The Impact of Military Spending on Sustainable Development: a Bayesian Analysis for BRICS Countries

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Abstract

This study provides evidence that military expenditure hinders sustainable development within the BRICS nations. Analyzing data from 2000 to 2022 using a Bayesian regression methodology for panel data, the results reveal that increased military spending negatively impacts sustainability in these emerging economies. Policymakers are urged to prioritize sustainable initiatives over expanding military spending to promote a long-term growth and stability. The effects of military spending on sustainable development vary depending on measurement metrics, such as military spending per capita or as a percentage of GDP. Additionally, it is found that international commerce and foreign direct investment (FDI) are vital for advancing sustainable development, while factors like corruption and energy consumption reduce sustainable development levels. The effect of economic growth on sustainable development remains ambiguous. The findings strongly indicate that military expenditure has a detrimental effect on the progress of BRICS countries toward achieving the Sustainable Development Goals (SDGs).

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INTRODUCTION

Sustainable development is not merely an economic indicator; it is the indispensable foundation for a thriving future. It demands a profound understanding of our present consumption, compelling us to harmonise economic advancement, social equity, environmental conservation, and resource preservation for generations to come (Nguyen et al., 2025). This is not an option, but an imperative for our collective survival and prosperity (Dembicka-Niemie, Buczyński and Mołodowicz, 2023). The imperative of sustainable development has transcended a mere academic discourse, emerging as a critical economic variable demanding the urgent attention of policymakers and economic analysts alike. Its profound impact on long-term development achievements, spanning generations, necessitates immediate and decisive action. The United Nations, recognizing this global exigency, established 17 Sustainable Development Goals (SDGs) in 2015. These goals are not merely aspirational; they are a comprehensive blueprint for confronting and overcoming the most pressing global challenges of our time, including the eradication of poverty, reduction of inequality, creation of employment opportunities, reversal of biodiversity loss, and improvement of public health outcomes. Failure to prioritize and vigorously pursue these SDGs will undoubtedly lead to dire consequences for our planet and its inhabitants (Chasek et al., 2016). Consequently, over the past decade, achieving the SDGs has become a prominent objective on the agenda of most governments and international organizations. However, achieving this goal has proven to be very challenging, particularly in the context of increasing warfare, armed conflicts, and geopolitical tensions (Jiang et al., 2023), along with the growing trend of nations to increase their military spending. Military spending touches on the funds allocated to a nation's defence budget (Akusta, 2024). Elevated military investment is not merely a defensive measure; it is a proactive strategy for national prosperity. By fortifying security and guaranteeing peace, a nation cultivates an environment ripe for robust investment, thereby igniting and sustaining powerful economic growth (Atesoglu, 2009; Uddin and Shafiq, 2023).

In today's societies, the military stands as an indispensable pillar, wielding cutting-edge weaponry forged by advanced manufacturing powerhouses and supported by vast infrastructures crucial for safeguarding national defence (Asongu and Ndour, 2023). These entities not only focus on the development of cutting-edge technology but also play an absolutely critical role in shaping geopolitical dynamics and ensuring security on a global scale. The Stockholm International Peace Research Institute (SIPRI) reported that global military expenditure attained a historic peak of $2.4 trillion USD in 2023 (SIPRI, 2024), and this upward trajectory is seen as an escalating challenge for governments in their pursuit of the SDGs. Scarce resources directly constrain governmental expenditures, including critical areas like military spending, thereby severely compromising the quality of budget allocations for the SDGs and, as a direct consequence, undermining the capacity to achieve these vital objectives. Perlo-Freeman (2016) posits that the influence of military spending on the SDGs is significant, suggesting that reallocating slightly under half of global annual military expenditures would suffice to achieve the majority of the SDGs. Consequently, governments are compelled to strike a critical balance between safeguarding national security through robust military expenditure and vigorously pursuing solutions to attain the SDGs.

Numerous empirical studies have explored the factors influencing sustainable development, aiming to identify pathways for improvement. This research endeavours to critically examine the profound influence of military spending on sustainable development within a sample of five pivotal BRICS nations (Brazil, Russian Federation, India, China, and South Africa), highlighting its crucial implications. BRICS constitutes one of the most significant economic coalitions globally, representing about a quarter of the world's GDP and 42% of the global population (Duong et al., 2021; Nguyen and Duong, 2021; Nguyen et al., 2025; UNCTAD, 2023). BRICS has increased its economic influence over the past decades, acting as a driver of growth, trade, and global investment. This paper examines this topic as Sustainable Development Goal 16 (SDG 16) – encompassing peace, justice, and robust institutions – is deemed essential

for the achievement of other goals (Thorp, 2022). This paper spotlights the BRICS nations because their immense budget allocations for weapons, ammunition, and military-industrial advancement are not just substantial – they are a critical anomaly. While global military expenditure has thankfully declined due to the undeniable benefits of peace, the BRICS nations stubbornly funnel a disproportionate share of their central government budgets into military sectors and enterprises, a trend that demands urgent scrutiny. The five BRICS countries accounted for 21.56% of total global military spending in 2023 (SIPRI, 2024), and the amount allocated for investment in the military sector in the BRICS countries has increased significantly compared to other blocs and regional groups (Oladotun et al., 2019). There are eleven countries in the BRICS right now: Brazil, China, India, Russia, and South Africa were the original five members, and Egypt, Ethiopia, Indonesia, Iran, Saudi Arabia, and the United Arab Emirates joined in 2024–25. Brazil, Russia, India, and China formed the group in 2006. South Africa joined in 2011, and the new additions that started in 2024 came from the Johannesburg Declaration, which was made in August 2023 (BRICS Brasil, 2025). The expansion of new members into the group (BRICS+) implies that the world is fragmenting into opposing blocs, and geopolitical competition is intensifying (Patrick, 2024). A second, even more compelling reason is that BRICS leaders have not merely pledged, but have consistently demonstrated an unwavering commitment in summit statements to actively enhance collaboration to foster peace, establish a truly representative international order, fundamentally reform and significantly improve the multilateral system, vigorously promote sustainable development, and ensure genuinely equitable growth for all. These five influential countries possess a unique opportunity to leverage the BRICS summit as a powerful platform to not only reflect but actively champion the SDG agenda with other nations, especially given that all BRICS summits are strategically hosted in one of the five BRICS nations, with the host nation extending crucial invitations to other key regional leaders, thereby amplifying their collective impact. Such events can be used to rally regional support for the implementation of the SDGs (Papa, 2017). The internal struggle among BRICS nations renders this empirical inquiry not merely intriguing but critically imperative to examine. The undeniable conflict between India and China, while acknowledged, belies the profound truth that these nations, as the fastest-growing global powers, possess a collaborative potential that could irrevocably reshape the political landscape. Their ability to transcend internal friction and forge a unified front is not just a matter of economic growth, but a pivotal determinant of future global power dynamics.

Building upon the compelling arguments presented, this groundbreaking research meticulously investigates the profound impact of military spending on sustainable development. Employing sophisticated Bayesian regression models and leveraging comprehensive annual data from the five BRICS nations spanning 2000 to 2022, our findings unequivocally demonstrate a detrimental effect of military expenditure on sustainable development. This work significantly enriches the existing literature in three crucial ways. Firstly, to our knowledge, this is the inaugural empirical research to rigorously examine the influence of military spending on the level of sustainable development, specifically within the BRICS nations. We decisively address this critical gap by providing a robust empirical evidence illuminating the intricate correlation between military spending and sustainable development in these pivotal economies. Secondly, our analysis offers an unparalleled, holistic perspective, meticulously encompassing the economic, social, and environmental dimensions of military spending's impact on sustainable development. This paper delivers an exhaustive and nuanced analysis of military expenditure's far-reaching consequences. Thirdly, by pioneering the application of the Bayesian linear regression technique for panel data, this paper delivers results that are demonstrably more robust and inherently reliable than those yielded by conventional frequentist regression techniques, thereby setting a new standard for methodological rigour in this field.

