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Governance and the Manufacturing Sector Growth among the BRICS Nations

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Abstract: The objective of this study was to examine the relationship between selected governance factors and growth rates in the manufacturing sector's output among the member states of BRICS. This study examined the institutionalized growth theory and explored four governance factors: government effectiveness, regulatory quality, control of corruption, and voice and accountability. The study also considered factors associated with both exogenous and endogenous growth theories. The estimation process involves applying the first difference generalized method of moments (D-GMM) on a linear dynamic panel model. The data spans from 2010 to 2021. The findings of this study suggest that among the BRICS nations, government effectiveness is the most significant predictor of growth in the manufacturing sector, out of the four governance factors that were examined. The factors of voice and accountability, control of corruption, and regulatory quality did not demonstrate the capacity to exert influence on variations in the growth of the manufacturing sector within the BRICS countries. Unlike prior studies, our research incorporates a range of established growth theories in constructing the empirical model. Additionally, we employ an instrumental variable approach for dynamic panel data analysis. We utilize robust standard errors to address potential issues of endogeneity and model misspecification. Therefore, BRICS countries should devote a sizeable portion of their resources to building solid mechanisms that make it easier for the implementation, oversight, and thorough reporting of government activities inside their manufacturing sector. This strategy could increase governmental effectiveness, which would encourage overall manufacturing sector growth.

Keywords: *Manufacturing sector output growth, governance factors, D-GMM, BRICS.*

1. Introduction

According to Saba & Ngepah (2023), empirical evidence suggests that the manufacturing sector plays a significant role in driving long-term economic growth. According to Aiginger and Rodrik (2020), it is argued that no economy on a global scale has achieved economic progress without making significant investments in the manufacturing sector. The manufacturing sector plays a crucial role in facilitating structural transformation, creating productive employment opportunities, and fostering sustainable economic growth (Su & Yao, 2016; Herman, 2020). According to the United Nations Conference on Trade and Development (UNCTAD, 2020), there is empirical evidence suggesting that both developed and emerging economies have demonstrated a strong emphasis on the manufacturing sector, allocating a significant portion of their budget towards its development. The BRICS economies have significantly benefited from the manufacturing sector. Due to the quick industrialization these nations have experienced, the acronym BRICS—which stands for Brazil, Russia, India, China, and South Africa—has recently attracted a lot of attention. This has led to substantial growth in their respective manufacturing sectors (Das & Kalita, 2018; Lima & Navarro, 2017).

The narrative surrounding the BRICS remains ongoing, but as of late, this coalition of countries has emerged as a representation of noteworthy shifts taking place within the sphere of global economic and political dynamics (Lopez-Claros, Dahl, & Groff, 2020). The political environments within the member states of BRICS have experienced a range of transformations (United Nations, 2023). The expansion of the manufacturing sector within the BRICS nations has been impacted by a number of significant governmental factors, such as voice and accountability, regulatory quality, government effectiveness, and control of corruption. The factors in question have been identified by Kaufmann, Kraay, and Mastruzzi (2010), as well as Chen (2020). Guriev and Tsyvinski (2018) assert that Russia has consistently pursued efforts to expand the breadth of its economy and reduce its dependence on natural resources through a focus on the manufacturing sector. India implemented substantial economic reforms, including the introduction of the Goods and Services Tax (GST), to streamline the tax system and promote business convenience (Saraswat & Kaur, 2019). According to Zhang (2020), China underwent a significant economic transformation, transitioning from an investment-led growth model to a consumption-driven one. The aforementioned transition led to a reorganization of the manufacturing industry. Brazil underwent a series of political controversies that led to the removal of its head of state from office and the subsequent installation of a new administration (Lopes & Power, 2019).

South Africa experienced political instability as a result of leadership changes and implemented strategies to address issues such as corruption and economic inequality (Nolutshungu, 2021). Understanding the diverse modifications is crucial for policymakers and stakeholders to develop and implement effective governance reforms that promote the growth and competitiveness of the manufacturing sector in the BRICS countries. Previous studies have recognized the importance of effective governance practices and the relationship between governmental factors and the promotion of the manufacturing sector to foster economic growth in the BRICS countries (Naudé et al., 2013; Aradhna, 2014; Aldrighi and Colistete, 2015, and others). This study employs panel data from 2010 to 2022 to analyze the influence of government factors on the growth of the manufacturing sector in the BRICS nations. It specifically focuses on benchmarking the institutionalized growth theory and considers the effects of exogenous and endogenous growth theories as control variables. According to the World Bank (2022), the average manufacturing sector output for the BRICS countries between 2010 and 2021 was around 822 billion US dollars.

