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Sustainable Development Indicators and Their Relationship to GDP: Evidence from Emerging Economies

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Abstract: This paper aims to analyze the metrics the United Nations has set and called the Sustainable Development Goals (SDGs) and their association with the gross domestic product (GDP) in emerging economies. SDGs have been identified to measure healthy development, whereas GDP has historically been used to measure economic health and has been prioritized above many other indicators. This research deploys the feasible generalized least squares (FGLS) and the seemingly unrelated regressions (SUR) on panel data consisting of the five BRIC countries spanning 2000 through 2017 to estimate a regression model that shows the association of SDGs with GDP. The paper concludes that targeting GDP may not lead to achieving overall SDGs.

Keywords: emerging economies; GDP; well-being; economic vs. social health; sustainable development indicators; socioeconomic development



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1. Introduction

Consumers measure the well-being of humans by the quantity of goods and services consumed. The last few decades have ushered in a dynamic transformation across the planet, catapulting millions of people out of poverty. As standards of living have improved, consumers' demand for goods and services has outstripped local production capabilities. For instance, [1] observes that the rise of globalization has altered societies throughout the world and created global consumer markets that behave homogeneously. Globalization of production and consumption gives the erroneous impression that gross domestic product (GDP) growth and consumption expansion have no boundaries and natural resources are infinite.

The rise in consumer culture has raised standards of comfort for people around the globe to levels that were unthinkable even at the turn of the century. The United Nations (UN) reports, "Living standards have risen to enable hundreds of millions to enjoy housing with hot water and cold, warmth and electricity, transport to and from work—with time for leisure and sports, vacations and other activities beyond anything imagined at the start of this century" [2] (p. 1).

However, according to the same report, 20% of the consumers living in the highest income nations account for 86% of all private consumption, whereas the bottom 20% consume slightly more than 1% [2] (p. 2). One researcher [3] (p. 753) states, "Four fifths of the world's population can no longer accept that the remaining fifth should continue to build its wealth on their poverty." Furthermore, a paper [4] argues that the criticisms targeting inequities in consumption also highlight the negative externalities of consumption, that is, environmental and ecological degradation.

Within this context, all consumption-related activities, from production to usage to disposal, have environmental effects that are experienced throughout the world regardless of the physical location of the consumer. Thus, one author [5], (p. 112) reflects, "Consumption and production patterns of affluent countries are responsible for most transboundary problems, such as ozone layer depletion, ocean pollution, and chemicalization of the habitat."

A paper [6] developed a theoretical model of the relationship between consumption as GDP and environmental degradation as a result of CO₂ emissions. The dynamic optimization problem yields a set of differential equations for sustainable consumption and pollution (SCP). Authors then test the relationship between CO₂ emissions and GDP across nation-states as well as within the UN categories of low, medium, and high human development countries. Results show that nations with rising GDP levels produce more environmental damage through greater CO₂ emissions. Additionally, countries at lower GDP levels produce emissions at a greater absolute rate than nations at higher GDP levels. An explanation for this is that countries at lower GDP levels experience higher percentage growth rates in consumption, which are associated with greater rates of harmful emissions. Results of additional analysis using the environmental Kuznets curve have supported these results. Many developing nations are striving to provide better standards of living for their citizens. By some accounts, developing countries account for over 80% of the world population. Improving the standard of living for this massive population only increases the threat of environmental catastrophe.

Given the magnitude of CO₂ emissions associated with GDP growth, Ref. [7] (p. 258) recommends three “policy options designed to reduce such environmental degradation based on the belief that pollution is a residual discommodity that is created concurrently with a valued commodity”. The first option is command and control policies, which require that firms deploy the latest pollution abatement technology. The second is environmental taxes, which internalize the external (social) cost of environmental degradation. It requires the marginal cost of production to include environmental costs, which in turn raises market prices of goods and economizes their consumption and the negative external costs such as CO₂ emissions. The third option has come to be known as cap and trade. It boils down to determining the optimal level of emissions and providing marketable pollution permits that can be traded freely and that allow the bearer to pollute up to a defined limit.