The subsequent sections of the paper are organized as follows: Section 1 offers a review of the literature about the correlation between military expenditure and sustainable development; Section 2 delineates the model and research methods; Section 3 articulates the findings; and last Section provides the conclusion.

1 LITERATURE REVIEW ON THE RELATIONSHIP BETWEEN MILITARY SPENDING AND SUSTAINABLE DEVELOPMENT

Sustainable development is a complex notion defined as progress that fulfils existing demands without hindering the next generations' capacity to meet their own needs (WCED, 1987). It is widely recognized that sustainable development encompasses three main components: economic, social, and environmental pillars (Dembicka-Niemie et al., 2023). These components are absolutely vital for rigorously evaluating and measuring progress and sustainability in a country's development process. The SDGs, unequivocally established by the United Nations in 2015, are universally recognized and comprise 17 primary objectives and 169 subsidiary targets, forming an indispensable framework. Simultaneously, the SDG indicators powerfully illuminate diverse facets of economic, social, and environmental concerns. The SDGs include a series of interconnected, urgent plans for nations and regions worldwide, aimed at achieving sustainable development by 2030 – a critical deadline. These objectives are the essential successors of the Millennium Development Goals (MDGs), a collection of international development targets established in 2000, building upon their legacy with renewed ambition and scope. The SDGs aim to perpetuate the agenda established by the MDGs (Akusta, 2024).

Military spending, a portion of public funds, has an impact on national economies and global stability, making the study of military expenditure not merely important but essential for both general economics and the specialized field of defence economics. Ganesh (2017) argues that it is difficult to define military spending because its composition varies across countries and organizations. Moreover, governments wield the power to define military spending according to their own strategic imperatives and national aspirations. Simply put, military spending represents the critical investment a country makes to fortify and sustain its armed forces, ensuring robust defence capabilities and safeguarding national interests. This includes the salaries of military personnel, the purchase of weapons and ammunition, research and development (R&D) activities, military operations, and maintenance costs (Akusta, 2024; Ganesh, 2017).

The undeniable influence of military spending on sustainable development is powerfully illuminated by the Peace Economics Theory. This compelling theory unequivocally asserts that robust economic interconnectedness not only fosters peace but also actively mitigates violence. The profound truth is that economic interdependence is a cornerstone of peace, as collaborative efforts among private entities demonstrably yield significant national economic advantages, paving the way for a more sustainable and prosperous future (Bijaoui, 2014). Increasing military spending is not only destructive and inefficient, but it also diverts crucial resources from peaceful and productive endeavours. Empirical evidence overwhelmingly demonstrates the detrimental impact of military expenditure across economic, social, and environmental spheres. Economically, elevated military spending leads to a severe misallocation of resources, actively hindering sustainable growth. While it may temporarily boost aggregate demand by replacing a non-defence governmental expenditure, this surge is fleeting and fails to translate into long-term economic prosperity. Instead, the redirection of resources towards the military industry stifles innovation and limits productivity growth, ultimately impeding overall economic advancement (Arshad et al., 2017; Saeed, 2025). Previous research has shown diverse findings regarding the influence of military expenditure on health, education, inequality, and overall social welfare. Previous research has unequivocally demonstrated diverse and often detrimental findings regarding the influence of military expenditure on health, education, inequality, and overall social welfare, demanding immediate and critical re-evaluation. For example, Lin et al. (2015) show a positive trade-off between military expenditure and two categories of social welfare spending (i.e., spending on education and health) in the OECD nations. Lin et al. (2015) propose that one reason for this phenomenon may be that the OECD countries allocate greater resources to social welfare programs; hence, when military expenditure rises (e.g., military personnel and conscripts), the government may concurrently augment spending on health

and education. Töngür and Elveren (2015) demonstrate a positive correlation between income inequality and the proportion of military expenditure in central government budgets, indicating that the frequency of terrorist incidents significantly affects both military expenditure and inequality across a sample of 37 nations. Military activities, along with the weapons and ammunition used in these operations, contribute to environmental pollution and deplete natural resources (Asongu and Ndour, 2023; Mahmood, 2024; Tarczyński et al., 2023). According to Asongu and Ndour (2023), military spending contributes directly to environmental deterioration through increased carbon emissions. Elgin et al. (2022) analysed a sample of 160 nations from 1950 to 2018 to investigate the correlation between military expenditure and economic indicators, encompassing health, education, environmental factors, and social dimensions of sustainable development. The comprehensive findings indicate that military expenditure is inversely correlated with educational achievement, life expectancy, rates of infant and maternal mortality, gender equality, women's labour force participation, and access to potable water, electricity, and sanitary facilities. It is positively correlated with mortality and levels of poverty, as well as air pollution. The comprehensive findings clearly demonstrate that military expenditure is not merely inversely correlated with crucial societal indicators, but actively undermines them. It directly erodes educational achievement, diminishes life expectancy, tragically inflates rates of infant and maternal mortality, stifles gender equality, restricts women's labour force participation, and severely limits access to potable water, electricity, and sanitary facilities. Conversely, it is a direct catalyst for increased mortality, exacerbated levels of poverty, and intensified air pollution. This is not a mere correlation; it is a devastating causal link that demands immediate re-evaluation of priorities. Furthermore, Elgin et al. (2022) findings indicate a stronger (weaker) relationship between military spending and stronger (weaker) development indices in less (more) developed nations. When examining the impact of military expenditure on the level of sustainable development for military organizations specifically, the North Atlantic Treaty Organization (NATO), Akusta (2024) used annual data from 1995 to 2019 and found that military spending has a negative impact on sustainable development in 26 NATO countries. The analysis of military expenditure's effect on sustainable development in individual NATO nations reveals that such spending significantly influences sustainable development in 20 countries (79.9%). In 13 out of 20 nations (65%), the detrimental effect of military spending on sustainable development was substantiated. The analysis of military expenditure's effect on sustainable development in individual NATO nations reveals that such spending significantly influences sustainable development in 20 countries (79.9%). In 13 out of 20 nations (65%), the detrimental effect of military spending on sustainable development was substantiated, underscoring a critical need for re-evaluation and policy shifts to prioritize sustainable growth over military expansion.

In summary, the evidence from past research unequivocally demonstrates that the defence expenditures – sustainable development relationship is intricate and subtle. In some cases, the destructive impact of defence expenditures is quite considerable, but in other cases, defence expenditures have other implications when interacted with the variables of the economy or the variables of the defence's strategy. These compelling findings underscore the critical requirement of rigorously evaluating the defence policies and defence expenditures' probable impacts upon sustainable development.

