MACROECONOMIC FACTORS AND HUMAN DEVELOPMENT INDEX IN BRIS

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***Abstract*—The study explored the relationship that exist between macroeconomic factors like Gross Domestic Product, Gross Capital Formation and Export of Goods and Services of Brazil, Russia, India and South Africa for the period 1990 to 2022. The study was conducted using panel data regression model. The study brought to light the significant relationship that exist between all three explanatory variables and the response variable. However, the gross capital formation had a negative impact on the HDI highlighting the fact capital expenditures have long gestation period and fruits of which are enjoyed over a long period of time. Also, stressing on the findings of the previous studies, focus should not only be on economic factors but also important non-economic factors for the all-round development of the society.**

***Index Terms*—Gross Domestic Product, Gross Capital Formation, Export of Goods and Services, Human Development Index**

I. Introduction

1.1 Gross Domestic Product

Gross Domestic Product (GDP) as the market value of all the finished goods and services produced by a country within a specified time period. He further went on to say that the GDP is used by the government of a country to tout its economic strength i.e. more the GDP, more the strength of the economy (Rajarathinam. & Manikandan., 2023). Concepts like GDP and other national income accounts might seem little convoluted; however, they are considered to be the most seminal invention of the 20th century (Samuelson & Nordhaus, 2010).

1.2. Export and import of goods and services

Export and import of goods and services (EXIM) is a vital aspect of an economy, further EXIM leads to technological transfer and know-how between the trading countries this in turn can lead better quality of goods and services which will result in increase of EXIM (Kang & Wang, 2023). There is a direct and proportional relationship between the GDP of the country and its EXIM. EXIM acts as a vital factor in determining the trade balance of a country (Rajarathinam. & Manikandan., 2023).

1.3. The Gross capital formation

The Gross capital formation (GCF) is the amount of investments made on fixed assets like plant & machinery, land & building etc. during a particular period. It is vital indicator of a country's future economic growth and development (Ojo Ekiran & Ojo, 2024).

1.4. Human Development Index

Human Development Index (HDI) is a geometric mean of three dimensions namely: Health index, education index and standard of living index. HDI has its foundation on the following six elements: equality, sustainability, productivity, empowerment, cooperation and security. Growth in per capita income alone cannot be considered as development rather it should also consider changes in social structure and public institutions, along with evolution in behaviour and attitude for holistic assessment of the state of an economy. Human Development Index as a concept for assessing the economic development of a country was proposed so that human skills and capabilities should also be considered while assessing the economic development of a country. HDI also helps in analysing the effectiveness of the national policies by comparing two countries with similar Gross National Income (GNI) but with different HDI score (Arisman, 2018). HDI in totality was proposed to develop a human centric approach of development and help the citizens of the country live a fulfilling life (Alamoudi et al., 2023). Henceforth, it is necessary to study the relationship between economic factors and HDI score and also explore whether economic factors alone can contribute to living a fulfilling life. So, this study focuses on:

a. To understand the effect of GDP, export and GCF on HDI scores of Brazil, Russia, India and South Africa (BRICS minus China) using panel data analysis.