The UN reported in 2001 that total consumption exploded significantly during the last 100 years. By the end of the twentieth century, consumption expenditure had reached USD 24 trillion, twice the level of 1975 and 6 times that of 1950 [8]. Compared with the real consumption expenditure in 1900 of USD 1.5 trillion, this figure represents an increase by a factor of 16. According to latest estimates, the global population is projected to be at around 8.5 billion in 2030 and 9.7 billion in 2050. The estimated natural resources necessary to maintain current levels of consumption and GDP growth would cover the equivalent of almost three planets.

Increasing demand for energy, food, water, and other resources has led to resource depletion, pollution, environmental degradation, and climate change, pushing the earth to the brink of environmental disaster. With existing consumption levels, the current growth trajectory is not sustainable across the globe. The key to achieving sustainable development is to transition toward SCP. This need was first articulated at the 1992 Rio Earth Summit and was recently reiterated at the Rio +20 summit and during the adoption of the 10 Year Framework Programs. The aim of SCP is to highlight constraints on resources, which include energy, clean air, and clean water. It is predicated on the age-old constrained optimization that undergirds all economic decisions, including the notion of satisfying human needs while minimizing negative externalities such as pollution and ecological degradation.

SCP can contribute to poverty alleviation and the transition toward a low carbon, green economy and is essential for improving the lives of the world’s poorest people, whom the World Bank currently estimates to be around 10% of the world’s population. It can provide the framework for efforts that improve quality of life and create employment opportunities, complementing other poverty reduction strategies. The success of SCP requires the engagement of stakeholders from various sectors of the world’s economies. The involvement of governments at all levels is critical in the development and implementation of policies that ensure improvements in production, curtailment of pollution, and consumer education on sustainable consumption. In short, all organizations and individuals in society have a role to play in the transition toward a sustainable economy.

This paper assesses the Sustainable Development Goal (SDG) metrics the UN has identified from five major emerging economies, known as the BRICS nations: Brazil, Russia, India, China, and South Africa. Analyzing emerging economies provides a better understanding of the trends in economies experiencing growth and accelerated transformation. These economies are nimbler because they are currently developing new infrastructure rather than operating within the constraints of rigidity. BRICS countries have been the main engines of global economic growth in the past two decades, with 41% of the world population, 24% of the world GDP, and over 16% of the share in world trade.

The SDGs the UN has set consist of 17 global challenges (Appendix A) and serve as a roadmap to achieving a sustainable future consistent with SCP for all by 2030 (see United Nations, www.un.org/sustainabledevelopment/sustainable-development-goals/, 1 November 2021).

Many of these goals are difficult to quantify. However, data on others are available. The purpose of assessing which SDG indicators are associated with GDP is to better understand the compatibility of economic development as defined by GDP growth with SDGs, especially in economies that are in transition compared to developed nations.

This investigation is relevant today because climate change is occurring, and economies are beginning to understand the urgency of decreasing emissions. Many of the SDGs directly address the issues related to the environment and climate change. For instance, SDGs 6, 13, 14, and 15 emphasize the climate, oceans, and ecology, among other environmental objectives. However, attempts to enact sustainable and climate-friendly policies are typically met with pushback from various players in societies, ranging from high-polluting firms to consumer groups and political parties.

The desire to avoid the high private cost of adopting clean technology motivates these objections. These negative external costs are ultimately unavoidable, and the public at large has to bear them. From their myopic viewpoint, firms see added costs as an obstacle to maximizing profits and shareholders' wealth and contributing to GDP. Equally, the consuming public, which is on the demand side of transactions, directly incentivizes firms' production decisions. As SCP clearly states, collaboration of all players is required to promote sustainable growth consistent with SDGs. The challenge facing societies is the reality that with the currently available technology, the finite resources, and the exploding population of the planet, sustainable economic growth may contradict the goals of SCP and run contrary to SDGs.

In this study, we analyze the association of GDP with environmental concerns as articulated in the UN SDGs. Our goal is to shine a light on some of the contradictions and challenges that GDP growth presents to the UN SDGs, and by implication to Earth Summit SCP.