2 MODEL AND RESEARCH METHODOLOGY
2.1 Model and dataset

The framework for examining the influence of military spending on the level of sustainable development is structured as follows:

$$SDI_{i,t} = \beta_0 + \beta_1 ME_{i,t} + \gamma X_{i,t} + \alpha_i + \varepsilon_{i,t} ,$$

(1)

where *i* represents a country and *t* represents the year. The SDI signifies the sustainable development indicator, used as the dependent variable. SDI measures the capacity to meet present and future needs. Specifically, the SDI is developed from the human development index (HDI), incorporating environmental aspects to gauge sustainable development based on a balance of economic, social, and environmental progress (Hickel, 2020). This indicator was used by Akusta (2024) when analysing the impact of military spending on the level of sustainable development in NATO nations. ME represents military spending and is measured by two indicators: military spending per capita (MEpc) and military expenditure as a percentage of GDP (MEgdp). Military expenditure per capita and as a percentage of GDP are two distinct ways to measure a country's military spending, each offering a different perspective. Military expenditure per capita reflects the average amount spent on the military for each person in a country. This metric divides the total military expenditure of a country by its population, providing a per-person cost. It reflects the individual financial burden of military spending. This metric reveals the individual financial burden of military spending on each citizen. A high per capita expenditure might suggest a significant commitment to defence. In contrast, military expenditure as a percentage of GDP indicates the proportion of a nation's economic output that is allocated to its military. It's a useful indicator of the relative economic burden of military spending (Ganesh, 2017). This measure reflects the relative economic effort a country is putting into its military. A higher percentage indicates a greater portion of the nation's resources being dedicated to defence, potentially impacting other sectors. The computed coefficient β_1 quantifies the effect of military spending on the sustainable development index. X denotes supplementary control variables incorporated in the analysis, while γ signifies the regression coefficients associated with these variables. Regarding the control variables, we considered a broad set of control variables commonly used in the sustainability literature (Akusta, 2024; Khan and Farooq, 2019; Sheikh et al., 2021). These control variables include: international trade (Trade), foreign direct investment (FDI), corruption (CORRP), energy consumption (PEC), and economic growth (GDPgr). α_i represents the individual country fixed effects, and ε_{it} represents the random error term.

This study gathers annual data from 2000 to 2022 for the five BRICS countries. The SDI data are sourced from Hickel (2020), military spending data from the SIPRI, corruption data from Standaert (2015), PEC data from the US Energy Information Administration (IEA), and all remaining data are from the World Bank's World Development Indicators (WDI). The study period is determined by the availability of data, specifically the SDI data. In this study, the MEpc and PEC data are transformed using the natural logarithm to reduce skewness and minimize heteroscedasticity. The notation "Ln" is applied before the variables in indicating the use of this transformation.

115 observations make up the final sample. A more precise breakdown of the measurement as well as the variables' sources in the model is indicated in the ensuing Table 1.

Table 1 Definitions and data sources of variables

Variable	Symbol	Measurement	Source
Dependent variable			
Sustainable development	SDI	Sustainable development index (values range from 0 to 1, higher values indicate greater sustainability)	Hickel (2020)
Independent variables			
Military expenditure	MEpc	Military expenditure per capita (USD)	SIPRI
Military expenditure	MEgdp	Military expenditure as % of GDP	SIPRI

Table 1 (continuation)

Variable	Symbol	Measurement	Source
Control variables			
International trade	Trade	Total value of goods and service exports and imports as % of GDP	WDI
Foreign direct investment	FDI	Net FDI inflows as % of GDP	WDI
Corruption	CORRP	Bayesian corruption index (values range from 0 to 100, higher values indicate higher corruption)	Standaert (2015)
Energy consumption	PEC	Primary energy consumption per capita (kilowatt-hours)	EIA
Economic growth	GDPgr	Annual percentage growth of GDP (%)	WDI

Source: Own calculation

2.2 Regression strategy

This study employs Bayesian linear regression in analysing the effect of defence expenditures on sustainable development since Bayesian regression is less likely to encounter convergence problems when using limited sample sizes (Kruschke and Liddell, 2018) This is applicable since the sample size of the present paper is limited at 115 observations per year. Bayesian models can also be applied with the use of the preexisting knowledge about the relationship between predictor variables and the outcome variables (Gelman and Hill, 2006; Kruschke and Liddell, 2018). Bayesian models also measure the uncertainty level after considering the input of the data as well as the preexisting set's knowledge.

Bayesian linear regression employs Bayes' theorem in updating our beliefs about model parameters from the use of the observed data (Bayes, 1763). Bayesian linear regression is tasked with finding the posterior distribution of the model parameters as compared to finding a single "optimum" value for the model parameters. Bayesian linear regression's posterior model parameters depend entirely upon the input as well as the output as seen from the equation:

$$p(\theta|\text{data}) = \frac{p(\text{data}|\theta)p(\theta)}{p(\text{data})}, \tag{2}$$

where θ denotes a set of parameters, $p(\theta|data)$ represents the posterior distribution of the parameters, $p(\theta)$ is the prior distribution of the parameters, $p(data|\theta)$ is the likelihood function, and $p(data)$ is the marginal likelihood of the data, which can be treated as a constant; therefore, it can be omitted from Formula (2). Consequently, Formula (2) can be rewritten as follows:

$$p(\theta|\text{data}) \propto p(\text{data}|\theta)p(\theta). \tag{3}$$

Prior information be incorporated into the likelihood to derive the Bayesian posterior distribution. To conduct Bayesian regression, this study uses an uninformative prior, following the work of Nguyen and Duong (2021), Nguyen et al. (2025), and Duong et al. (2021). The reason for using uninformative priors is that we avoid the appearance of subjectivity. Non-informative priors are essential in Bayesian statistics, signifying negligible prior knowledge regarding parameters. Their objective is to allow facts to govern posterior distributions, in accordance with unbiased inference goals. These priors seek to eliminate the incorporation of subjective judgments or biases into analysis (Banner et al., 2020; Wesner and Pomeranz, 2021). The likelihood function is assumed to be derived from Formula (1). The Markov Chain Monte Carlo (MCMC) technique and the Gibbs sampling algorithm are employed to generate

the posterior distribution. The levels of evidence for the impact of military spending on sustainable development depend on the posterior probability of each mean parameter, as proposed by Raftery (1995).

3 RESEARCH RESULTS
3.1 Descriptive statistics

Figure 1 vividly illustrates the stark disparities in military expenditure (ME) and their profound implications for sustainable development within the BRICS nations. The 2022 data, representing the culmination of the study period, reveals a critical juncture. South Africa, with its remarkably modest military spending of just over 3 billion USD, stands in stark contrast to its BRICS counterparts. Brazil's expenditure, at approximately 20.5 billion USD, pales in comparison to India's nearly 80 billion USD. Russia's staggering outlay of over 102 billion USD is dwarfed only by China's colossal military spending, approaching 292 billion USD – an astonishing 2.9 times greater than Russia's and an almost unfathomable 97 times greater than South Africa's. It is a sobering reality that three BRICS members – China, Russia, and India – were among the top five global military spenders in 2022, diverting immense resources that could otherwise fuel sustainable progress. When examining military spending as a percentage of GDP, Russia's alarming 4.69% (a direct consequence of the Russia-Ukraine conflict) underscores the devastating economic toll of militarization. India's 2.36%, China's 1.62%, and Brazil's 1.07% further highlight this trend, with South Africa's commendable 0.77% serving as a beacon of fiscal prudence. These figures are not mere statistics; they represent a critical choice between investing in instruments of war and fostering a future of sustainable prosperity for all.

The SDI unequivocally highlights the critical importance of sustainability in developmental processes, serving as a powerful metric for a nation's commitment to a healthy environment, elevated living standards, and equitable educational opportunities for future generations. Brazil (0.741) and South Africa (0.712) stand out with the highest scores for the Sustainable Development Index, demonstrating their remarkable success in environmentally sustainable investments, energy savings, and maintaining robust educational standards. In stark contrast, India (0.694) and Russia (0.541) exhibit only a mediocre level of sustainable development, underscoring the urgent need for improvement. Most concerning is China, with a dismal 0.378, indicating the lowest levels of sustainable development and revealing a profound deficit in achieving essential advancements in environmental management, health, and education. This data compels us to recognize that sustainable development is not merely an aspiration, but a fundamental imperative for global well-being and future prosperity.