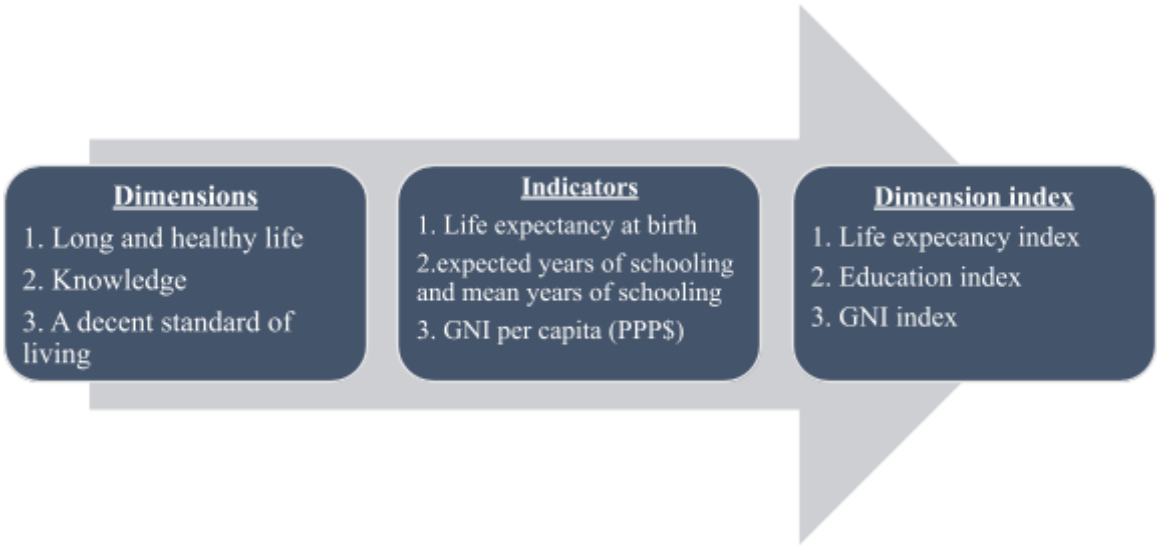

Figure 1 Dimensions of Human Development Index

Source: https://hdr.undp.org/data-center/human-development-index#/indicies/HDI

The section- 2. Review of literature summarises the findings of the previous studies undertaken on the same research area across the globe and it elucidates the importance of GDP, government spending on social factors like health and education and covers various other aspects of economy that affects the Human Development Index.

II. REVIEW OF LITERATURE

The influence of population and GDP per capita growth on HDI were of great significance when compared to the level of influence of unemployment rate and inflation. However, it is suggested that the government of the day should focus on unemployment levels and inflation rise as any persistent increase in both of these factors will negatively affect the living standard of the people (Arisman, 2018). The study by (Runtunuwu, 2020) confirmed the same minimal & negative effect of inflation on HDI score whereas the per capita income and unemployment level were found to have a significant negative impact on the HDI score of Ternate city. (Khan et al., 2019) added a new dimension to the existing literature by establishing the existence of positive influence of GDP, FDI and urbanisation on HDI score with the technological advancement as a moderating factor. (Ruslan, 2017) found out that in North Sumatra Province, the Gross Regional Domestic Product had a significant effect in bolstering the HDI score of the region. Similarly, government spend on health and education had a positive impact but of little significance. (Fadillah & Setiartiti, 2021) conducted study in the five districts of Yogyakarta, and affirmed the results of the study undertaken by (Ruslan, 2017) however in contrast, the government spending on education had negatively influenced the HDI in Yogyakarta. (Widodo et al., 2019) had used Panel data-based analysis to study the impact of government spending on education, health and minimum wages in select five provinces of Indonesia. Minimum wage alone was found to have a significant and proportional impact on HDI score. The study further went on to explain how increase in minimum wages increase the purchasing power of the citizens which in turn improves their standard of living. (Murbanto Sinaga & Rika Surianto Zalukhu, 2022) in North Sumatra, increase in poverty by 1% reduced the HDI score by 0.726 also the capital expenditure had negligible influence on the HDI score. (Al-Nasser & Al Hallaq, 2019) the relationship between Human poverty Index and Human Development Index in Jordan during 2003- 2016 was studied and it highlighted the existence of negative relationship between the two indices. (Alamoudi et al., 2023) found out the important elements that have positive material impact on the HDI score. They are: skilled workforce, research and development expenditure, level of international tourism, and finally followed by export and imports of goods and services. They also suggested that for a country to top the HDI index it has to work on the above listed four important elements affecting HDI and have to better than 70% of the countries in these four important indicators. (González Yñigo & Venancio Flores, 2024) brought to light an evolving and not so simple to understand kind of relationship

that exist between a particular territory and human develop index. They suggested developing a human development index that can incorporate territorial differences so that comparison of human development becomes fair and worthy to consider. To summarise, they are basically not for the one size fits all approach of present human development index.

The above review of literature highlights the findings of the study undertaken in different countries. However, while reviewing the existing literature it was found out that the majority of the study on Human Development Index were conducted in Indonesia and few other countries. Also, we found very few literatures on HDI pertaining to India and BRIS (Brazil, Russia, India and South Africa) countries.

This research paper adds to the existing knowledge by studying the dynamic relationship between select economic factors and Human Development Index (HDI) score using statistical tools like correlation coefficient and multiple regression analysis to fulfil the objectives of the study. Also, (Mahendru et al., 2023) in their **"Survival of the richest"** report highlighted the growing disparity between the poor and rich across the globe. Hence, the study helps us in understanding whether focussing on economic indicators alone as a measure of development will aid in improving the standard of living or should non-economic factors like Human Development Index etc. also be considered while assessing the development of the country. Also, countries from BRICS (except China) were selected to compare the effect of these macroeconomic factors on HDI scores which are socio-economically positioned similar to India at present.

III. METHODOLOGY

3.1. Scope of the study

The study aims to find out the influence of Gross Domestic Product (GDP), Export of goods and services, and Gross Capital Formation (GCF) on HDI score of BRIS. Also, a multiple regression equation was developed with HDI as dependent variable and Gross Domestic Product (GDP), Export of goods and services, and Gross Capital Formation (GC F) as independent variables.