The remainder of this paper is organized as follows: Section 2 offers the review of the relevant literature. Section 3 explains the sources of data. The methodology and the analysis of findings are the subjects of Sections 4 and 5, respectively. A brief summary of the findings and their policy ramifications constitute Section 6.

2. Literature Review

The relationship between economic growth and its environmental impact has been the subject of several research papers in recent years. For instance, Ref. [9] examines whether continuous GDP growth is sustainable and finds that it is closely linked to emissions output. He discusses how a false impression of GDP decoupling from emissions appears when resources are substituted, monetary flows unassociated with energy output are financed, and the environmental impact of financial activity is placed offshore or exported. The model used in his study assesses the plausibility of exponential GDP growth with respect to technology, resources, and pollutants. Increasing efficiency while harvesting nonrenewable resources has been found to deplete those resources at an unsustainable rate. The model in [9] determines exponential GDP growth to be unsustainable despite the existence of dynamic variables such as technology. His study deems GDP a misleading

objective for policies to pursue. He also notes that GDP is historically a poor indicator of social well-being and that it was never intended for that purpose. Finally, the paper articulates that decoupling GDP and environmental well-being would be misleading. His recommendation is that nations in transition acknowledge physical resource limitations and aim for sustainable GDP levels and growth rates.

To understand and define sustainable development, it is necessary to define its indicators first. Sustainable development encompasses economic, ecological, social, and institutional considerations [10]. In the case of the European Union, the authors suggest that indicators of sustainable development be defined and examined for the countries of Southeastern Europe. Based on these indicators, some countries, such as France and Germany, may be considered to be on an equal level. However, developing nations such as Greece show that ecological and economic development indicators clash, as they normally do at the earlier stages of development. Therefore, the authors conclude that sustainable development in many cases cannot be achieved based on all indicators of sustainability. Indicator weights may have to be varied at different stages of development.

Even though the UN's Agenda 21 created sustainable development indicators (SDIs) in 2009, there has been no consensus on models that may use SDIs [11]. This paper [11] investigates whether global SDIs provide clear guidelines for sustainable development. They compare the performance of six global SDI metrics in assessing nations' sustainable development [11]. Their results reveal that the six metrics produce conflicting assessments of sustainability. Therefore, the authors conclude that there is no clear path to sustainable development using the global SDIs as guidelines.

A paper [12] argues that GDP, which has been used as the single measure of national well-being, should be dethroned. They note that continuous economic growth as measured by GDP has exhausted natural resources, devastated the environment, and perhaps contributed to climate change. Ever-increasing wealth has not improved income distribution, leading to social strife. The authors cite John Stuart Mill, who famously declared two centuries ago that once decent living standards were achieved, societies should focus on social and moral progress and leisure. Similarly, the economist John Kenneth Galbraith stated, "To furnish a barren room is one thing. To continue to crowd in furniture until the foundation buckles is quite another" [13].

Other scholars have investigated the association of the UN SDGs with other socioeconomic variables. For example [14], studies migration and SDGs in the European Union (EU). Prada's findings suggest that migration and achieving these goals are interrelated. The main conclusion is that migration can influence the achievement of sustainable development, and there is a feedback such that achieving these goals also contributes to migration into the EU.

It has been stated that SDGs are unlike traditional development indicators and pursuing them may result in contradictory outcomes [15]. To analyze the trade-offs or synergies among SDGs, they employ the available official data for 227 countries. They statistically test significance of positive and negative correlation coefficients between SDGs where positive and negative correlations are considered synergies and trade-offs, respectively. SDG 1 (no poverty) has a synergetic association with most of the other goals, whereas SDG 12 (responsible consumption and production) is the goal often associated with trade-offs. Their study identifies more synergies than trade-offs within and among the SDGs in most countries.