Figure 1 Military spending and sustainable development in BRICS countries for 2022
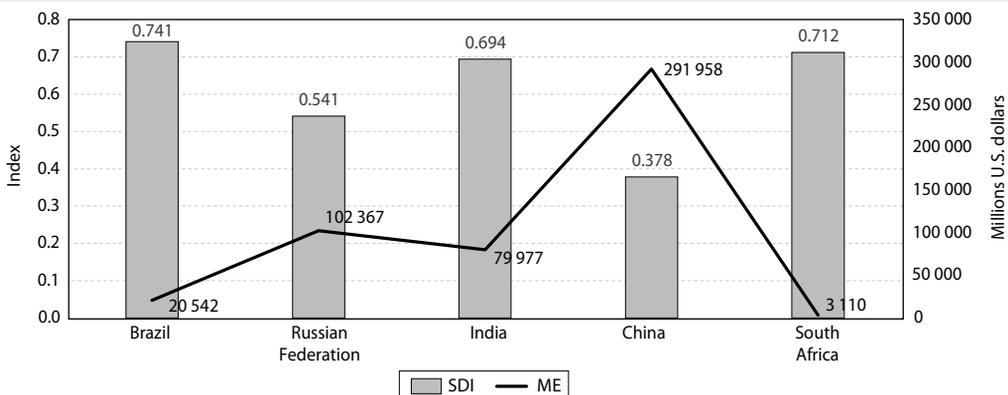
Source: Own calculation

Figure 1 shows an inverse relationship between military expenditure and sustainable development in BRICS nations. Brazil and South Africa, for example, achieve high SDI values with moderate military spending, powerfully illustrating how prioritizing education, health, and environmental sustainability over excessive defence spending maximizes national development. Conversely, Russia and China's high military expenditure coupled with low SDI values starkly reveals the detrimental impact of diverting crucial economic resources to military endeavours, neglecting vital investments in environmental management and social services.

Table 2 Descriptive statistics of the variables

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
SDI	115	0.6622	0.0827	0.3780	0.7620
LnMEpc	115	4.4434	0.9446	2.5974	6.5616
MEgdp	115	2.1637	1.0253	0.7678	5.4251
Trade	115	44.4182	11.7438	22.1060	68.0939
FDI	115	2.3080	1.4421	−1.7564	9.6603
CORRP	115	52.5935	5.2309	42.7773	62.5274
LnPEC	115	9.8310	0.8055	8.1511	10.9963
GDPgr	115	4.4968	3.9405	-7.8000	14.2309

Source: Own calculation

Table 2 compellingly reveals that sustainable development (SDI) in the BRICS nations, while moderate with a mean of 0.6622, still presents significant room for growth, ranging from a concerning low of 0.3780 to a promising high of 0.7620. This average level underscores the urgent need for enhanced strategies to elevate sustainable practices across the board. Simultaneously, the substantial military spending, averaging 4.4434 for LnMEpc (approximately 135 USD per capita) and consuming an average of 2.16% of GDP (with a striking range of 0.7% to 5.43%), highlights a critical allocation of resources that could potentially be redirected towards bolstering sustainable development initiatives. The descriptive data on control variables further enriches this picture, offering crucial insights for strategic interventions.

3.2 Regression results

Table 3 compellingly showcases the results of our Bayesian regression model from Formula (1), providing crucial insights into the mean and posterior probability of the parameters. Furthermore, Table 3 offers essential information for a thorough MCMC diagnosis. This study rigorously employs two distinct military spending variables: military spending per capita (Column 1) and military spending as a percentage of GDP (Column 2), ensuring a comprehensive and robust analysis.

The posterior distributions of the parameters are generated using the MCMC technique in Bayesian estimation, as outlined in the regression strategy section. Kruschke (2015) underscores that researchers must prioritize representativeness (convergence) and stability (accuracy) when employing the MCMC approach to produce the posterior distribution. Before analysing the experimental effect of military spending on the level of sustainable development, MCMC diagnostics are rigorously conducted. This study employs the Rc statistic to definitively test convergence and sampling efficiency to robustly ensure stability, thereby strengthening the reliability of our findings. The results from Table 3 reveal that

the highest values of the Rc statistic are 1.1150 and 1.1670 (both less than 1.2), which means that the model parameters have converged (Brooks and Gelman, 1998). Simultaneously, the average sampling efficiency varies from 11.30% to 11.75% (greater than 1%); therefore, the Bayesian estimates demonstrate sufficient accuracy.

Table 3 Bayesian regression results

Independent variables	Column (1)		Column (2)	
	Mean	Posterior probability	Mean	Posterior probability
LnMEpc	−0.0171 (−0.0499; 0.0155)	0.8468**		
MEgdp			−0.6108 (−3.9955; 2.7640)	0.6443**
Trade	0.0040 (0.0024; 0.0056)	0.9999*	0.0 43 (0.0028; 0.0058)	1.0000*
FDI	0.0054 (−0.0015; 0.0124)	0.9377*	0.0043 (−0.0025; 0.0112)	0.8951*
CORRP	−0.0095 (−0.0137; −0.0053)	1.0000**	−0.0095 (−0.0134; −0.0052)	1.0000**
LnPEC	−0.1289 (−0.2249; −0.0278)	0.9968**	−0.1699 (−0.2322; −0.0918)	1.0000**
GDPgr	−0.0001 (−0.0034; 0.0032)	0.5079**	0.0001 (−0.0032; 0.0034)	0.5328*
_cons	2.3605 (1.3014; 3.3343)	1.0000*	2.9698 (1.6933; 4.0436)	1.0000*
σ_i	0.0657		0.4412	
$\varepsilon_{i,t}$	0.0017		0.0017	
Number of observations	115		115	
Number of countries	5		5	
MCMC diagnostics				
Average sampling efficiency	0.1130		0.1175	
Maximum Rc value	1.1150		1.1670	

Notes: The dependent variable is SDI; ME in column (1) is measured by LnMEpc; ME in column (2) is measured by MEgdp; a Bayesian 95% credible interval in brackets. * The probability that the mean coefficient is positive. ** The probability that the mean coefficient is negative.
Source: Own calculation

Next, this study investigates the influence of military expenditure on the level of sustainable development. Specifically, the results in Column 1 show that the mean of the LnMEpc variable is −0.0171, with a probability of 84.68% that this parameter negatively affects sustainable development (SDI). Therefore, it is concluded that military spending (measured by military expenditure per capita) exerts a moderate and adverse impact on sustainable development. In Column 2, the mean of the MEgdp variable is −0.6108, with a probability of 64.43% that this parameter harms sustainable development (SDI). Therefore, it has been concluded that military spending (measured as a percentage of GDP) had a weak negative effect on sustainable development. In general, the experimental results of this paper suggest that the greater