3.2 Sampling design

The data for study was collected from various sources like World bank's data bank, United Nations Development Program etc. GDP, export of goods and services, and Gross capital formation, HDI score of India, Brazil, Russia and South Africa for the period 1990-2022 were compiled for the study from the above-mentioned sources. Therefore, the study was undertaken using secondary data and statistical tools like E-views and SPSS were used for analysis of the data.

3.3 Statistical technique

The equation used in this model is as follows:

$HDI_{it} = \alpha + \beta 1 ex_{it} + \beta 2\ GDP_{it} + \beta 2\ GCF_{it} + E_{it}$.

HDI- Human Development Index; i- country; t- time; α- Constant; β1- regression coefficient of export of goods and services; β2- regression coefficient of gross domestic product; β3- regression coefficient of gross capital formation; EX- Export of goods and services; GDP- Gross Domestic Product; GCF- Gross Capital Formation; E- error term

IV. RESULTS AND DISCUSSION

4.1 Unit root test

(Chen et al., 2022) One of the important characteristics of panel data is stationarity. All the statistical tools can be applied and the results of the analysis will be reliable only if the data is stationary or free from unit root. If the data used is non-stationary, it creates many problems the most important one being the "Spurious regression"

Both Levin, Lin & Chu T (LLC) and Im, Pesaran and Shin W- Stat (IPS) unit root test belong to the first-generation unit root. Both have the same hypothesis i.e. Ho- unit root exist in the panel; Ha- unit root is absent in the panel. From table 1 and table 2, it is clear that the variables under the study are stationary at first difference since the p-value of all the variables are less than 0.05 and hence we reject the null hypothesis.

Table 1- Results of panel unit root test using Levin, Lin & Chu T (LLC)

LLC	**Level**		**First difference**	
Variables	Statistics	Probability	Statistics	Probability
HDI	-1.12252	0.1308	-3.89175	0.0000
Gross Capital Formation	0.29332	0.6154	-5.38925	0.0000
Gross Domestic Product	1.72630	0.9579	-4.74119	0.0000
Export of goods and services	0.15642	0.5621	-4.41697	0.0000

Table 2- Results of panel unit root test using Im, Pesaran and Shin W- Stat (IPS)

IPS	**Level**		**First difference**	
Variables	Statistics	Probability	Statistics	Probability
HDI	1.42001	0.9222	-3.57494	0.0002
Gross Capital Formation	-0.17209	0.4317	-5.65704	0.0000

Gross Domestic Product	3.53772	0.9998	-3.70586	0.0001
Export of goods and services	2.07634	0.9811	-5.86954	0.0000

4.2 Multicollinearity Test

Multicollinearity is a situation in a regression model where the explanatory variables in the model are very highly correlated with each other. They further went on to discuss about the various techniques to identify the existence of multicollinearity in a regression model such as observing correlation coefficients, finding out the Variance Inflation Factor (VIF) etc. (Upendra et al., 2023). The important problem in having multicollinearity in a regression model, i.e. it artificially increases the standard error of coefficients, which in turns falsely rules out explanatory variables as insignificant when they are actually significant. Further, the study went on to explain why depending on correlation values cannot be a reliable way of identifying multicollinearity as correlation value is highly subjective in nature and varies with area of research. Hence, multicollinearity test using Variance Inflation Factor (VIF) was conducted on the panel data to confirm the absence of multiple correlation between the independent variable (Daoud, 2018). Table 3 reveals that the VIF value of all the three independent variables are less than 10 and the tolerance value of all the three independent variables are not less than 0.10 both of which indicates that the problem of multicollinearity is not severe to affect the reliability of our regression model.

Table 3: Results of Multicollinearity test

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.610	.014		44.775	.000		
	GDP (constant 2015 US$)	3.699	.000	.243	1.467	.145	.177	5.639
	Exports of goods and services (constant 2015 US$)	6.784	.000	.977	7.395	.000	.278	3.598
	Gross capital formation (constant 2015 US$)	-4.305	.000	-.929	-5.758	.000	.186	5.367
a. Dependent Variable: HDI Score								

4.3 Heteroscedasticity

The errors are to be independently identically distributed in a linear regression model for it to be called as homoscedastic. In the absence of independently identically distributed errors in a regression model, it is called as heteroscedastic (Klein et al., 2016). The problem of having a heteroscedastic regression model is wrong standard errors which in turn reduces the statistical significance of the model. All the parameters estimated in both homoscedastic and heteroscedastic model will be the same except for estimated covariance matrix this will result in increase in type I error (Rosopa et al., 2013). Thus, it is important to confirm absence of heteroscedasticity in the regression model. The H0 in Breusch- Pagan-Godfrey model is that the data is homoscedastic and Ha states that the data is heteroscedastic. The Significance value from Table 4 clearly highlights that there is sufficient evidence to reject the alternate hypothesis and hence, the data used in this study is free from Heteroscedasticity.