Coscieme et al. [16] discuss the synergies and trade-offs emerging among the indicators used to measure progress toward SDG objectives. Specifically, the role of gross domestic product (GDP) per capita as an indicator for SDG 8 (decent work and economic growth) creates a dilemma as unconstrained GDP growth clashes with the reality of finite natural resources. They highlight how targeting the GDP growth leads to failing to achieve the SDGs overall. They show that in the European Union, GDP is unrelated to levels of employment and is inversely associated with indicators of environmental sustainability and other measures of wellbeing. Therefore, achieving SDG 8 through GDP growth impedes the fulfillment of the environmental and social equality goals. They propose guidelines for

selecting alternative indicators for SDG 8 with the aim of improving coherence among all of the SDGs, as well as between the SDGs and other policy initiatives for sustainability.

Recently researchers discussed environmental degradation and sustainable economic growth, clean and affordable energy, and quality education [17]. They designed two indices for environmental degradation and technological advancement. The analysis of the association between them in the context of the environmental Kuznets curve led to a better understanding of achieving several SDGs.

It is clear that there is no consensus among researchers regarding indicators of sustainable development. Perhaps the lack of an agreeable and quantifiable measure of sustainable development has been an impediment to taking coordinated international action to promote sustainable economic growth and development. However, with the popular media and scientific community sounding the alarm regarding the climatic, environmental, and social calamities of unsustainable development, the need for clear guidelines is more urgent than ever. In this paper, we examine the relationship between GDP as a measure of economic well-being and a set of variables in an effort to determine the association of GDP with these variables. For instance, if GDP growth and emission reduction are significantly associated, then perhaps policies that improve GDP need to be advocated.

3. Data

The data set for the analysis of the SDGs in relation to GDP for BRICS countries was taken from the UN database. Eleven quantifiable and available time series data that are associated with SDGs were recorded for each country. These variables covered a variety of issues in each nation and indicated sustainable development. While the variables of the model in this paper are not identical to those selected by other scholars [13,15], they are qualitatively similar. The fact that the findings of the current paper overall support the findings of [13] among others, indicates that the research results are robust despite the differences in the model variables and empirical approaches. All annual observations were for the years 2000 through 2017 for BRICS countries. Table 1 lists the SDGs according to the United Nations. The data for model variables in BRICS are not available for the entire 17 UN SDGs.

Table 1. The Sustainable Development Goals (SDGs) of the United Nations.

SDG	Description
1	End poverty in all its forms everywhere
2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
3	Ensure healthy lives and promote well-being for all at all ages
4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5	Achieve gender equality and empower all women and girls
6	Ensure availability and sustainable management of water and sanitation for all
7	Ensure access to affordable, reliable, sustainable and modern energy for all
8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
10	Reduce inequality within and among countries
11	Make cities and human settlements inclusive, safe, resilient and sustainable
12	Ensure sustainable consumption and production patterns
13	Take urgent action to combat climate change and its impacts

Table 1. *Cont.*

SDG	Description
14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15	Protect, restore and promote sustainable use of terrestrial ecosystems, and halt biodiversity loss, sustainably manage forests, combat desertification, and halt and reverse land degradation
16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17	Strengthen the means of implementation and revitalize the global partnership for sustainable development

4. Methodology

In this section, we explain the regression equation that we estimated as the mainstay of our investigation into the association of GDP and SDG variables.

$$\text{GDP} = f(\text{model variables}), \quad (1)$$

where the model variables and the related SDGs are presented in Table 2.

Table 2. Explanatory variables in Equation (1) and the corresponding SDGs.

Explanatory Variable	Relevant SDG	Variable Description
Emissions	12 and 15	Carbon dioxide emissions per unit of GDP
Energy Access	7	The percentage of the population with access to electricity
Hunger	1 and 2	The proportion of the population suffering from hunger
Gender Equity	5	The proportion of seats held by women in single or lower houses of parliament
Mortality	3	The mortality rate of children under 5 years of age
Natural Gas	7	Natural gas consumption per capita (cubic feet per thousand families)
Poverty Line	1, 2, 3, 4	The proportion of the population living below the extreme poverty line
R&D	8, 9, 11	Investment in research and development (R&D)
Water	1, 3	The percentage of population using a “safely managed” sanitation service—a basic facility that safely disposes of human waste

The variables Water and Education were not included in regression estimations because at least two of the countries in the panel did not show data for the entire time period. While the selected variables are associated with SDGs, they are not unique. Different researchers have employed different variables to represent given SDGs. There are no standard variables that represent SDGs. However, our choice of variables in many cases is qualitatively similar to the variables in other studies [14–16].