the military spending, the less likely there will be sustainable development. The impact of military spending on sustainable development is weak or moderate, depending on how military spending is measured. There is a difference in the impact of the two measures of military spending on sustainable development in the five BRICS countries that can be explained as follows. Firstly, military expenditure per capita is a significant indicator, reflecting the resources a country allocates to its military relative to its population. It offers observations about a nation's security priorities, economic capacity, and potential for military engagement. Higher per capita military spending can indicate a greater perceived threat, a strong military focus, or the ability to afford a larger military force. Conversely, the vast differences in national economies distort military expenditure as a percentage of GDP. A large, wealthy nation, for example China, spends a relatively small percentage of its GDP on defence and still commands an enormous budget in absolute terms, capable of funding advanced research, large forces, and global reach. A smaller economy, such as South Africa, may achieve only a fraction of that absolute spending, even with a higher percentage of its GDP dedicated, which limits the scale and sophistication of its capabilities. Both conflict/war and geopolitical tensions are undeniably potent catalysts for escalating military spending within BRICS nations. This expenditure, far from being a mere line item, consumes a disproportionately large share of government budgets, often at the expense of vital sectors like healthcare and education. The implications of this prioritization are profound and warrant immediate attention. This field is often among the top four in government budgetary decisions (Anifowose, 2019). Given resource scarcity, changes in government expenditure of the BRICS countries can profoundly affect the nature of budget allocation for SDGs, with dire consequences for the prospect of accomplishing these vital goals. Specifically, public expenditures such as military spending, in which increasing military spending has the potential to severely impede the path towards SDGs, because the scarcity of resources inherently limits the extent to which governments can increase resources for military purposes and also continue to adequately allocate resources for critical goals such as education, poverty, equality, and the environment. This is not merely a matter of competing priorities; it is a fundamental trade-off that demands urgent attention and strategic foresight to ensure a sustainable and equitable future. Military activities are associated with the use of fossil fuels, which are the main sources of greenhouse gas emissions (Bargaoui and Nouri, 2017). Additionally, Jorgenson et al. (2010) argue that the production and maintenance of military equipment, construction and maintenance of military infrastructure, and defence R&D activities also increase emissions. Military activities degrade ecosystems because they use a large amount of natural resources and pollute them through the use of toxic and radioactive substances (Singer and Keating, 1999). Additionally, military spending impacts the environment by increasing the mobility of military personnel and large military hardware, both of which require high energy consumption (Clark et al. 2010). Similarly, military experiments, training, and exercises use large amounts of fuel, such as on ships, missiles, and aircraft. Such activities increase the amount of pollutant emissions into the atmosphere (Asongu and Ndour, 2023; Jorgenson et al., 2010). Thus, the literature unequivocally agrees that the opportunity cost of military spending serves as a critical and undeniable causal factor contributing to the severe and detrimental adverse effects of military spending on national sustainability. Our findings corroborate the Peace Economics Theory and the research of Akusta (2024) and Elgin et al. (2022), which emphasize the substantial adverse effect of military expenditure on sustainable development.

Regarding the control variables, our results unequivocally demonstrate that international trade and FDI are powerful catalysts for sustainable development. Conversely, increased corruption and energy consumption are significant impediments, actively diminishing sustainable development. Moreover, while the influence of economic growth on sustainable development presents a nuanced picture, the impact of trade is crystal clear. With mean coefficient estimates for trade of 0.0040 in Column 1 and 0.0043 in Column 2, and an astounding probability of 99.99 to 100% for a positive impact, it is undeniable that a rise in international trade is a direct pathway to enhanced sustainable development. Our findings

contradict those of Sheikh et al. (2021), yet align with the conclusions of Khan and Farooq (2019), who reached analogous results. worldwide commerce enhances employment, elevates living standards, boosts domestic and worldwide demand, expands production, and facilitates technological adaptation. Furthermore, international commerce is a powerful engine for progress, dramatically boosting both the quantity and quality of goods and services exchanged. This leads to the most efficient and effective utilization of global resources, forming the bedrock of sustainable development. The strategic expansion of trade is not merely about economic growth; it is a commitment to safeguarding our natural resources and environment, pioneering advanced conservation methods for future generations, and significantly elevating economic and social mobility across the BRICS nations. Moreover, the compelling evidence from FDI coefficients, at 0.0054 (Column 1) and 0.0043 (Column 2), reveals an overwhelming probability – ranging from 89.51% to an impressive 93.77% – of a positive and transformative impact on sustainable development. This isn't just a possibility; it's a near certainty for a brighter, more sustainable future. Therefore, a higher level of FDI tends to increase the level of sustainable development. This finding is consistent with earlier evidence, for instance, Khan and Farooq (2019), since they contend that increased FDI results in increased sustainability due to technological advancement. Third, the average coefficient of CORRP is negative with a 100% probability of the negative effect of this variable on sustainable development. The results show that corruption significantly discourages sustainable growth in the BRICS economies. This is consistent with Khan and Farooq (2019) and supports the sand in wheels hypothesis, which contends that corruption has a negative effect on economic growth due to inefficient allocation of resources and poor decisions, thereby negatively affecting socioeconomic development. The estimated coefficients of LnPEC are negative, with 99.68% (Column 1) and 100% (Column 2) probability of a negative effect on sustainable development, showing that primary energy consumption is associated with lower sustainable development. These results align with Akusta (2024). Ultimately, we observe a mixed impact of economic growth on sustainable development within the BRICS nations. Specifically, the mean coefficient of GDPgr is negative (Column 1) and positive (Column 2). In addition, the probability that the economic growth variable affects sustainable development is between 50.79% and 53.28% (indicating a weak impact), so the relationship between economic growth and sustainable development remains ambiguous.

3.3 Robustness test

To test robustness, we control for country fixed effects to eliminate all sources of constant heterogeneity at the country level and use year dummies to account for shocks that are common across our sample countries. We assess how strong our main results are by comparing them with results from Bayesian models that include year-fixed effects, country-fixed effects, and both year- and country-fixed effects.

Tables 4, 5, and 6 display the results of the robustness test. The convergence and stability diagnostics for MCMC show that the largest Rc statistic values are 1.0731 (less than 1.2) in Column 1 of Table 5 and the smallest average efficient sampling index is 23.11% (greater than 1%) in Column 1 of Table 4. Therefore, the posterior distribution has stopped at the target distribution, and the Bayesian inferences are reliable.

Table 4 presents the outcomes of the Bayesian panel regression that includes year-fixed effects for our sample. The results show that the mean parameter of the variable LnMEpc is negative and its posterior probability is 99.93% (Column 1). Therefore, the impact of military spending, measured by LnMEpc, on sustainable development is very strong. For the expenditure variable, measured by MEgdp, its mean parameter is negative and its posterior probability is 90.60% (Column 2), so there is moderate evidence of a negative impact of military spending on sustainable development.

Table 4 Bayesian regression results with year-fixed effects

Independent variables	Column (1)		Column (2)	
	Mean	Posterior probability	Mean	Posterior probability
LnMEpc	−0.1129 (−0.1739; −0.0509)	0.9993**		
MEgdp			−2.3404 (−6.0292; 1.2919)	0.9060**
Trade	0.0009 (−0.0014; 0.0032)	0.7922*	0.0043 (0.0028; 0.0058)	1.0000*
FDI	0.0094 (0.0028; 0.0159)	0.9966*	0.0079 (0.0007; 0.0151)	0.9843*
CORRP	−0.0118 (−0.0155; −0.0079)	1.0000**	−0.0107 (−0.0145; −0.0068)	1.0000**
LnPEC	−0.0753 (−0.1740; 0.0228)	0.9334**	−0.2039 (−0.2787; −0.1268)	1.0000**
GDPgr	0.0014 (−0.0033; 0.0060)	0.7460*	0.0017 (−0.0033; 0.0068)	0.7621*
_cons	1.8844 (0.4405; 3.1783)	0.9980*	2.8381 (1.7454; 3.9734)	1.0000*
Year fixed effects	Yes		Yes	
Country fixed effects	No		No	
$\varepsilon_{i,t}$	1.4841		0.2227	
σ_i	0.0012		0.0014	
Number of observations	115		115	
Number of countries	5		5	
MCMC diagnostics				
Average sampling efficiency	0.2311		0.2507	
Maximum Rc value	1.0252		1.0363	

Notes: The dependent variable is SDI; ME in column (1) is measured by LnMEpc; ME in column (2) is measured by MEgdp; a Bayesian 95% credible interval in brackets. * The probability that the mean coefficient is positive. ** The probability that the mean coefficient is negative.
Source: Own calculation

Table 5 presents the results of the Bayesian panel regression that includes country-fixed effects for the entire sample. This table shows that the mean parameter of the variable LnMEpc is negative and its posterior probability is 80.60% (Column 1), so the impact of military expenditure, measured by LnMEpc, on sustainable development is moderate. Meanwhile, the impact of the variable MEgdp on sustainable development is found to be weak because the posterior probability of the parameter MEgdp is only 69.22% (Column 2).

