

# Sustainable development goals, going beyond GDP: India's case

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## Abstract

**Objective:** The study is about the effect of indicators of Sustainable Development goals on India's GDP. The major objective is to find the partial correlation of various dimensions like Poverty, Education, Gender Equality, Environmental Sustainability and Health with the country's GDP.

**Methods/ Statistical Analysis:** The correlation analysis is performed by creation of a multi-dimensional SDG Index via statistical technique called as Principle Component Analysis (PCA). PCA is used to obtain a factor component from linear combination of indicator variables for each dimension. Our sample consists of a series for time period 1990-2016. The study uses the secondary data from authentic sources like World Bank, UNDP and HDI Reports. A regression equation involves each factor component as a regressor and logarithm of India's GDP per capita (based on Purchasing Power Parity constant 2011 \$) Index as a dependent variable.

**Findings:** It exhibits that Poverty, Environmental Sustainability, Health, Gender Equality and Education explain about 99% of the variation in India's GDP. The indicators of all the dimensions are significant in explaining country's GDP. In order to measure welfare in a developing economy like India there is a dire need to construct a measure which promotes sustained growth and higher level of productivity. According to Amartya Sen's Capability Approach a merger of wellbeing and income or utility is opposed, whereas broadening of social evaluation with key focus on education and health is a way forward. India has assumed a critical job in forming the Sustainable Development Goals (SDGs), it is nothing unexpected that the nation's national advancement objectives are reflected in the SDGs. The articulation "Sabka Saath Sabka Vikas," which deciphers as "Aggregate Effort, Inclusive Growth" and has been advanced recently which frames the foundation of India's national improvement plan.

**Application:** To quick track this plan, the Government of India has recently discharged a draft Three-Year Action Agenda covering years 2017-18 to 2019-20. In parallel, work is ahead of time organizes on a 15-Year Vision, which will likewise incorporate a 7-year Strategy. Mirroring the nation's long-standing bureaucratic convention, these records are being set up with dynamic investment of the States under these dimensions.

**Keywords:** Gender inequality Index, Millennium Development Goals, Principal Component Analysis.

## 1. Introduction

According to UN, 2000 there exists 17 international development goals that are to be achieved by UN member states by 2030. These goals are based on the major dimensions like poverty reduction, education, good health and wellbeing, gender equality and climate action. Sustainable development aims at striking a balance between economic growths, care for the environment and society's wellbeing. It accords primacy to present generation without compromising with the needs of future generation [1] [2]. The Rio+20 meeting (UN Conference on Sustainable Development) [3] in Rio de Janeiro, June 2012, executed a strategy to develop another course of action of Feasible Progression Objectives (SDGs) which will bear on the vitality made by the MDGs and fit into an around the world progression framework post 2015 [4]. In order to analyze welfare, we need to construct a measure which promotes sustained growth with high levels of productivity. There has been a change from the MDGs to the 2030. Agenda due to the following reasons that are to bolster cross-institutional joint effort between the UN framework and the World Bank; propel better comprehension of cross-sectoral work, and the interrelatedness of objectives and targets and advance worldwide and abnormal state promotion [5]. GDP, that does not capture broader goals like environmental sustainability and state of well-being there exists a need to go well past GDP [6,7], to make a measure can be utilized for the estimation of these Sustainable development objectives and to help approach.

In context to 16 Asian countries analysis by [8], the correlation of Inclusive growth index created by them, using various dimensions of health, environment sustainability, education, poverty, political stability and governance effectiveness is 0.77 with per capita GDP. According to a working paper by IMF: 'SDG's and GDP: What National Accounts brings the table'[9] The impediments of GDP were perceived by the planners of the System of National Accounts, SNA who worried upon the need to take a gander at a more extensive scope of information to dissect welfare. According to a study of financial Requirements and gaps-Report by 'Technology and Action for Rural Advancement A Social Enterprise of Development Alternatives Group [10]. Sustainable Development Goals ought to teach an expansive scope of interconnected issues, from financial development to social issues to worldwide open products .With reference to goal 8 amongst the UNDP Sustainable development goals, the SDGs must advance maintained financial development, more elevated amounts of profitability and mechanical development. It not only involves encouragement of business enterprise and employment creation as critical components as are needed to end forced labor and slavery.