The class of models that can be estimated may be written as:

$$y_t = \alpha I_m + x'_t \beta_{it} + I_m \varphi + \phi_t I_m + u_t \quad (2)$$

where y_t is the dependent variable, x'_t is the k -element vector of regressors, I_m is the m -element identity matrix, φ is a vector containing the cross-section effects, and u_t are the error terms for $t = 1, \dots, T$. The parameter α is constant in the model, while the β and ϕ represent period-specific effects (random or fixed).

We can formulate equation (XX) as a set of period-specific equations which are stacked by period as in Equation (2):

$$y = \alpha I_{Mt} + X\beta + (I_M \otimes I_t)\varphi + \phi(I_M \otimes I_T) + u \quad (3)$$

where M is 5 in this case standing for the number of cross-sections.

$$\text{The error covariance is given by } \Theta = E(uu') = E \begin{pmatrix} u_1u_1' & u_2u_1' & \dots & u_Tu_1' \\ \vdots & \ddots & & \vdots \\ u_Tu_1' & u_Tu_1' & \dots & u_Tu_T' \end{pmatrix}.$$

The panel data in the paper required attention because of the behavior of residuals across time and the cross-section of countries in the sample. The Eviews software deployed in this research offers many approaches for estimating balanced and unbalanced panels. For instance, the cross-section SUR generalized least squares, known as the Parks estimator, is the feasible GLS (FGLS) estimator for systems where the residuals are both cross-sectionally heteroskedastic and contemporaneously correlated. We employ residuals from the first stage to form an estimate of covariance matrix Θ . In the second stage, FGLS estimates are derived. As cautioned by [18], a large number of cross-sections combined with short time series may result in a nonsingular covariance matrix and FGLS estimation will fail.

It is necessary to recognize that the countries in the sample may be influencing one another's policies and perhaps even learning from each other's experiences. We deployed several estimation methods that were appropriate for the balanced panel data in this study: seemingly unrelated regressions (SUR) and panel estimation with fixed and random time effects. The estimation assumptions and methods are explained in detail in most econometrics textbooks [19], so we will not cover them in detail here. However, we will offer a brief explanation of each estimation methodology and our rationale for applying it.

The first methodology, SUR, uses covariance structures that allow for conditional correlation between the contemporaneous residuals in each cross-section, but no autocorrelation of residuals over time. The rationale is that in each country policies toward growth in each period are interdependent. Therefore, it is reasonable to assume that residuals are correlated in a given time period across various countries. However, autocorrelation of residuals for each individual country's time series is unlikely as policies of each country in each year may depend on new information and therefore goal changes.

The fixed effects estimation method assumes that all regression coefficients are the same across all countries. This estimation methodology is equivalent to estimating a model on the stacked data, assuming fixed effects over time and cross-sectional identifiers. The last methodology, random time effects, assumes a random effect over time, with cross-section weights in coefficient covariance matrix computations. Changing these assumptions leads to estimates that are virtually identical and that corroborate each other. The estimation method is feasible generalized least squares (FGLS), which uses covariances to weight the observations.

The last estimation method that we deployed is the White cross-section which assumes that the errors are contemporaneously (cross-sectionally) correlated (period clustered) and computes the robust standard errors of the coefficient estimates.