Table 4: Results of Breusch- Pagan-Godfrey Heteroscedasticity test

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	.008	3	.003	40.319	2.062[b]
	Residual	.008	128	.000		
	Total	.016	131			
a. Dependent Variable: residual squared						
b. Predictors: (Constant), Gross capital formation (constant 2015 US$), Exports of goods and services (constant 2015 US$), GDP (constant 2015 US$)						

4.4 Hausman Test

Hausman test is used to determine the random or fixed individual effect on a given panel data. It helps in concluding whether the conditioning regressors and unobserved individual effect is strongly related. If the exogeneity of unobserved individual effect is rejected then fixed effect is considered to be the suitable and if exogeneity of unobserved individual effect is not rejected then the Hausman test highlights the suitability of random effect for the regression model (Amini et al., 2012). H0- accept random effect model and Ha- accept fixed effect model for the given data set. It is evident from the table 5 that the P-value is less than the 0.05, So the null hypothesis is rejected and the alternate hypothesis is accepted and hence we proceed with fixed effect test for the panel data set.

Table 5: Results of Hausman test

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	1750.892663979439	3	0

4.5 Fixed effect model

The probability value presented in Table 6 clearly highlights the presence of significant influence of all the three independent variables (GDP, EX and GCF) on dependent variable (HDI score) as the p-value is less than 0.05. However, Gross Domestic Product had a positive impact on HDI score and this is in conformity to the studies undertaken previously (Khan et al., 2019); (Ruslan, 2017); (Arisman, 2018); (Fadillah & Setiartiti, 2021). Export of goods and services also had a positive impact on HDI score, this concurs with previous study (Alamoudi et al., 2023); whereas Gross Capital Formation has a significant negative influence on the HDI score, previous studies however concluded that the influence of Gross capital formation was negligible on HDI score (Murbanto Sinaga & Rika Surianto Zalukhu, 2022). From the table it is evident that for 1 unit increase in GDP the HDI score will more or less increase at the same level, for 1 unit increase in export of goods and services the HDI score will increase by 1.5 unit on the other hand for 1 unit increase in Gross capital formation the HDI will the decrease will be more or less the same as the increase of Gross Capital Formation. The adjusted R-squared value of 0.9566 implies that these three independent variables can explain 95.66% of the model and the rest 4.34% can be explained by variables that are not considered in this model.

Table 6: Results of Fixed effect model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GROSS CAPITAL FORMATION C...	-1.06E-13	2.56E-14	-4.152056	0.0001
GDP CONSTANT 2015 US$	1.01E-13	1.82E-14	5.570597	0.0000
EXPORTS OF GOODS AND SERVI...	1.52E-13	5.41E-14	2.814640	0.0057
C	0.562238	0.006350	88.54297	0.0000
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.958601	Mean dependent var		0.671098
Adjusted R-squared	0.956614	S.D. dependent var		0.098651
S.E. of regression	0.020548	Akaike info criterion		-4.880506
Sum squared resid	0.052779	Schwarz criterion		-4.727630
Log likelihood	329.1134	Hannan-Quinn criter.		-4.818384
F-statistic	482.4046	Durbin-Watson stat		0.144688
Prob(F-statistic)	0.000000			

V. CONCLUSION AND RECOMMENDATIONS

The current study aims to find the relationship dynamics between select macro-economic factors and Human development index score of Brazil, Russia, India and South Africa. Secondary data on economic indicators like gross domestic product, gross capital formation and export of goods and services were collected from World open data bank and data on HDI scores were collected from United Nations Development programme data bank. The study conducted using panel regression model to explore the kind of relationship that exist between the variables under the study. All the explanatory variables had significant impact on the HDI score of which gross capital formation had a negative impact on the HDI score. One of important factors for this negative influence could be the long gestation period taken by capital expenditure to create a positive impact on the society. The same was highlighted in the study (Murbanto Sinaga & Rika Surianto Zalukhu, 2022). Also, focussing on economic factors alone might not yield the expected holistic development of the society so it is important to focus combinedly on economic and non-economic factors which was stressed in previous studies (Arisman, 2018).

VI. LIMITATIONS

The study was limited to four countries i.e. Brazil, Russia, India and South Africa and only three macro-economic factors like GDP, export of goods and services and gross capital formation were considered for the study. Future studies can expand the geography of the study to other countries and regions in the world and other macro-economic indicators and non-economic indicators can also be considered and analysed to expand the scope of the study.

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