Table 5 Bayesian regression results with country-fixed effects

Independent variables	Column (1)		Column (2)	
	Mean	Posterior probability	Mean	Posterior probability
LnMEpc	−0.0127 (−0.0419; 0.0163)	0.8060**		
MEgdp			−0.7385 (−3.6713; 2.2642)	0.6922**
Trade	0.0041 (0.0027; 0.0055)	1.0000*	0.0043 (0.0030; 0.0055)	1.0000*
FDI	0.0049 (−0.0018; 0.0115)	0.9252*	0.0041 (−0.0024; 0.0106)	0.8950*
CORRP	−0.0103 (−0.0139; −0.0066)	1.0000**	−0.0103 (−0.0139; -0.0066)	1.0000**
LnPEC	−0.1543 (−0.2462; −0.0610)	0.9988**	−0.1864 (−0.2473; −0.1259)	1.0000**
GDPgr	0.0001 (−0.0027; 0.0029)	0.5318*	0.0002 (−0.0027; 0.0031)	0.5563*
_cons	2.7787 (1.6008; 3.9232)	1.0000*	3.2417 (1.5565; 5.1804)	1.0000*
Year fixed effects	No		No	
Country fixed effects	Yes		Yes	
$\varepsilon_{i,t}$	2.6		1.9	
σ_i	0.0		0.0	
Number of observations	115		115	
Number of countries	5		5	
MCMC diagnostics				
Average sampling efficiency	0.5		0.5	
Maximum Rc value	1.1		1.1	

Notes: The dependent variable is SDI; ME in column (1) is measured by LnMEpc; ME in column (2) is measured by MEgdp; a Bayesian 95% credible interval in brackets. * The probability that the mean coefficient is positive. ** The probability that the mean coefficient is negative.
Source: Own calculation

The regression results in Table 6, which include both year and country fixed effects, indicate that military spending, measured by LnMEpc, has a very strong effect (with a 99.99% posterior probability in Column 1). Column 2 shows that the average effect of the variable MEgdp has a 93.70% posterior probability, providing strong evidence that military spending negatively affects sustainable development.

The findings obtained by the estimate align closely with the Bayesian estimated coefficients in Table 3, but the posterior probabilities of the mean parameter of the military spending variable in Tables 4, 5, and 6 are stronger than those in Table 3. These results again confirm evidence that military spending has had a negative impact on sustainable development in the BRICS countries.

Table 6 Bayesian regression results with year-fixed and country-fixed effects

Independent variables	Column (1)		Column (2)	
	Mean	Posterior probability	Mean	Posterior probability
LnMEpc	−0.1135 (−0.1690; −0.0578)	0.9999**		
MEgdp			−2.2664 (−5.2208; 0.7354)	0.9370**
Trade	0.0009 (−0.0012; 0.0029)	0.7927*	0.0043 (0.0030; 0.0056)	1.0000*
FDI	0.0092 (0.0031; 0.0153)	0.9977*	0.0077 (0.0009; 0.0144)	0.9878*
CORRP	−0.0122 (−0.0156; −0.0087)	1.0000**	−0.0108 (−0.0145; −0.0070)	1.0000**
LnPEC	−0.0843 (−0.1737; 0.0042)	0.9693**	−0.2092 (−0.2784; −0.1394)	1.0000**
GDPgr	0.0016 (−0.0023; 0.0055)	0.7943*	0.0019 (−0.0024; 0.0062)	0.8112*
_cons	3.0036 (1.8849; 4.2497)	1.0000*	3.0253 (1.9041; 4.2608)	1.0000*
Year fixed effects	Yes		Yes	
Country fixed effects	Yes		Yes	
$\varepsilon_{i,t}$	0.9		0.5	
σ_i	0.0		0.0	
Number of observations	115		115	
Number of countries	5		5	
MCMC diagnostics				
Average sampling efficiency	0.8		0.8	
Maximum Rc value	1.1		1.0	

Notes: The dependent variable is SDI; ME in column (1) is measured by LnMEpc; ME in column (2) is measured by MEgdp; a Bayesian 95% credible interval in brackets. * The probability that the mean coefficient is positive. ** The probability that the mean coefficient is negative.
Source: Own calculation

CONCLUSION

This paper illustrates a critical inverse association: escalating military spending actively undermines sustainable development. Through rigorous Bayesian linear regression applied to extensive panel data from the BRICS nations (2000–2022), we unequivocally show that both military spending per capita and as a percentage of GDP are detrimental to sustainable progress. Our findings serve as an urgent call to action, highlighting the imperative to reallocate resources from military expenditures towards initiatives that genuinely foster sustainable development.

This research offers critical policy implications rooted in compelling empirical findings. Firstly, given the unequivocally detrimental effects of military expenditure on sustainable development, the governments of the BRICS nations should reallocate resources from the defence industry to vital sectors such as health, education, and innovation. This strategic shift is essential for fostering long-term societal well-being. Secondly, the significant positive impact of international trade and foreign direct investment on sustainable development cannot be overstated. Therefore, BRICS nations must proactively cultivate an environment that is exceptionally attractive to investors, streamlining investment procedures to maximize this beneficial influence. Moreover, by rigorously integrating environmental and social criteria, direct investment can be channelled into truly sustainable projects, thereby generating both robust economic and profound social benefits over the long term. Concurrently, a concerted effort to dramatically increase exports and imports of green trading products is crucial. Thirdly, enhancing institutional quality through the vigorous implementation of anti-corruption measures, alleviating economic burdens, and unequivocally reinforcing the rule of law is not just important, but absolutely critical, as these factors are powerful and undeniable predictors of sustainable development. Fourthly, while increasing energy demand is a pervasive trend across developed and rising economies, including the BRICS nations, our results starkly reveal that greater energy consumption will diminish sustainability. Consequently, the governments of the BRICS countries must urgently prioritize and invest heavily in the renewable energy sector. This is not merely an option, but an indispensable tool for drastically reducing CO_2 emissions and significantly boosting sustainability. Policymakers must deploy a comprehensive suite of instruments, including robust tax incentives, accessible low-interest loans, and targeted subsidies, to aggressively encourage both consumers and the private sector to accelerate their transition to renewable energy usage. Finally, it is paramount to vigorously promote economic progress to reach that pivotal turning point where additional GDP growth will unequivocally enhance the sustainable development levels of these nations.

While our findings significantly advance the current body of literature, we acknowledge certain limitations and propose compelling avenues for future exploration. To robustly validate or challenge our conclusions, we strongly advocate for an expanded analysis encompassing diverse regions and countries affiliated with various international organizations. Furthermore, a deeper understanding of the intricate dynamics between military expenditure and sustainable development levels necessitates a thorough investigation into their potential nonlinear relationship.

Finally, the relationship between military spending and sustainable development may be causal. This idea is implicit in the concept of the development-security nexus, which the United Nations reiterates in its SDGs (United Nations, 2015): "Sustainable development cannot be realized without peace and security, and peace and security will be at risk without sustainable development." Therefore, future studies may examine this causal relationship.