5. Empirical Findings

Prior to our regression estimation, we examined the bilateral correlation among various UN SDG variables. Pearson's correlation coefficient indicated how closely the SDG measures were related. Pearson's correlation coefficients ranged from -1 indicating perfect negative relationship to $+1$ indicating perfect positive relationship; zero indicated no relationship between the two variables. High degrees of bilateral correlation may pose multicollinearity in the regression model. There was a moderate positive correlation between mortality and poverty, as well as unemployment and poverty, but no collinearity appeared to be present that distorted the regression results. Table 3 summarizes these findings. Hunger, poverty line, and emissions were highly positively correlated. Therefore, at higher GDP, one expects higher levels of emissions. However, it is more difficult to explain the high correlation of hunger and higher GDP. Bilateral correlation coefficients cannot capture the full story of the association of variables when multiple variables are at work. It is necessary to examine these complex associations within a multivariate framework. In the next stage of this investigation, we introduced and estimated a multivariate regression model that was capable of measuring the association of SDG variables with GDP.

The proposed multivariate regression properly accounted for the association of each SDG variable with GDP while holding everything else constant. To minimize biases stemming from multicollinearity, we also computed variance inflation factor (VIF) and excluded SDG variables that demonstrated high VIFs.

Table 3. Correlation coefficients between model variables.

	GDP	Hunger	Mortality	Energy Access	Poverty Line	Emissions	R&D	Gender Equity	Nat. Gas
GDP	1.0000								
Hunger	0.417	1.0000							
Mortality	0.2392	0.0170	1.0000						
Energy Access	0.1019	−0.7633	−0.1724	1.0000					
Poverty Line	0.4129	0.3555	0.6269	−0.5409	1.0000				
Emissions	0.3193	−0.2000	0.6284	0.0285	0.2553	1.0000			
R&D	0.288	−0.5022	0.0342	0.6142	0.072	0.0922	1.0000		
Gender Equity	−0.1202	−0.3121	0.651	−0.1471	0.3181	0.6518	−0.0842	1.0000	
Nat. Gas	−0.0475	−0.2410	−0.4883	0.4184	−0.6868	0.2113	0.0777	−0.2691	1.0000

In the presence of collinearity, regression estimates are unstable and have high standard errors, thus having misleading *t* statistics and *p* values. VIF measures inflation in variances of parameter estimates caused by collinearities that exist among variables. VIF is the degree of inflation due to the correlation among variables. VIF equal to 1 indicates no correlation between variables. VIFs exceeding 5 signal possible collinearity among variables.

Table 4 presents the VIFs from auxiliary regressions of each variable on the remaining SDG variables, which constituted our explanatory variables in Equation (1).

Table 4 shows that many of the variables in the regression model may be highly correlated with others. This is plausible because UN SDG variables are measuring various aspects of sustainable growth. This was a source of concern for empirical estimation of the regression model, and we eliminated the highly correlated variables in regressions that may have had high coefficient of determination (R^2) and *F* statistics but many statistically insignificant coefficients. For instance, access to energy, emissions, and natural gas consumption had a larger VIF than the other variables. This could indicate greater collinearity than that of other explanatory variables.

Table 4. Summary statistics of the model variables.

Variable	Mean	Std. Dev.	Min	Max	VIF
GDP	4.130	3.848	−7.830	13.580	
Emissions	0.461	0.218	0.120	0.810	8.15
Energy Access	90.308	12.202	55.800	100.000	8.20
Hunger	16.242	6.245	6.900	37.700	5.69
Gender Equity	17.631	11.025	5.653	44.750	5.89
Mortality	35.704	24.916	7.500	87.000	5.88
Natural Gas	0.466	0.826	0.001	32.288	7.52
Poverty Line	18.239	13.421	0.000	38.200	6.67
R&D	1.069	0.349	0.620	2.110	3.01

Note: VIF is an indication of the severity of bilateral collinearity of the model variables. A VIF > 5 may indicate collinearity.

The results of these attempts are summarized in Table 5. Estimation results in columns 1 and 2 in Table 5 show that energy access, gender equity, mortality, emissions, and R&D

were significantly associated with GDP by both SUR and under the panel estimation with period random effects (PRE). However, high values of R-squared and F statistics combined with several statistically insignificant model explanatory variables suggested that multicollinearity was a serious problem.