South Africa struggled with a manufacturing output of just 39.4 billion US dollars in 2020, while China emerged as the manufacturing powerhouse, reaching a high output of 4.87 trillion US dollars in 2021. When it comes to measuring governance, the average government effectiveness index for the BRICS countries was 0.0098. China had the highest rating in 2021 (0.8407), and Russia had the lowest in 2010 (-0.6015) (World Bank, 2021). The average regulatory quality for the BRICS countries was -0.1695. South Africa had the highest rating in 2011 (0.4464), while Russia had the lowest in 2015 (-0.5599) (World Bank, 2021). The average score for examining corruption control was -0.3888, with Brazil exhibiting the least corruption in 2011 (0.1684), and Russia showing the worst in 2010 (-1.0992). The average score for voice and accountability was -0.2461, with the highest score recorded in South Africa in 2021 (0.7885) and the lowest in China in 2010 (-1.6805). This demonstrates substantial growth among the BRICS.

Theoretical Framework: This study discusses three growth models that have been influential in the field of economics. The first is the exogenous growth model that Solow proposed in 1956 and which Mankiw and Romer further developed in 1992. The second is the endogenous growth model, initially introduced by Romer in 1990 and later popularized by Lucas in 2000. Lastly, the study also considers the institutionalized theory introduced by Acemoglu and Robinson in 2006. The exogenous growth theory, commonly known as the neoclassical growth theory, elucidates the mechanisms by which a consistent rate of economic growth can be achieved through the optimal allocation of labor, capital, and technological advancements. Based on the exogenous growth theory, the impact of capital investment and labor force growth on output is primarily limited to their influence on output levels rather than their effect on the long-term growth rate. Technological advancement emerges as the sole determinant influencing the long-term growth rate of an economy, thereby serving as the primary driver behind productivity disparities among nations worldwide. Nevertheless, the theory operates under the assumption of fixed technology, constant returns to scale, and diminishing returns to factor inputs. As a result, the theory posits that nations will converge towards their respective long-term growth rates.

According to Romer (1990), the endogenous growth theory posits that economic growth is contingent upon investments made in research and development. The proponents of the endogenous growth theory posit that enhancements in productivity lead to advancements in overall production. Moreover, they argue that productivity is closely associated with a more rapid rate of innovation, the development of new inventions, and increased investment in human capital. The institutional growth theory emphasizes the influence of various factors, such as the quality of governance, on the process of economic growth. Furthermore, it takes into account additional factors such as ethnic diversity, religion, culture, and institutions at large. Previous studies have recognized the importance of effective governance practices and the relationship between governmental factors and the promotion of the manufacturing industry to foster economic growth in the BRICS countries (refer to Naudé et al., 2013; Aradhna, 2014; Aldrighi and Colistete, 2015, and other relevant literature). This study employs panel data from 2010 to 2022 to investigate the influence of government factors on the growth of the manufacturing sector in the BRICS nations. The analysis incorporates the institutionalized growth theory and controls for factors associated with both exogenous and endogenous growth theories.

2. An Abridged Literature Review

The empirical literature examining the correlation between governance factors and the growth of the manufacturing sector in the BRICS countries has garnered significant scholarly interest. This relationship has been the subject of several recent studies, including those by Yadav and Jain (2017), Dzisi and Appiah (2020), and Zhang and Li (2018). A notable study conducted by Naude et al. (2013) examines the impact of institutional quality on the growth of the manufacturing sector in the BRICS countries. The findings of the study revealed a significant correlation between higher levels of institutional quality and the growth of the manufacturing sector. The study by Aradhna (2014) looked at how democratization affected the economies of Brazil, India, and South Africa. The results indicated that the process of democratization had a favorable influence on both governance and economic growth within the aforementioned nations. In a similar vein, Aldrighi and Colistete (2015) investigated the effects of trade liberalization and institutional reforms on the process of industrialization and economic growth within the BRICS countries, namely Brazil, Russia, India, China, and South Africa. The researchers discovered that institutional enhancements, particularly those pertaining to the legal framework, play a more pivotal role than trade liberalization in promoting industrialization and fostering economic growth. Zhang and Li (2018) emphasized the significance of governmental policies and regulations in facilitating the expansion of the manufacturing industry in China.

The authors of the study discovered that the provision of governmental assistance for research and development, alongside investments made in infrastructure, has played a crucial role in fostering the expansion of this particular industry. In their study, Dzisi and Appiah (2020) emphasized the significance of governmental policies and regulations in facilitating the expansion of the manufacturing industry in Brazil. The study revealed that the presence of corruption and political instability has impeded the progress of growth within this particular sector. Consequently, the researchers recommended that the Brazilian government undertake the necessary reforms to effectively tackle these prevailing challenges. Several studies have examined the correlation between governance and the growth of the manufacturing sector in the BRICS countries. In addition, other studies have focused on identifying the factors that contribute to the growth of the manufacturing sector in these countries, irrespective of governance considerations. Islam and colleagues (2018) conducted a study to examine the factors influencing the growth of the manufacturing sector in the BRICS countries. They employed a panel dataset for their analysis. The findings showed that capital investment, labor force, and technology had a significant impact on the growth of the manufacturing sector in the BRICS countries. Chandra and Sengupta's (2019) study focused primarily on the factors that affect competitiveness in the BRICS countries' manufacturing sectors.