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APPENDIX

Table A1 Some parameters of sample data for BRICS countries (2000–2022)

ID	Country	Year	SDI	LnMEpc	MEgdp	Trade	FDI	CORRP	INF	LnPEC	GDPgr
1	Brazil	2000	0.7120	4.1667	1.7307	22.6398	5.0339	52.4032	52.5316	9.5030	4.3879
1	Brazil	2001	0.7170	4.1163	1.9519	26.9363	4.1476	52.2633	56.1249	9.4645	1.3899
1	Brazil	2002	0.7210	3.9806	1.8958	27.6184	3.2536	52.0011	60.8676	9.4744	3.0535
1	Brazil	2003	0.7250	3.8277	1.5035	28.1404	1.8134	51.7541	69.8242	9.4813	1.1408
1	Brazil	2004	0.7320	3.9693	1.4613	29.6783	2.7135	51.5362	74.4306	9.5174	5.7600
1	Brazil	2005	0.7380	4.2870	1.5240	27.0868	1.7339	51.2370	79.5437	9.5319	3.2021

Table A1   (continuation)

ID	Country	Year	SDI	LnMEpc	MEgdp	Trade	FDI	CORRP	INF	LnPEC	GDPgr
1	Brazil	2006	0.7400	4.4645	1.4811	26.0417	1.7531	50.9656	82.8714	9.5483	3.9620
1	Brazil	2007	0.7430	4.6764	1.4663	25.2926	3.1908	50.6406	85.8890	9.6004	6.0699
1	Brazil	2008	0.7430	4.8435	1.4419	27.2576	2.9906	50.2982	90.7663	9.6327	5.0942
1	Brazil	2009	0.7470	4.8817	1.5386	22.1060	1.8885	49.9952	95.2030	9.6161	-0.1258
1	Brazil	2010	0.7400	5.1543	1.5394	22.7722	3.7300	49.6064	100.0000	9.6941	7.5282
1	Brazil	2011	0.7330	5.2277	1.4119	23.9344	3.9152	49.4577	106.6364	9.7190	3.9744
1	Brazil	2012	0.7330	5.1355	1.3787	25.1143	3.7550	49.2084	112.3985	9.7388	1.9212
1	Brazil	2013	0.7420	5.0936	1.3294	25.7860	3.0415	48.9053	119.3721	9.7539	3.0048
1	Brazil	2014	0.7470	5.0784	1.3302	24.6854	3.5714	48.8167	126.9272	9.7710	0.5040
1	Brazil	2015	0.7490	4.7873	1.3655	26.9536	3.5921	48.6126	138.3886	9.7492	−3.5458
1	Brazil	2016	0.7590	4.7631	1.3480	24.5337	4.1374	48.3060	150.4826	9.7167	−3.2759
1	Brazil	2017	0.7600	4.9441	1.4140	24.3197	3.3383	48.1532	155.6688	9.7177	1.3229
1	Brazil	2018	0.7620	4.8984	1.4697	28.8762	4.0786	47.7374	161.3738	9.7135	1.7837
1	Brazil	2019	0.7600	4.8067	1.3828	28.8903	3.6927	46.6364	167.3979	9.7221	1.2208
1	Brazil	2020	0.7500	4.5206	1.3267	32.3021	2.5926	45.1783	172.7743	9.6754	−3.2768
1	Brazil	2021	0.7470	4.4945	1.1637	37.6563	2.7798	45.4104	187.1174	9.7208	4.7626
1	Brazil	2022	0.7410	4.5581	1.0698	38.8161	3.8222	45.7417	204.4821	9.7604	3.0167
2	Russia	2000	0.7470	4.1406	3.3070	68.0939	1.0312	60.5855	30.7596	10.8022	10.0001
2	Russia	2001	0.7520	4.3807	3.5463	61.1109	0.9287	60.4199	37.3658	10.8220	5.1001
2	Russia	2002	0.7560	4.5620	3.7563	59.6454	1.0055	60.0956	43.2654	10.8224	4.7000
2	Russia	2003	0.7590	4.7631	3.6708	59.1283	1.8424	59.8663	49.1768	10.8472	7.3000
2	Russia	2004	0.7510	4.9779	3.3004	56.5819	2.6062	59.6910	54.5315	10.8600	7.1999
2	Russia	2005	0.7430	5.2476	3.3312	56.7132	2.0298	59.8159	61.4490	10.8625	6.4000
2	Russia	2006	0.7300	5.4840	3.2464	54.7334	3.7977	59.8097	67.3903	10.9091	8.2001
2	Russia	2007	0.7060	5.7177	3.1185	51.7061	4.2990	59.8800	73.4603	10.9160	8.5000
2	Russia	2008	0.6870	5.9729	3.1495	53.3825	4.5027	58.9145	83.8262	10.9208	5.2000
2	Russia	2009	0.7120	5.8860	3.9241	48.4351	2.9921	58.4590	93.5897	10.8694	−7.8000
2	Russia	2010	0.7050	6.0160	3.5851	50.3555	2.8308	58.2257	100.0000	10.9069	4.5000
2	Russia	2011	0.6670	6.1942	3.4330	48.0354	2.6924	57.5460	108.4405	10.9396	4.3000
2	Russia	2012	0.6530	6.3407	3.6892	47.1514	2.2908	57.8745	113.9435	10.9436	4.0241
2	Russia	2013	0.6360	6.4196	3.8540	46.2871	3.0194	59.6136	121.6390	10.9295	1.7554
2	Russia	2014	0.6620	6.3750	4.1130	47.8013	1.0699	59.7610	131.1553	10.9304	0.7363
2	Russia	2015	0.6510	6.1293	4.8715	49.3593	0.5026	59.7949	151.5295	10.9118	−1.9727

Table A1											(continuation)
ID	Country	Year	SDI	LnMEpc	MEgdp	Trade	FDI	CORRP	INF	LnPEC	GDPgr
2	Russia	2016	0.7040	6.1679	5.4251	46.5181	2.5485	59.7079	162.2008	10.9282	0.1937
2	Russia	2017	0.6970	6.1313	4.2490	46.8765	1.8141	60.3721	168.1752	10.9319	1.8258
2	Russia	2018	0.6600	6.0473	3.7198	51.5809	0.5301	61.0483	173.0158	10.9663	2.8072
2	Russia	2019	0.6120	6.1034	3.8603	49.2288	1.8885	60.3651	180.7503	10.9583	2.1981
2	Russia	2020	0.5690	6.0493	4.1715	45.9669	0.6349	60.4302	186.8626	10.9238	−2.6537
2	Russia	2021	0.5770	6.1186	3.6117	50.1964	2.1943	60.5002	199.3721	10.9586	5.6143
2	Russia	2022	0.5410	6.5616	4.6900	43.2587	−1.7564	60.4318	226.8000	10.9963	−2.0697
3	India	2000	0.5280	2.6015	2.9489	26.9009	0.7652	62.5274	54.3383	8.1650	3.8410
3	India	2001	0.5330	2.6051	2.9244	25.9933	1.0564	62.4175	56.3919	8.1511	4.8240
3	India	2002	0.5400	2.5974	2.8269	29.5087	1.0116	62.3699	58.8152	8.1674	3.8040
3	India	2003	0.5530	2.6822	2.6778	30.5924	0.6059	62.3307	61.0536	8.1852	7.8604
3	India	2004	0.5630	2.8798	2.8288	37.5038	0.7656	62.2457	63.3536	8.2508	7.9229
3	India	2005	0.5730	2.9948	2.9106	42.0017	0.8861	61.5069	66.0439	8.2919	7.9234
3	India	2006	0.5830	3.0170	2.6804	45.7245	2.1302	59.0308	69.8721	8.3287	8.0607
3	India	2007	0.5920	3.1676	2.4782	45.6863	2.0734	58.8537	74.3250	8.3959	7.6608
3	India	2008	0.6000	3.3087	2.6315	53.3682	3.6205	57.1905	80.5306	8.4384	3.0867
3	India	2009	0.6060	3.4546	3.1294	46.2729	2.6516	56.0946	89.2942	8.4963	7.8619
3	India	2010	0.6160	3.6150	2.8895	49.2552	1.6350	55.3213	100.0000	8.5249	8.4976
3	India	2011	0.6310	3.6755	2.7045	55.6239	2.0021	54.9194	108.9118	8.5644	5.2413
3	India	2012	0.6400	3.6122	2.6182	55.7937	1.3129	54.0247	119.2355	8.6038	5.4564
3	India	2013	0.6470	3.6032	2.5488	53.8441	1.5163	53.0550	131.1804	8.6234	6.3861
3	India	2014	0.6580	3.6622	2.5440	48.9222	1.6957	51.6458	139.9244	8.6764	7.4102
3	India	2015	0.6670	3.6578	2.4575	41.9229	2.0921	50.0527	146.7905	8.6986	7.9963
3	India	2016	0.6790	3.7450	2.5432	40.0825	1.9374	48.2217	154.0540	8.7305	8.2563
3	India	2017	0.6850	3.8644	2.5315	40.7425	1.5073	47.2760	159.1812	8.7564	6.7954
3	India	2018	0.6850	3.8795	2.4243	43.6170	1.5582	46.3160	165.4511	8.8006	6.4539
3	India	2019	0.6870	3.9449	2.5460	39.9054	1.7848	45.2922	171.6216	8.8153	3.8714
3	India	2020	0.6870	3.9557	2.8072	37.7581	2.4062	44.0900	182.9888	8.7518	−5.7777
3	India	2021	0.6810	3.9934	2.4804	45.4231	1.4122	44.3333	192.3787	8.8261	9.6896
3	India	2022	0.6940	4.0331	2.3639	49.9653	1.4892	44.5718	205.2662	8.8719	6.9870
4	China	2000	0.6300	2.8674	1.8358	39.4110	3.4751	53.1070	80.9700	9.1415	8.4901
4	China	2001	0.6410	3.0383	1.9831	38.5272	3.5130	52.9119	81.5523	9.1899	8.3357
4	China	2002	0.6520	3.1630	2.0594	42.7472	3.6091	52.6446	80.9554	9.2688	9.1336