Column 3 offers estimation results for the panel FGLS method after the deletion of the statistically insignificant variables from the regression. SUR estimation produced similar outcomes which are not presented in the interest of brevity.

Energy access and emissions were positively associated with GDP, as one would expect. The positive association of these two variables with GDP points to the complexity of sustainable growth. If nations attempt to raise their GDP and the standard of living, the need for more energy and emissions are expected to rise as well. The inconsistency of sustainable growth with rising standards of living exposes the challenge many developing countries face. It also suggests that there is a need to control population growth around the globe to reduce the need for energy and to limit emissions. Furthermore, progress in the fields of wind- and solar-based energy is critical. This progress can contribute to the world GDP and the standard of living without the adverse emissions problem.

The results of the regression indicated that carbon dioxide emissions per unit of GDP are the strongest indicator of national GDP. This is partly because emissions account for economic activities ranging from production to farming and transportation, which in turn contribute to GDP. However, this indicates a strong relationship between carbon output and economic growth. Because carbon emissions have been found to have an increasingly negative impact on the planet, aiming to increase GDP while consequently increasing emissions does not seem sustainable. A number of researchers [20] suggest that by observing emerging economies, it can be inferred that climate change and urbanization are connected. Economic development prompts urbanization (which can contribute to meeting SDGs), but it also prompts carbon emissions. Emerging economies are experiencing rapid and dynamic socioeconomic development. For instance, some authors [21] conclude that countries operate with the goal of achieving economic growth and prosperity, but once this is achieved, they need to slow down the extraction of resources by pressing the brakes on their economic growth rate.

At first glance, a statistically significant and negative association of gender equity with GDP appears implausible. Advances in gender equity should bring a wider pool of qualified individuals into the workforce, thus contributing to a positive change in GDP. However, this variable is defined narrowly as the portion of seats women hold in parliament. This measurement, while simple, ignores women's participation rate in the labor force, wage inequalities, and the availability or lack of availability of opportunities in many fields, among others. The negative sign of this variable may be an indication of the inadequate and improper measurement of gender equity.

Mortality was negatively and statistically significantly associated with GDP, as expected. Falling mortality rates are associated with rising incomes, better health care, and rising standards of living. Therefore, it is plausible that falling mortality signals rising GDP and vice versa.

R&D was negatively associated with GDP. The explanation may be that as more resources in transitional economies in this sample are allocated to R&D, the immediate impact on GDP may be negative because scarce resources are diverted to R&D. Although R&D is critical for long-run development, it is risky in the short run. The benefits of R&D investments may not be realized for quite some time in the future. Furthermore, for R&D investments to bear fruit, a scientific infrastructure is necessary. Most BRIC countries in the sample, perhaps with the exception of Russia, may not have the necessary foundation for R&D.

To examine the robustness of the estimates, we also deployed the White robust OLS estimation method. The results are reported in column 4 of Table 5. These estimates are qualitatively similar to the ones reported in columns 1 and 2, corroborating the reported estimates and confirming their robustness.

Table 5. Estimation results applying panel EGLS. Dependent Variable: GDP.

Explanatory Variables	(1) Cross-Section SUR	(2) Period Random Effects	(3) Period Random Effects	VIF	(4) Panel OLS
Intercept	−0.551 (9.840)	−12.301 (12.842)	5.584 (7.302)		19.540 ^c (11.683)
Energy Access	0.128 ^b (0.063)	0.197 ^b (0.085)	0.102 ^b (0.050)	1.744	0.227 ^a (0.092)
Gender Equity	−0.421 ^a (0.114)	−0.419 ^a (0.144)	−0.427 ^a (0.127)	3.361	−0.180 ^c (0.099)
Hunger	0.036 (0.069)	0.107 (0.096)			−0.035 (0.146)
Mortality	−0.137 ^a (0.031)	−0.113 ^a (0.039)	−0.114 ^a (0.058)	6.329	−0.014 (0.041)
Emissions	18.541 ^a (4.176)	20.865 ^a (5.915)	10.952 ^a (3.869)	1.852	18.532 ^a (1.056)
Natural Gas	4.279 (4.625)	8.841 ^a (6.058)			−1.971 ^a (0.283)
Poverty Line	0.127 (0.071)	0.123 (0.102)			0.242 (0.450)
Unemployment	0.222 (0.119)	−0.238 (0.174)			−0.230 (0.163)
R&D	−4.393 ^a (1.127)	−3.778 ^a (1.489)	−3.851 ^a (1.366)	5.004	−1.144 (1.511)
R ²	0.821	0.716	0.735		0.628
F	26.844 ^a	14.731 ^a	24.697 ^a		15.065 ^a
χ^2 Test of Cross-Section Fixed Effect					11.94 ^a
χ^2 Test of Period Random Effect					18.04 ^b