The study found that a number of factors, including the growth of human capital, infrastructure, and technology, had an impact on the manufacturing sector's competitiveness. In their study, Zhang et al. (2019) analyzed the factors that influence the growth of the manufacturing sector in BRICS countries. The authors employed panel data analysis as their methodology for this investigation. The study's results emphasized several key factors that play a critical role in driving growth in the manufacturing sector, including foreign direct investment, human capital, technological innovation, and trade openness. In their study, Goyal et al. (2018) investigated the factors that influence the growth of the manufacturing sector in the economies of the BRICS. They employed the dynamic panel threshold approach as their analytical framework. The findings of the study indicate that there is a significant relationship between capital investment, research and development, export orientation, institutional quality, and the growth of the manufacturing sector. Furthermore, the analysis conducted in this study has uncovered the existence of threshold effects, suggesting that certain factors have varying effects on economic growth depending on specific thresholds. Despite the existing literature on the determinants of manufacturing sector growth in the BRICS countries, there remains a research gap in understanding the influence of governance factors, such as voice and accountability, regulatory quality, control of corruption, and government effectiveness, on the growth of the manufacturing sector in these countries. Hence, the objective of this research is to fill this void by examining the influence of governance factors on the growth of the manufacturing sector in the BRICS nations.

3. Methodology

Research Design: This study employs a hybrid research design that combines elements of both longitudinal and causal relationship research designs. The annual data for the five BRICS nations from 2010 to 2022 has been collected and utilized to form panel data. These data sets have been subjected to analysis using panel data regression techniques.

Data Type and Data Sources: The present study employs secondary data sourced from the World Bank Development Indicators (WDI). The data has been organized in a panel format, allowing for analysis using panel data analytical techniques. Panel data has gained popularity as a preferred method of data compilation due to its ability to facilitate multiple-country analysis, offer additional degrees of freedom, and effectively handle heterogeneity and multicollinearity in the data involving multiple countries (Moyo & Jeke, 2019; Tran, Ivashchenko & Brooks, 2019).

Model Specification: The research employs a linear dynamic panel regression model for estimation. The empirical model was developed through a series of steps, which are outlined as follows in this study: The study introduces a broader panel model, as follows:

$$y_{it} = \alpha + x'_{it}\beta + u_{it} \qquad i = 1, \ldots, N; t = 1, \ldots, T \qquad (1);$$

The variable of interest, denoted as y_{it}, refers to the output of the manufacturing sector. In this context, i represents the specific country in the panel, while t represents the time indicator within the panel. The indexes i and t are used to represent the cross-section dimension and the time-series dimension in the panel, respectively. The scalar α represents a constant term, while β is a vector consisting of the gradient coefficients of the regression variables. The symbol x_{it}' denotes the stimulus variables in the panel model, and u_{it} represents a two-error component idiosyncratic error term that follows a specific form.

$$u_{it} = \mu_i + v_{it} \qquad (2)$$

In equation (7), μ_i represents a perturbation that remains constant over time and is not observable in relation to a specific effect on a country. It accounts for the individual-specific effects that are not included in the regression model. However, v_{it} represents a residual perturbation that exhibits temporal fluctuations in relation to the time period of the respective countries. Both μ_i and v_{it} are assumed to be identically and independently distributed (Baltagi, 2008). Furthermore, in the specified model (1), it is assumed that the vector of stimulus variables is independent of the error term, denoted as $E(X'_{it}u_{it}) = 0$. In this particular instance, the conditional expectations y_t are as follows:

$$E(y_{it} \setminus x_{it}) = x'_{it}\beta \qquad (3)$$

The specification of the unconditional population moment condition is as follows:

$$g(\beta) = E[x_{it}u_{it}] = E[x_{it}(y_{it} - x'_{it}\beta)] = 0 \qquad (4)$$

The sample moment condition is as follows:

$$g_T(\hat{\beta}) = \frac{1}{T}\sum_{t=1}^{T} x_{it}(y_{it} - x_{it}'\hat{\beta}) = 0 \qquad (5)$$