## 2. Data, Variables, Methodology

### 2.1. Index construction & choice of variables

The study uses secondary data from various international sources like World bank, UNDP HDI Reports and it covers period between 1990-2016 to analyze the drivers of GDP growth in India and how much variation in principal factors of SDG's is responsible for the explanation of India's GDP. In order to maintain the comparability in our analysis, all the variables are transformed into a normalized value which is explained below. To examine the relationship between certain selected indicator variables for each dimension we have used Principal Component Analysis to eliminate multicollinearity among these indicator variables and use the factor component derived as a linear combination of indicators as our explanatory variable, which represents each dimension in suitable way. We use these factor components obtained from PCA as the drivers of development in India additionally utilizing the Ordinary Least Square (OLS) strategy in substitute models and present the pertinent models in the paper. The expansive idea of SDG can be evaluated into a list, to develop this broad measure. We have recognized a large group of 12 indicators that can be ordered into 5 noteworthy dimensions for the time arrangement from period 1990-2016. The 5 major dimensions with their indicators are given below:-

#### 1. Eradicate poverty and Income inequality

1. Poverty headcount ratio at national poverty line(percentage of population)
2. Poverty Headcount ratio (\$1.90 per day) percentage of population

#### 2. Achieve universal primary education

1. School enrollment primary (% gross)
2. Mean years of schooling

#### 3. Promote gender equality

1. Labor force participation rate, female (15+age)
2. Gender Inequality Index

#### 4. Environmental sustainability

1. Carbon dioxide emissions per capita
2. Forest area (%of tot land area)

#### 5. Child's and Mother's health

1. Maternal Mortality ratio (deaths per10'000 live births)
2. Fertility rate,
3. Infant mortality rate (per'000 live births)
4. Birth rate

### 3. Index construction

#### 3.1. Normalization of indicator variable

All the major aspects of SDG's are captured so create an Index. These indicators selected for this purpose can also be used for construction of other socio economic indices like Poverty based, financial inclusion based and HDI.

For every one of the indicators, standardized value is ascertained as:-

$NV_{ij} = (X_{it} - \min X_i) / (\max X_i - \min X_i)$ , for  $i$ th indicator and  $t$ th time period. The largest and the smallest values are computed dependent on indicator values for each time period. This is called Standardization of the indicators with the end goal that standardized /normalized values fluctuate from 0 to 1. It is to be noticed that largest value is not the best in subjective terms, for example the largest value value for poverty headcount ratio is the worst value and its least value is the best value i.e. the lesser the no. of poor, the better it is for the economy. The data sources and normalized values of all these indicators are enlisted in Appendix.

Principal Component Analysis is a variable reduction technique, its use depends on the way that multicollinearity is inside sure limits, as this strategy changes over expansive number of (conceivably) connected factors into a (littler) number of uncorrelated factors. It's a Factor model in which the factors are based on summarizing the total variation.

#### 3.2. How PCA works?

Exceptionally related factors are brought down to less no. of directly uncorrelated principal components by means of orthogonal transformation. These principal components are the linear combination of optimally weighed variables for each dimension.

Weights are obtained through system of Eigen equations. PCA

Procedure is given below:-

1. Calculate the covariance matrix for the variables.
2. Find the Eigen values and Eigen vectors of those
3. Variables, where Eigen value represents the variation.
4. Captured by the component and Eigen vector represents
5. The correlation between the variable and the component.
6. We choose the components with eigenvalue > 1 or
7. Cumulative proportion of variance more than 80%.

Table 1. Indicators with corresponding Extrema

Indicator's Index	Minimum	Maximum
Poverty		
Poverty headcount ratio at national poverty line(percentage of population)	19.70	50.34
Poverty Headcount ratio (\$1.90 per day) percentage of population	21.2	46.43
Education		
School enrolment primary (% gross)	91.59	114.52
Mean years of schooling	3	6.3
Gender Equality		
Labour force participation rate, female(15+age)	26.8	36.7
Gender Inequality Index	0.53	0.72
Environmental Sustainability		
Carbon dioxide Emissions(per capita metric tonnes)	0.71	1.99
Carbon dioxide Emissions(per capita metric tonnes)	0.71	1.99
Forest area(% of land area)	21.5	23.95
Child and Mother's Health		
Maternal Mortality ratio(deaths per10'000 live births)	136.56	556
Fertility rate	2.32	3.9
Infant Mortality rate( per 000' live births)	34.6	88.4
Birth rate	19.01	31.50
GDP_PPP(CONSTANT 2011 US\$)(trillion)	1.52	8.07

Source:World Development Indicators 2018 and Statistical Updates 2018 Human Development Reports[11]

With PCA, all the ones used in the diagonal of the correlation matrix, computationally implying that all the common variation. Higher multicollinearity raises variation of factor loadings and produces estimates that are sensitive to minor changes in the model. Principal component for each dimension i.e. poverty, health, education, environmental sustainability and gender is obtained as the sum of the product of factor loadings and Eigen values. These principal components of each dimension are then used as regressors to model our final Regression equation with India's GDP per capita constant at 2011US\$ (PPP) as the dependent variable. We use log India's GDP per capita constant at 2011 US\$(PPP) and transform it into an index as our dependent variable as shown in Table 1.