Note: Estimations in columns 2 and 3 are by the feasible generalized least squares (FGLS). Cross-section effects are fixed in columns 2 and 3. ^a, ^b, and ^c indicate significance at 1%, 5%, and 10% levels, respectively.

The findings of this paper may be interpreted with caution. Data emerging economies provide are not always robust or meticulously recorded, limiting the data available for various SDG indicators. Given more robust data, the model used in this study could have analyzed all the indicators of the UN. Data on the percentage of children participating in preprimary or primary education in the year prior to the official entrance age for primary school (education) and data on the percentage of the population using a “safely managed” sanitation service (water) were absent from a few nations’ records. These data could have potentially been beneficial independent variables, providing more insight into socioeconomic development in emerging economies. Additionally, this study inspected a sliver of emerging economies, only focusing on five. With a larger sample pool of more emerging economies and developing nations, statistical analysis could be more thorough and significant. However, the empirical findings for BRICS countries corroborate the conclusions of other research by [9,22], and others.

6. Summary and Conclusions

This paper investigates the metrics the United Nations has set and called the Sustainable Development Goals (SDGs; see Table 1) and their association with the gross domestic product (GDP) in a sample of five emerging economics for the period of 2000 through 2017. Based on the balanced panel sample data we estimate a regression equation to examine the association of GDP and a set of explanatory variables that are proxies for the SDGs.

In conclusion, three of the eight SDG indicators analyzed were found to have a statistically significant association with the GDP growth rate. These indicators were created to track sustainable development and societal well-being. Specifically, pursuing GDP growth in the BRICS countries leads to less gender equity (SDG 5) and increased emissions (SDGs 12 and 13), but a lower mortality rate (SDG 3). Thus, a sole focus on GDP targets as is done by BRICS countries results in conflicting SDG outcomes. GDP has been referred to as the primary indicator of a nation's prosperity, but its performance contradicts metrics of social well-being. Thoughtful policies to incentivize slow economic growth will be imperative in decreasing emissions in a timely manner. These recommendations are discussed and supported by the findings of others [23]. As discussed in [24,25], the economy cannot operate indefinitely while disregarding physical and environmental constraints; soon, appropriate policies will be needed to bridge the gap between economic and environmental prosperity. This study found that the narrow focus on using GDP as the primary indicator of achievement will ultimately lead nations to achieve unsustainable, short-term prosperity. The findings of the current research corroborate the conclusions found in [11,16], among others.

Further research to quantify the “depreciation” of the environmental and climatic resources is needed. The dollar value of the environmental costs may be used to compute the real change in the GDP that accounts for the loss of environmental resources. This effort may further prove that the traditional GDP growth targeting may be in contrast to the UN Sustainable Development Goals.

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Appendix A. Sustainable Development Goals (SDGs)

- Goal 1. End poverty in all its forms everywhere.
- Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
- Goal 3. Ensure healthy lives and promote well-being for all at all ages.
- Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
- Goal 5. Achieve gender equality and empower all women and girls.
- Goal 6. Ensure availability and sustainable management of water and sanitation for all.
- Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all.
- Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
- Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
- Goal 10. Reduce inequality within and among countries.
- Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable.
- Goal 12. Ensure sustainable consumption and production patterns.
- Goal 13. Take urgent action to combat climate change and its impacts.
- Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

- Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
- Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
- Goal 17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.

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