When the x'_{it} matrix contains one or more endogenous regressors, the least squares estimator is prone to bias and inconsistency. The empirical model under investigation in this study exhibits endogenous regressors resulting from potential simultaneity in the growth equation for the manufacturing sector. Consequently, it is not feasible to estimate this model using panel least squares procedures such as fixed effects (FE), random effects (RE), or pooled ordinary least squares (OLS) estimation. Estimation procedures of this nature are prone to encountering endogenous consequences resulting from variable bias (Baltagi, 2008). To mitigate these concerns, the present study introduces a specific empirical model that enables the application of an Instrumental Variable (IV) estimation procedure. This approach effectively addresses the issue of endogeneity bias arising from endogenously determined regressors in the panel model. Therefore, this research employs Arellano & Bond (1991) first differenced generalized method of moments (D-GMM) estimator. This estimator is a dynamic panel data estimation technique that utilizes instrumental variables to mitigate the issue of endogeneity bias in the panel model. The specification of the generalized linear dynamic panel model is as follows:

$$y_{it} = \alpha\, y_{i,t-1} + x'_{it}\beta + \mu_i + \gamma_t + \varepsilon_{it} \quad (6)$$

In this study, the variable under investigation is denoted as $y_{i,-1}$, representing the first lag of the variable. The unobserved heterogeneity effect is denoted as γ_t, which represents the time dummy variable that captures shocks affect $y_{i,\,t}$ across the individual countries being examined. Lastly, the idiosyncratic error term is represented as$\varepsilon_{i,t}$. The empirical model to be estimated in this study is specified with reference to the generalized dynamic panel mode in equation (6).

$$logmso_{i,t} = \alpha\; logmso_{i,t-1} + \beta_1\, ge_{i,t} + \beta_2\; regq + \beta_3\; cc + \beta_4\; voice + \beta_5 loggkf_{i,t} + \beta_6 log⯑umc_{i,t} + \beta_7 \log(n + g + \delta)_{i,t} + \beta_8 domcred_{\;i,t} + \beta_9 fdi_{i,t} + \beta_{10} inf_{i,t} + \beta_{11} tradeopen_{i,t} + \beta_{12} lrate_{i,t} + +\mu + \gamma t + \varepsilon_{i,t} \quad (7)$$

Where;
$logmso$ is the logarithm of manufacturing sector output (manufacturing sector output has been measured in current US dollars) ; $Logmso_{t-1}$ is the logarithm of the one-period lag of the manufacturing sector output; ge is a measure of government effectiveness which is measured in units of standard normal distribution ranging from -2.5 (very weak) to 2.5 (very strong); $regq$ is regulatory quality which captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development and it is in units of a standard normal distribution ranging from -2.5 (very poor quality) to 2.5 (very good quality); cc is the control of corruption index which captures perceptions of the extent to which public power is exercised for private gain including both petty and grand forms of corruption as well as "capture" of the state by elites and private interests and it is in units of a standard normal distribution ranging from -2.5 (very poor quality) to 2.5 (very good quality); voice stands for voice and accountability index which captures perceptions of the extent to which a country's citizens are able to participate in selecting their government, freedom of expression, freedom of association and a free media with range of standard normal distribution from -2.5 (very poor) to 2.5 (very good).

The variables *loggkf*, *loghumc* and *log(n + g + δ)* in (7) are motivated by the neoclassical growth theory and stand for the logarithm of gross capital formation, the logarithm of human capital and the logarithm of population growth which is adjusted for extrinsic technological advances, g and head extrinsic depreciation, δ. Gross capital formation has been measured in current US dollars, human capital is captured by the labor force with basic education, n is the population growth rate and $g + \delta$ has been approximated to 0.05 as in the study by Ding and Knight (2008). The rest of the variables in (7), that is; fdi which stands for foreign direct investment (net inflows, % of GDP); inf which stands for inflation (GDP deflator, annual %), $tradeopen$ which stands for trade openness measured by current account balance as a percentage of GDP; $lrate$ which stands for lending interest rate (%), all of these variables are motivated by the endogenous growth theory. μ_i, γ_t and $\varepsilon_{i,t}$ are as defined in equation (6).

Diagnostic Checks and Robustness Tests: The study performed necessary diagnostic checks prior to model estimation to examine the behavior of the data. Additionally, the study conducted robustness tests after model estimation to assess the reliability of the estimated model. Initially, the investigation assessed the normality of the dependent variable by constructing a histogram with a superimposed normal density that was appropriately scaled. Subsequently, an examination was conducted to determine if the resulting density plot significantly deviated from a normal distribution. Also, the study looked closely at multicollinearity, which is an important diagnostic step in linear regression analyses with more than one independent variable. This is due to the undesirable nature of explanatory variables exhibiting high linear correlations, as they have the potential to result in inefficient regression estimations. In the context of multicollinearity in multiple linear regression models, variables with correlation coefficients of more than +/-0.8 and p-values of less than 0.05