### 3.3. Econometric analysis

We use Ordinary least square method of Regression to determine the impact of some of the major dimensions of SDG's on log of India's GDP per capita based on purchasing power parity ,PPP (CONSTANT 2011 US\$). The time period of study is 1990-2016 i.e. period of 27 years. The general equation is given as:

$$Y_t = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5$$

1. In the above equation  $Y_t$  is the log GDP per capita PPP (CONSTANT 2011 US\$)
2.  $X_1$  is the factor obtained by the components of Environmental Sustainability which are carbon emissions per capita metric tonnes and forest area as a percentage of land area,
3.  $X_2$  is the factor obtained by the components of Education-which are School enrolment primary (% gross) and Mean years of schooling,
4.  $X_3$  is the factor obtained by the components of Health which are Maternal Mortality ratio (deaths per '000 live births), Infant Mortality rate (per 000' live births), fertility rate and birth rate.
5.  $X_4$  is the factor obtained by the components of Poverty which are Poverty headcount ratio at national poverty line (% of population) and Poverty Headcount ratio (\$1.90 per day) percentage of population.
6.  $X_5$  is the factor obtained by components of Gender Equality which are Labour force participation rate, female (15+age) and Gender Inequality Index as shown in Table 2.

Table 2. Regression results 1990- SDG'S factor components 2016

Variable Name	Coefficient Estimates
Constant	0.46 (0.005)*
Environmental sustainability	-0.034 (0.01)*
Education	0.017 (0.007)*
*Health	-0.32 (0.012)*
Poverty	-0.16 (0.009)*
Gender	0.04 (0.117)*

Author's Computation via SAS with Source: World Development Indicators 2018 and Statistical Updates 2018 Human Development Reports [11]

Note: \* denotes the significance of the variable at 5% level of significance ( $p$  value <0.05)

## 4. Results

The Regression results are appeared in the Table 2:-

It can be clearly seen that more is the Carbon dioxide emission (variable name: Environmental sustainability), it would lead to a negative and significant impact on GDP. Also more is the primary enrolment ratio in school (variable name: Education), greater is the impact on GDP. However greater is the participation of female in labour force (variable name: Gender) would lead to positive and significant impact on GDP. Also larger is the head count ratio of poor in the country, less is GDP of the nation. Also higher the infant mortality rate, fertility rate and maternal mortality rate in the country (variable name: Health), would lead to the reduction in nation's growth. All these dimensions of Health, Environmental sustainability, Education, Poverty and Gender explain about 99% of variation in GDP.

Mean Absolute Percentage error is the average of the absolute percentage of the residuals, which is approximately 10% that is on average forecast is off by 10%. Smaller the MAPE value indicates a better fit of the model. VIF depicts that how much is the variance of estimated coefficient is inflated when multicollinearity exists. VIF less than 5 is desirable for our model.

## 5. Conclusion

Sustainable development goals are measured by creating a multi-dimensional index through a set of factors using linear combination of indicator variables for various dimensions like Poverty, Education, Gender Equality, Environmental Sustainability and Child's and mother's health. The correlation of SDG Index and Per capita GDP of India is quite high, however all the SDG's cannot be captured in quantitative terms. Sustainable Development is a hard subject to nail down on the grounds that it comprises of an extensive variety of things. Because of the detail and multifaceted nature of this subject, it's best to look at its significance comprehensively to have the capacity to get a handle on it effortlessly. The way forward to deal with the subject is to capture the effects of Population explosion among the economies, fossil fuels usage, financial stability among countries and biodiversity sustenance. It is imperative to go beyond GDP to measure the quality of life like in various aspects like eradication of poverty, attainment of good health and education and gender diversity.

## 6. Appendix

The results for PCA for each dimension and Regression have been obtained via use of statistical software SAS, is given below:-

### 1. Environmental sustainability: PCA results

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The FACTOR Procedure
Initial Factor Method: Principal Components
Prior Communality Estimates: ONE

Eigenvalues of the Correlation Matrix: Total = 2 Average = 1
Eigenvalue   Difference   Proportion   Cumulative
1    1.93389768   1.86779537    0.9669    0.9669
2    0.06610232    0.0331    0.0331    1.0000

2 factors will be retained by the NFACTOR criterion.