Table A1   (continuation)

ID	Country	Year	SDI	LnMEpc	MEgdp	Trade	FDI	CORRP	INF	LnPEC	GDPgr
4	China	2003	0.6590	3.2471	1.9963	51.8042	3.4874	52.4037	81.8682	9.4152	10.0380
4	China	2004	0.6650	3.3752	1.9385	59.5055	3.4836	51.9729	84.9994	9.5661	10.1136
4	China	2005	0.6720	3.4902	1.8719	62.2080	4.5543	51.6821	86.5093	9.6875	11.3946
4	China	2006	0.6770	3.6683	1.8696	64.4792	4.5086	51.3531	87.9362	9.7730	12.7210
4	China	2007	0.6830	3.8506	1.7502	62.1936	4.4010	50.8664	92.1719	9.8498	14.2309
4	China	2008	0.6790	4.0821	1.7160	57.6123	3.7336	50.3005	97.6333	9.8813	9.6507
4	China	2009	0.6580	4.2786	1.8935	45.1850	2.5689	49.5536	96.9224	9.9174	9.3987
4	China	2010	0.6370	4.3602	1.7335	50.7171	4.0035	48.4821	100.0000	9.9782	10.6359
4	China	2011	0.6040	4.5253	1.6591	50.7409	3.7088	49.3138	105.5539	10.0472	9.5508
4	China	2012	0.5800	4.6653	1.7009	48.2675	2.8271	49.8371	108.3189	10.0805	7.8637
4	China	2013	0.5530	4.7810	1.7143	46.7444	3.0399	49.9313	111.1580	10.1105	7.7662
4	China	2014	0.5410	4.8788	1.7384	44.9052	2.5592	49.9039	113.2941	10.1295	7.4258
4	China	2015	0.5390	4.9489	1.7768	39.4642	2.1922	49.6920	114.9221	10.1350	7.0413
4	China	2016	0.5240	4.9532	1.7689	36.8944	1.5556	49.5159	117.2206	10.1332	6.8488
4	China	2017	0.5110	5.0054	1.7112	37.6324	1.3491	47.8811	119.0881	10.1654	6.9472
4	China	2018	0.4900	5.1004	1.6736	37.5658	1.6939	46.3539	121.5589	10.2075	6.7498
4	China	2019	0.4420	5.1301	1.6829	35.8901	1.3107	44.7397	125.0832	10.2494	5.9505
4	China	2020	0.4190	5.1987	1.7567	34.7543	1.7232	43.0762	128.1094	10.2792	2.2386
4	China	2021	0.3930	5.3010	1.6053	37.3020	1.9308	42.7773	129.3662	10.3337	8.4485
4	China	2022	0.3780	5.3218	1.6231	38.3515	1.0637	43.5311	131.9194	10.3488	2.9507
5	South Africa	2000	0.6580	3.6991	1.3873	46.2207	0.6384	50.4248	59.9007	10.1394	4.2000
5	South Africa	2001	0.6550	3.6418	1.4832	49.1709	5.3683	50.2123	63.3162	10.1357	2.7000
5	South Africa	2002	0.6580	3.6124	1.5293	53.4655	1.1464	49.9880	69.3279	10.1008	3.7004
5	South Africa	2003	0.6490	3.9799	1.4688	45.7239	0.3975	49.9191	73.2653	10.1716	2.9491
5	South Africa	2004	0.6460	4.1561	1.3557	45.6436	0.2742	49.8601	72.7583	10.2496	4.5546
5	South Africa	2005	0.6480	4.2873	1.2348	47.4278	2.2578	49.8527	74.2592	10.1852	5.2771
5	South Africa	2006	0.6510	4.2605	1.1539	53.7681	0.2051	49.8047	76.6681	10.1959	5.6038
5	South Africa	2007	0.6540	4.2559	1.0585	57.1251	1.9776	49.7536	81.4045	10.2127	5.3605
5	South Africa	2008	0.6640	4.1741	1.0394	65.9745	3.1269	49.7970	89.6056	10.2705	3.1910
5	South Africa	2009	0.6780	4.2515	1.0895	49.5875	2.3122	49.5811	96.0710	10.2541	-1.5381

Table A1 (continuation)

ID	Country	Year	SDI	LnMEpc	MEgdp	Trade	FDI	CORRP	INF	LnPEC	GDPgr
5	South Africa	2010	0.6840	4.3929	1.0035	50.4061	0.8849	49.6762	100.0000	10.2496	3.0397
5	South Africa	2011	0.6920	4.4728	1.0027	54.6364	0.9034	49.5415	104.9993	10.2247	3.1686
5	South Africa	2012	0.7010	4.4365	1.0335	55.5826	1.0649	49.1719	111.0101	10.1958	2.3962
5	South Africa	2013	0.7090	4.3365	1.0278	58.8750	2.0536	48.6918	117.4315	10.1866	2.4855
5	South Africa	2014	0.7200	4.2644	1.0219	59.4996	1.5193	48.3710	124.6298	10.1824	1.4138
5	South Africa	2015	0.7280	4.1342	1.0069	56.7267	0.4387	48.0846	130.2888	10.1414	1.3219
5	South Africa	2016	0.7170	4.0189	0.9710	55.8613	0.6846	48.7471	138.8506	10.1763	0.6646
5	South Africa	2017	0.7300	4.1496	0.9436	53.5359	0.5397	49.5412	146.0490	10.1687	1.1579
5	South Africa	2018	0.7360	4.1460	0.8948	54.4855	1.3743	50.2979	152.6462	10.1180	1.5568
5	South Africa	2019	0.7450	4.0800	0.8824	53.8980	1.3141	50.6937	158.9356	10.1495	0.2599
5	South Africa	2020	0.7230	4.0064	0.9556	50.7597	0.9331	51.6027	164.0375	10.0727	−6.1689
5	South Africa	2021	0.7200	4.0453	0.8074	56.0347	9.6603	52.3545	171.6024	10.0722	4.9550
5	South Africa	2022	0.7120	3.9498	0.7678	64.7830	2.2705	51.5503	183.6827	10.0255	1.9115

Source: Own editing