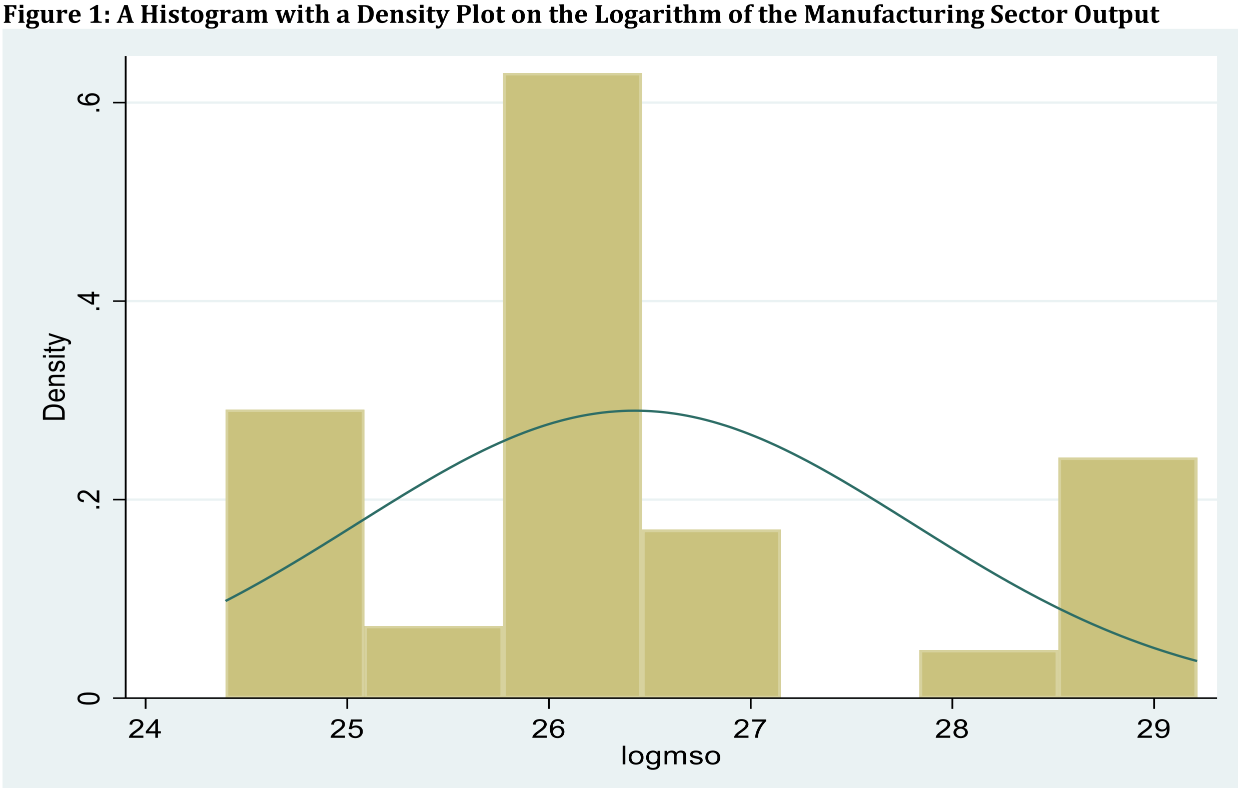
are thought to be a potential problem (Morrissey & Ruxton, 2018). This study did not prioritize the examination of stationarity and cointegration tests, as the main objective was not to analyze short-term and long-term relationships within the modeled model through the utilization of cointegration estimation techniques.

Concerning robustness tests, the study first did two significant post-estimation robustness tests for panel regressions in which one or more independent variables are determined endogenously. The first test was the Hausman specification test, which tries to find out if there is a systematic difference between the coefficients of the instrumental variable (IV) estimator (i.e., the D-GMM) and the ordinary least squares (OLS) estimator. The null hypothesis assumes that the difference in coefficients between the corresponding estimates from the two estimators is not systematic. The second test employed was *the over-identifying restrictions test*, specifically the Sargan test of over-identifying restrictions. This test assesses the joint validity of instruments employed in the D-GMM estimation under the null hypothesis that the instruments used are jointly valid. This study includes two additional robustness tests. The first test is the *Wald test*, which is used to assess the significance of the entire regression model. It involves testing both simple and composite linear *hypotheses*. The second test is the *Serial correlation test*, specifically the Arellano-Bond test (Arellano & Bond, 1991). This test is employed to detect the serial correlation of first-order and second-order residuals in the first-differenced residuals. In other words, it examines the presence of AR (1) and AR (2) after the D-GMM estimation.

