a data set or residuals are regularly distributed or not. As per economic theory, it is predicted that the hypothesis states the residuals are regularly distributed. Based on the outcomes from Table 5.10 above the residuals are normally distributed as probability value of Jarque-Bera is greater than 5 percent and very significant.

Gujarati (2004) argues that if the probability value of the Jarque-Bera statistics is very low in an application, at that time the study may reject the null hypothesis and declare the residuals are normally distributed. In this regard, the researcher therefore concludes by accepting the null hypothesis which suggests the residuals are normally distributed and rejecting the alternative hypothesis which predicts that the residuals are not normally distributed.

The autocorrelation test was used to tests for serial correlation amongst the variables. The null hypothesis of the autocorrelation test states that there is no serial correlation. If the p-value is not higher than 5 percent level of significance, then we reject the null hypothesis and infer that the residuals are serially associated. The outcomes obtained reveal that LM tests probability value (0.16713) is over 5 percent at lag one up to two, so the null hypothesis is accepted and it is inferred that there was no serial correlation amid the residuals. Since the selected lag length was one, hence we determine that the residuals are not serially correlated.

Several research have demonstrated that when we employ a regression model containing time series data, it may happen that there is a structural shift in the relationship between the regression and the regressors (James et al., 661 - 692, 1978). Generally, what is meant by structural change is that the values of the parameters in the model do not remain the same through the entire time period. The significance of stability in our model is dependent upon the effectiveness of ant inflationary and hence the need for the following tests of stability. The findings shows that all the eigenvalues sit inside the circle, hence the model satisfied the stability condition.

Summary of findings

The study demonstrates a strong, long-term correlation between Manufacturing Value-Added (MVA) and Foreign Direct Investment (FDI) in Zambia, indicating that FDI may help the manufacturing sector grow. The Zambian government has to actively monitor and encourage FDI inflows in order to take advantage of this. More focused policy actions can be informed by research that identifies the particular industrial sectors that are most impacted by FDI.

Similarly, MVA and GDP per capita have a long-term relationship. This suggests that manufacturing value-added can increase in tandem with rising GDP per capita. The government ought to give priority to measures that increase GDP per capita in order to promote industrial expansion. More targeted policy recommendations may come from future studies examining the precise processes via which variations in GDP per capita affect MVA.

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4. Conclusions

The results of the study point to a long-term, positive relationship between Manufacturing Value Added (MVA) and Foreign Direct Investment (FDI) in Zambia. This cointegration suggests that over time, increases in FDI will probably result in increases in Zambia's industrial output. This is positive because it may serve as a major catalyst for the expansion of Zambia's manufacturing industry if FDI is drawn in and kept there. One more feature of Zambia's macroeconomic situation is highlighted by the cointegration of GDP per capita and MVA. A robust economy, as seen by a greater GDP per capita, is ultimately associated with a larger and more productive manufacturing sector.

Further, the study's findings provide valuable insights into the unique long-run and short-run relationships between Manufacturing Value Added (MVA) and several key variables in Zambia. The study aimed to examine the factors that drive output growth in the manufacturing sector of Zambia. It utilised secondary time series data from 1986 to 2021 and conducted regression analysis to understand the relationship between macroeconomic variables and manufacturing value-added. The variables considered in the analysis included gross domestic capital, foreign direct investment, net exports, exchange rates, money supply, population, inflation, real interest rate and employment.

Moreover, the rejection of the null hypothesis about the absence of a cointegrating vector between manufacturing value-added (MVA) and foreign direct investment (FDI) at the 5% level of significance suggests a unique long-run relationship between these variables. This shows how FDI boosts Zambian manufacturing value-added. Since FDI may affect manufacturing's long-term growth, the government should monitor and encourage it.

As a policy implication, the government of Zambia should monitor and encourage FDI inflows to support manufacturing sector growth. Further research could focus on identifying specific sectors within manufacturing that are most influenced by FDI, allowing for focused policy actions.

Adding on, the rejection of the null hypothesis about the absence of a cointegrating vector between manufacturing value-added (MVA) and GDP per capita at the 5% level of significance supports a unique long-run link between these variables. This shows how GDP per capita affects manufacturing value-added. Growing GDP per capita should be a governmental priority to boost industrial growth. As a policy recommendation, growing GDP per capita should be a policy priority by the government if they are to boost manufacturing growth. Adding on, future research could delve into the specific mechanisms through which changes in GDP per capita impact manufacturing value-added, this could provide more targeted policy recommendations.

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