Factor Pattern
                Factor1   Factor2
CO2_EMIT_IND   0.98334    0.18180
Forest_ind     0.98334   -0.18180

Variance Explained by Each Factor
                Factor1   Factor2
1.9338977     0.0661023

Final Communality Estimates: Total = 2.000000

```

## 2. Gender: PCA results

The FACTOR Procedure  
Initial Factor Method: Principal Components  
Prior Communality Estimates: ONE

Eigenvalues of the Correlation Matrix: Total = 2 Average = 1

	Eigenvalue	Difference	Proportion	Cumulative
1	1.84585183	1.69170366	0.9229	0.9229
2	0.15414817		0.0771	1.0000

2 factors will be retained by the NFACTOR criterion.

Factor Pattern

	Factor1	Factor2
Gender_ind	0.96069	0.27762
Labour_partIND	0.96069	-0.27762

Variance Explained by Each Factor

	Factor1	Factor2
	1.8458518	0.1541482

Final Communality Estimates: Total = 2.000000

## 3. Education: PCA results

Prior Communality Estimates: ONE

Eigenvalues of the Correlation Matrix: Total = 2 Average = 1

	Eigenvalue	Difference	Proportion	Cumulative
1	1.86240870	1.72481739	0.9312	0.9312
2	0.13759130		0.0688	1.0000

2 factors will be retained by the NFACTOR criterion.

Factor Pattern

	Factor1	Factor2
school_enr_ind	0.96499	0.26229
Mean_school_ind	0.96499	-0.26229

Variance Explained by Each Factor

	Factor1	Factor2
	1.8624087	0.1375913

#### 4. Poverty: PCA results

Eigenvalues of the Correlation Matrix: Total = 2 Average = 1

	Eigenvalue	Difference	Proportion	Cumulative
1	1.80260047	1.60520093	0.9013	0.9013
2	0.19739953		0.0987	1.0000

2 factors will be retained by the NFACTOR criterion.

Factor Pattern

	Factor1	Factor2
Headcount_ind	0.94937	0.31417
ppp_1_9_IND	0.94937	-0.31417

Variance Explained by Each Factor

Factor1	Factor2
1.8026005	0.1973995

#### 5. Health PCA result

Prior Communality Estimates: ONE

Eigenvalues of the Correlation Matrix: Total = 4 Average = 1

	Eigenvalue	Difference	Proportion	Cumulative
1	3.60037789	3.20673183	0.9001	0.9001
2	0.39364606	0.38937724	0.0984	0.9985
3	0.00426882	0.00256160	0.0011	0.9996
4	0.00170722		0.0004	1.0000

3 factors will be retained by the NFACTOR criterion.

Factor Pattern

	Factor1	Factor2	Factor3
Mort_rate_IND	0.95212	-0.30420	0.01009
fer_ateIND	0.94970	0.30977	-0.04559
Maternal_ind	0.94598	-0.32286	-0.00921
Birth_rate_IND	0.94712	0.31767	0.04476

Variance Explained by Each Factor

Factor1	Factor2	Factor3
3.6003779	0.3936461	0.0042688

#### 6. Regression results

The REG Procedure

Model: MODEL1

Dependent Variable: gdp\_index

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	2.58748	0.51750	566.34	<.0001
Error	21	0.01919	0.00091375		
Corrected Total	26	2.60667			

R-sq	0.03023	R-Square	0.9976
Dependent Mean	0.46257	Adj R-Sq	0.9909
Coeff Var	6.53480		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t	Variance Inflation
Intercept	1	0.46257	0.00582	79.52	<.0001	0
Environ	1	-0.03483	0.01150	-3.03	0.0064	3.75990
Health	1	-0.32670	0.01221	-26.76	<.0001	4.24235
education	1	0.01790	0.00795	2.25	0.0352	1.79847
poverty	1	-0.16723	0.00963	-17.36	<.0001	2.64045
gender	1	0.04400	0.01172	3.75	0.0012	3.91116

Source: Author's Computation via SAS

## 7. Normalized values of the indicators

C02 Emissions	Forest cover	Infant mortality	Fertility Rate	Birth Rate	Maternal Mortalit	Mean years schoolii	Primary Enrollment	Headcount	HCR(1.905PPF	Gender Inequalit	Female Labc	log(GDP per capita(constant US\$))
0	0.046079545	1	1	1	1	0	0	1	1	1	0.838383838	0
0.023150267	0	0.959107807	0.936708861	0.953075	0.926899517	0.03030303	0.03712957	0.9615385	0.963330173	0.962861893	0.848484848	0.002465674