4. Results

Normality Check Results on the Logarithm of Manufacturing Sector Output: The present study assessed the normal distribution of the dependent variables through the creation of a histogram that was overlaid with a properly scaled normal density. The nature of the normal plot generated from the normality check is depicted in Figure 1.

Figure 1: A Histogram with a Density Plot on the Logarithm of the Manufacturing Sector Output



Source: Generated by the author.

The density plot presented in Figure 1 demonstrates that the logarithm of manufacturing sector output (*logmso*) variables, which serve as the dependent variable in the empirical model, exhibits a distribution that closely approximates a normal distribution. The normality assumption regarding the dependent variable indicates that the residuals of the regression model are expected to follow a normal distribution. This implies that any inferences made based on the model's estimates can be considered valid.

Multicollinearity Checks in the Explanatory Variables: The study conducted an estimation of a pairwise correlation matrix among the explanatory variables and analyzed the magnitudes of the estimated correlation coefficients between these variables. Table 1 presents the estimated correlation matrix.

Table 1: A Pairwise Correlation Matrix between the Independent Variables in the Empirical Model. Figures in Italics are P-Values

Variable	1	2	3	4	5	6	7	8	9	10	11
Government effectiveness	1.00										
Regulatory quality	0.199	1.00									
	0.1267	-									
Corruption control	0.599***	0.728***	1.00								
	0.0000	*0.0000*	-								
Voice and accountability	-0.202	0.579***	0.462***	1.00							
	0.1216	*0.0000*	*0.0002*	-							
Logarithm of gross capital formation	0.366***	-0.499***	-0.124	-0.732***	1.00						
	0.0041	*0.0001*	*0.3468*	*0.0000*	-						
Logarithm of human capital	0.425	-0.414***	0.076	-0.49***	0.783***	1.00					
	0.0007	*0.0010*	*0.5626*	*0.0001*	*0.0000*	-					
Logarithm of (n + g + δ)	0.098	0.358***	0.438***	0.477***	-0.180	0.081	1.00				
	0.4579	*0.0050*	*0.0005*	*0.0001*	*0.1686*	*0.5395*	-				
Foreign direct investment	-0.296**	0.024	0.052	0.076	0.0351	0.084	0.020	1.00			
	0.0215	*0.8576*	*0.6943*	*0.5620*	*0.7900*	*0.5239*	*0.8797*	-			
Inflation	-0.524***	-0.014	-0.365***	0.124	-0.235*	-0.264**	-0.119	0.133	1.00		
	0.0000	*0.9153*	*0.0042*	*0.3452*	*0.0704*	*0.0415*	*0.3668*	*0.3121*	-		
openness	-0.234*	-0.350***	-0.554***	-0.606***	-0.001	-0.251*	-0.572***	0.0738	0.237*	1.00	
	0.0720	*0.0061*	*0.0000*	*0.0000*	*0.9976*	*0.0525*	*0.0000*	*0.5750*	0.0686	-	
Lending interest rate	-0.493***	0.251*	0.096	0.439***	-0.224*	-0.185	0.111	0.417***	0.157	-0.223*	1.00
	0.0001	*0.0532*	*0.4668*	*0.0005*	*0.0854*	*0.1560*	*0.3964*	*0.0009*	*0.2304*	*0.0864*	-

Source: Authors' compilation. *, ** & *** denote significance at 10%, 5% and 1% levels respectively. 1= Government effectiveness, 2= Regulatory quality, 3= Corruption control, 4= voice & accountability, 5= Logarithm of gross capital formation, 6= Logarithm of human capital, 7= Logarithm of (n + g + δ), 8=Foreign direct investment, 9=Inflation, 10=openness, 11=Lending interest rate.

Examining the pairwise correlation coefficients between the regressors in the empirical model, as shown in Table 1, shows that all the estimates of the pairwise correlation coefficient between the model's regressors have an absolute value below 0.8. This indicates that the inclusion of all the explanatory variables as outlined in equation (7) does not result in significant multicollinearity in the empirical model.

Descriptive Statistics on Key Model Variables: The study analyzed key model variables, specifically focusing on the growth of the manufacturing sector as the dependent variable. The independent variables of interest were the governance factors, namely government effectiveness, regulatory quality, control of corruption, and voice and accountability. Descriptive statistics were generated for these variables. Table 2 presents the statistical measures, including the mean, standard deviation, minimum, and maximum values, for each of the primary model variables.

Table 2: Descriptive Statistics on Key Model Variable (all the 5 BRICS countries)

Variable	Obs	Mean	Std. Dev.	Maximum	Minimum
Manufacturing sector output (Current US $)	60	8.22E+11	1.29E+12	4.87E+12	3.94E+10
Government effectiveness	60	0.0098	0.3108	0.8407	-0.6015
Regulatory quality	60	-0.1695	0.2675	0.4464	-0.5599
Control of corruption	60	-0.3888	0.3338	0.1684	-1.0992
Voice and accountability	60	-0.2461	0.9153	0.7885	-1.6805

Source: Author's compilation.

