International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Economic Growth, Human Development and Gender Equality: A Trend Analysis

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Abstract

According to the UN (2002), "equality is the cornerstone of every democratic society that aspires to social justice and human rights." Positive change in gender equality is associated with improvement in economic growth (World Bank 2011), it is also intricately linked to human development. Women and men share many aspects of living together, collaborate with each other in complex and ubiquitous ways, and yet end up — often enough — with very different rewards and deprivations. Human development and gender equality are linked with each other. Gender equality is a development goal, a means of achieving other development goals, and a fundamental human right. There is a strong case at this time for concentrating specifically for a more comprehensive investigation of gender inequality in economic and social arrangements in the contemporary world. The present paper attempts to examine an empirical relationship between economic growth, human development, and gender development.

Introduction

The preamble to the Universal Declaration of Human Rights, adopted by UN General Assembly resolution 217 A (III) on 10 December 1948 recognises the inherent dignity and of the equal and inalienable rights of all members of the human family as the foundation of freedom, justice and peace in the world (Malizard Julien, 2010) . Positive change in gender equality is associated with improvement in economic growth (World Bank 2011), Gender equality is intricately linked to human development, which until the late 1980s was narrowly defined as wealth and measured by gross domestic product (Campbell Janine Anne, 2021). However, after 2010 a revised approach of human development is adopted to include not just factors determining conditions for development but also aspects of gender equality.

Human Development Report 1997 mentions that "there is no country that treats its women as well as its men, according to a complex measure that includes life expectancy, wealth, and education equally". (HDR, 1997). Similarly, Anand and Sen (1996) also mention that Women and men share many aspects of living together, collaborate with each other in complex and persistent ways, and yet end up — often enough — with very different rewards and deprivations.

Human development and gender equality are interconnected. Gender equality is a development goal, a means of achieving other development goals, and a fundamental human right (Lawson 2008; UNDP 2020; World Bank 2011). Development that perpetuates inequalities is neither sustainable nor worth sustaining.

Gender equality is linked to economic growth and human development, which until the late 1980s was narrowly defined as wealth and measured by gross domestic product (GDP. However, of late, a more holistic approach of Human Development Index has been adopted by UNDP. In 2010, the United Nations

expanded the dimensions of human development to include factors that create conditions for development and included gender equality)(Janine Anne Campbell, et.al., 2021).

Over the past twenty years, gender equality has become integral to policy analysis, design and implementation (World Bank 2001), and substantial reductions in gender gaps in health and education have occurred. However, despite a steady increase in women in the workplace, the anticipated improvement in labour force participation and political representation has been more moderate than expected (Bandiera and Natraj 2013).

Although this perspective has received some attention in past Reports, there is a strong case at this time for concentrating specifically on that issue for a more comprehensive investigation of gender inequality in economic and social arrangements in the contemporary world (WB,2012).

The present paper seeks to answer the following questions in context of human development and gender equality:

1. Is there a relationship between economic growth and human development?
2. Is there a relationship between economic growth and gender development?
3. Is there a relationship between human development and gender development?
4. Does rise in GNI PC improve Gender Development?

The present paper is divided into six sections. Section I deals with the introduction, section II with review of literature. Section III discusses the empirical relationship between economic growth, human development, and gender development. Section IV attempts to study the relationship between various indicators of human development and gender development. Section V discusses the labour force participation of women and gender development. Section VI deals with summary and conclusions. The study is based on the secondary data collected from UNDP. Categories selected are for very high, high, medium, and low human development countries. The time period chosen for the study is 1990-2021. Variables used in the study are GNI, HDI, GDI, GII, Life expectancy, literacy rate, women's political participation, women's labour force participation, etc. Statistical tools such as compound annual growth rate, coefficient of correlation and regression analysis have been used for the study.