0.046963123	0.04	0.918215613	0.873417722	0.907511	0.889823537	0.060606061	0.087842119	0.9230769	0.926660347	0.925723787	0.868686869	0.015391728
0.056013846	0.08	0.881040892	0.873417722	0.863469	0.852747556	0.090909091	0.166076041	0.8353342	0.978961987	0.88858568	0.888888889	0.027206902
0.078281047	0.12	0.842007435	0.873417722	0.821268	0.815671575	0.121212121	0.224451958	0.8461538	0.853320694	0.851447574	0.839898989	0.044554401
0.104337903	0.123636364	0.802973978	0.810126582	0.78107	0.797345802	0.151515152	0.241841541	0.8076923	0.816650867	0.78801829	0.868686869	0.065601077
0.148451545	0.2	0.762081784	0.746835443	0.742713	0.741519614	0.212121212	0.256085887	0.7692308	0.779981041	0.77717136	0.838383838	0.088167295
0.163097241	0.24	0.721189591	0.746835443	0.705557	0.704443633	0.272727273	0.269618355	0.7307692	0.743311214	0.740033254	0.808080808	0.101186474
0.164215234	0.28	0.678438662	0.683544304	0.668962	0.667367653	0.303030303	0.249457181	0.6923077	0.706641388	0.702895147	0.777777778	0.121873012
0.196301368	0.32	0.635687732	0.683544304	0.632687	0.630291672	0.363636364	0.281900051	0.6538462	0.669971561	0.66575704	0.747474747	0.153291469
0.209871585	0.239971591	0.594795539	0.620253165	0.596573	0.5660816	0.424242424	0.336075465	0.6153846	0.633301735	0.628618934	0.717171717	0.168140725
0.203479123	0.4	0.55204461	0.620253165	0.560458	0.55613971	0.454545455	0.340498266	0.5769231	0.596631908	0.591480827	0.777777778	0.187506483
0.200102381	0.44	0.50929368	0.556962025	0.524343	0.51906373	0.484848485	0.368705281	0.5384615	0.559962082	0.554342721	0.828282828	0.203514168
0.219665763	0.48	0.470260223	0.493670886	0.488069	0.481987749	0.515151515	0.582671253	0.5	0.523292255	0.517204614	0.888888889	0.237850068
0.245193747	0.52	0.425936803	0.430379747	0.451233	0.444911768	0.515151515	0.603296432	0.5710253	0.673779505	0.480066507	0.939393939	0.275179666
0.27924752	0.550198864	0.392193309	0.367088608	0.413037	0.341969898	0.545454545	0.582671253	0.4230769	0.449952602	0.446711005	1	0.322391867
0.321031572	0.6	0.355018587	0.303797468	0.372438	0.370759807	0.575757576	0.582671253	0.3846154	0.413282776	0.405790294	0.656565657	0.373871712
0.37674675	0.64	0.31598513	0.303797468	0.329356	0.333683826	0.606060606	0.833763165	0.3461538	0.376612949	0.368652187	0.493939394	0.433383606
0.46817711	0.68	0.278810409	0.240506329	0.284193	0.296607846	0.666666667	0.866254937	0.3076923	0.339943123	0.331514081	0.484848485	0.459324296
0.563407772	0.72	0.241635688	0.221518987	0.237748	0.259531865	0.696969697	0.846663885	0.3295578	0.392377477	0.294375974	0.323232323	0.51805803
0.536159387	1	0.20260223	0.17721519	0.191784	0.186999041	0.727272727	0.847606723	0.2306867	0.26660347	0.306172711	0.171717172	0.595147921
0.598483484	0.821647727	0.165427509	0.132911392	0.148222	0.165541538	0.696969697	0.833849214	0.071775	0	0.260999688	0.080808081	0.650143849
0.693452785	0.860426136	0.130111524	0.094936709	0.108664	0.144084034	0.787878788	0.877638262	0.1538462	0.193263816	0.215826665	0	0.698348413
0.688242686	0.899204545	0.094795539	0.063291139	0.074071	0.125010698	0.848484848	0.904138481	0.1153846	0.15659399	0.155595968	0	0.757844992
0.796627032	0.899204545	0.06133829	0.037974684	0.044843	0.105937362	0.939393939	0.83512981	0.0769231	0.119924163	0.070269147	0.01010101	0.831291695
0.904570987	0.937982955	0.029739777	0.018987342	0.0205	0.089248193	1	0.849755578	0.0384615	0.083254337	0	0.03030303	0.918103691
1	1	0	1	1	0	1	1	1	1	1	0.034	1

Author's Computation with source: World Development Indicators 2018 and Statistical Updates 2018 Human Development Reports

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