The descriptive statistics presented in Table 2 demonstrate that all variables included in the analysis had a comprehensive set of observations in the panel, with each variable having 60 observations. The study period from 2010 to 2021 revealed that the average manufacturing sector output for the five BRICS nations was approximately 822 billion US dollars. Among these nations, China recorded the highest manufacturing sector output of 4.87 trillion US dollars in 2021, while South Africa had the lowest manufacturing sector output of 39.4 billion US dollars in 2020. The average government effectiveness index for the five BRICS nations was 0.0098. The highest government effectiveness index of 0.8407 was recorded in China in 2021, while the lowest index of -0.6015 was observed in Russia in 2010. The average index for the regulatory quality variable among the five BRICS nations during the period of 2010-2021 was -0.1695. The highest index value, indicating the best regulatory quality, was recorded in South Africa in 2011 with a value of 0.4464. Conversely, the lowest index value, indicating the worst regulatory quality, was observed in Russia in 2015 with a value of -0.5599. The average control of corruption index for the five BRICS nations during the period of 2010-2021 was -0.3888. The highest index value, indicating the highest level of cleanliness in terms of corruption, was recorded in Brazil in 2011 with a value of 0.1684. Conversely, the lowest index value, indicating the highest level of corruption, was observed in Russia in 2010 with a value of -1.0992. In relation to the voice and accountability index, the average value for the five BRICS nations during the period from 2010 to 2021 was -0.2461. The highest index value (indicating a very good level) of 0.7885 was observed in South Africa in 2021, while the lowest index value (indicating a very poor level) of -1.6805 was recorded in China in 2010.

Regression Estimates: The empirical model presented in equation (7) includes certain independent variables, specifically gross capital formation (previously referred to as private investment) and foreign direct investment, which are determined endogenously. The influence of these variables on the growth of the manufacturing sector is reciprocal, as an increase in manufacturing sector output can also attract and influence these variables. Therefore, there exists a simultaneous relationship between these variables and the growth of the manufacturing sector. The presence of endogeneity concerns arises in the model. The empirical model has been estimated using the first difference generalized method of moments (D-GMM) dynamic panel estimator. Table 3 presents a comprehensive overview of the model's estimates obtained through the D-GMM estimation method.

Table 3: Regression Estimates from D-GMM Estimation

Logarithm of manufacturing Sector output	Coef.	Std. Err. (Robust)	z	P>z	[95% Conf.	Interval]

Logarithm of manufacturing sector o/p						
L1.	0.151842*	0.0773070	1.96	0.050	0.0003227	0.3033605
L2.	-0.237049***	0.0715396	-3.31	0.001	-0.3772636	-0.0968337
Government effectiveness	0.267465***	0.0562724	4.75	0.000	0.1571727	0.3777564
Regulatory quality	-0.057210	0.0781981	-0.73	0.464	-0.210475	0.0960557
Control of corruption	-0.087404	0.0830305	-1.05	0.292	-0.2501411	0.0753323
Voice and accountability	0.082652	0.0984148	0.84	0.401	-0.1102380	0.2755409
Logarithm of gross capital formation	0.780160***	0.0642608	12.14	0.000	0.6542106	0.9061084
Logarithm of human capital	0.081404**	0.0319893	2.54	0.011	0.0187057	0.1441015
Logarithm (n+g+δ)	0.012371	0.0076989	1.61	0.108	-0.0027188	0.0274604
Foreign direct investment	0.009158	0.0061248	1.50	0.135	-0.0028461	0.0211628
Inflation	-0.006587	0.0036231	-1.82	0.069	-0.0136897	0.0005125
Openness	2.733255***	0.5874761	4.65	0.000	1.5818230	3.8846870
Lending interest rate	0.007131***	0.0018695	3.81	0.000	0.0034671	0.0107955
_cons	2.797785**	1.322129	2.12	0.034	0.2064604	5.3891100

Instrumentization

Instrumented variables: *Loggcf, fdi*

GMM-type Instruments for 1st difference eq.: $Logmso_{t-1}$, ge_{t-1}, $regq_{t-1}$, cc_{t-1}, $voice_{t-1}$, $Loghumc_{t-1}$, $Log(n+g+\delta)_{t-1}$, Inf_{t-1}, $open_{t-1}$, $Lrate_{t-1}$

Standard Instruments for 1st difference eq.: *Δge, Δregq, Δcc, Δvoice,, ΔInf, Δopen, ΔLrate,*

Instruments for the level equation: Constant

Robustness Tests

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

Arellano-Bond test for Ho: No AR(1) in first difference errors: p>Z = 0.1023

Arellano-Bond test for Ho: No AR(2) in first difference errors: p>Z = 0.1422

Jarque-Bera normality of residuals test for Ho: Normally distributed residuals: p>chi-sq. = 0.3301

Sargan test of over-identifying restrictions for Ho: instruments are jointly valid: p>chi-sq. = 0.1232

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

Source: Authors compilation after D-GMM estimation. *, ** & *** indicate significance at 10%, 5% and 1% levels respectively.

Effect of Governance Factors on the Manufacturing Sector Growth among the BRICS: Table 3 shows the results of the empirical model. Of the four governance factors looked at in this study, only government effectiveness has a statistically significant positive coefficient at a significance level of 5% (coefficient = 0.267465, p = 0.000). According to estimates, the coefficients of the remaining three governance variables, namely regulatory quality, control of corruption, and voice and accountability, are individually found to be statistically insignificant at a significance level of 5 percent. Moreover, it is worth noting that the factor of government effectiveness not only exhibits statistical significance but also demonstrates the anticipated direction of influence. Additionally, it exerts the most substantial marginal effect on the growth of manufacturing sector output among the BRICS nations. According to estimates, the governance factor of voice and accountability exhibited the anticipated sign on its coefficient. However, the factors of control over corruption and regulatory quality displayed unexpected signs.

The surprising variations in the coefficients of control of corruption and regulatory quality governance factors can be attributed to the consistently low index values of regulatory quality and control of corruption observed in the BRICS nations throughout the study period. Furthermore, these values exhibited a narrower range compared to the other governance indicators that were analyzed. For example, the descriptive statistics revealed that the highest value observed for regulatory quality among the BRICS nations was merely 0.4464 (on a scale with a maximum possible value of 2.5). Similarly, the highest value observed for control of corruption among the BRICS nations was only 0.1684 (on the same scale). In addition to the impact of governance indicators, the model's estimations indicate that gross fixed capital formation, human capital, openness, and lending interest rates have a positive and statistically significant influence on the growth of the manufacturing sector within the BRICS nations. With the exception of the lending interest rate, the signs of the other three variables were as expected. The positive coefficient of interest rate can be attributed to the substantial government subsidies provided to the manufacturing sector in the majority of BRICS nations. Consequently, an increase in interest rates may be linked to an expansion in manufacturing sector output.

Results from Robustness Tests: The Wald Chi-square statistic rejects the null hypothesis of model insignificance at a 5 percent level of significance, suggesting that the entire model is significant statistically. The estimated Z-statistics from the Arellano-Bond test for AR(1) and AR(2) do not reject the null hypotheses of no serial correlation first order and second order respectively at a 5 percent level of significance, suggesting that the residuals from the estimated regression are not serially correlated of order and order two respectively. The Chi-square statistic from the Jarque-Bera does not reject the null hypothesis of normally distributed residuals at a 5 percent level, suggesting that the residuals from the estimated regression are normally distributed. The Chi-square statistic from the Sargan test does not reject the null hypothesis of no over-identifying restrictions at the 5 percent level, suggesting that the instruments used in the D-GMM estimation are jointly valid. The Chi-square statistic from the Hausman specification test rejects the null hypothesis, suggesting that the difference in coefficients between the D-GMM estimator and the OLS estimate is systematic, which is an indicator that the D-GMM estimator is preferred.

5. Conclusion

The objective of this study was to examine the impact of governance on the growth of the manufacturing sector within the BRICS countries during the time frame of 2010-2021. The study examined four governance factors, specifically government effectiveness, regulatory quality, control of corruption, and voice and accountability. The empirical model has been constructed, incorporating four governance variables as primary explanatory variables, alongside growth factors derived from exogenous and endogenous growth theories, serving as control variables. The estimation process has been accomplished through the utilization of the first difference generalized method of moments (D-GMM). According to estimates, among the BRICS nations, the factor of government effusiveness emerged as the most significant predictor of the growth in the manufacturing sector output, out of the four governance factors that were examined. According to the estimates, the governance factors of regulatory quality control of corruption, and voice and accountability do not exhibit a significant impact on the growth of manufacturing sector output among the BRICS nations. The findings of this study indicate that the BRICS nations have the potential to augment the growth of their manufacturing sector output through the enhancement of their respective governments' effectiveness, implementation of policies that promote capital formation, additional investments in human capital, and increased engagement in international trade. Therefore, BRICS countries should devote a sizeable portion of their resources to building solid mechanisms that make it easier for the implementation, oversight, and thorough reporting of government activities inside their manufacturing sector. This strategy could increase governmental effectiveness, which would encourage overall manufacturing sector growth.

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