Review of literature

Ranis, et.al., 2000) argue that Human development of a country comprises of the health and education of people. According to the authors, there exists a strong connection between economic growth and human development. On the one hand, with economic growth resources are provided to permit sustained improvements in human development. On the other, an important contributor to economic growth is improvements in the quality of the labour force. Given the fact that Women and men share many aspects of living together, collaborate with each other in complex and more pervasive ways, and still end up — often enough — with very different rewards and deprivations (Anand & Sen, 2000). Often, most studies emphasize bringing about women's empowerment in order to accelerate economic development. (Duflo, 2012), on the other hand, makes a critical contribution exploring the bi-directional relationship between economic development and women's empowerment.

Duflo (2012) cautions that economic development by itself cannot bring women's empowerment. Equality between men and women is likely to be achieved only by policy actions that favour women. Some of the earlier studies that analyse the impact of women's status on human development have primarily seen the issue from the point of view of gender inequality. The primary aim of these studies was to understand the effect of gender inequality on development. Some of these studies have found a negative impact (Ferrant,

2015; Klasen, 1999; Klasen, 2002; Klasen and Lamanna, 2009). Ferrant and Nowacka (2015) have examined the role of gender biased social institutions. According to them, the social institutions only reinforce, "acceptable" gender roles and inequalities between men and women that hamper development. Basu (2002) in his study mentioned that with higher human development, and advancement, employment and education among women rises and fertility among women tends to decline. The basic argument here according to the author is that as education among women rises, women tend to spend more on their children's education as a compensation for having less children. As education and employment among women rises, making them more financially stable, their dependence on children for financial security decreases. This is also because of rising cost of education desire of higher education levels for children and also the control over their earnings. Political empowerment also results into women friendly policy making (Duflo, 2012). As a result of these policies, there is an improvement in public healthcare, improvement in girls' school attendance and education attainment. Political empowerment, according to her includes women's participation and inclusion in democratic processes as this facilitates women to express their choices relating to safety and equality. (Duflo, 2012) notes that there are barriers to women's participation in politics because of the widespread perception about women not being competent leaders. Bharadwaj and Das (2021), analyse the effect of women's social status on development. The authors argue that empowering women across all domains of society has several benefits that extend beyond the current generation. Restraints imposed on their choices and mobility have negative effects for a country. If a country wants to achieve its highest potential and a high standard of living for its citizens, women must be actively engaged. Thus, efforts must be made to ensure women's active participation in all activities. The authors suggest that those policies should be prioritised that aim to increase the role and participation of women in paid employment. The authors further argue that gender equality helps reduce income inequality women's political participation at all levels would help in the policies and programmes favourable to women.

World Bank (2011), in its report on "Getting to Equal Promoting Gender Equality through Human Development", mentions that the services that promote human development are needed to improve the lives of deprived groups and can help reduce gender differences in health, education, and economic opportunities.

Greater gender equality today shapes the norms and cultures—as well as the constraints and possibilities—of tomorrow's men and women. A wealth of evidence demonstrates that gender equality begins a virtuous circle of higher productivity, lower poverty, and better development outcomes for generations to come (World Bank, 2011).

The World Bank report (2011) also suggests that gender equality is also important for better human development outcomes for future generations as women have control over household resources that leads to more investment in children's human capital. This in turn has positive effects on growth. Studies have also shown that nutritional status of mothers also has positive effect on child health and survival. The World Bank report(2011) further argues that the progress and persistence of gender equality is important both for development outcomes and policy making. Greater gender equality also leads to rise in productivity and improvement in development outcomes. Development by itself cannot reduce gender disparities. Necessary policy interventions are imperative.

Azuh Dominic, et. al., (2017) in their paper on "Factors of Gender Inequality and Development among Selected Low Human Development Countries in Sub-Saharan Africa" state that Gender inequality and poor women empowerment retard improvement in living standards of women and act as a clog in their

contributions to governance and economic development. Gender inequality lower quality of life and culminates in limited productivity, hinder economic efficiency and growth. For over three decades, gender issues have been at the front burner of international summits. In spite of much progress in recent times, gender inequalities remain pervasive in many dimensions of life in various regions around the world particularly in sub-Saharan Africa (SSA). Treatment of women is yet to be fairer and related policies can be more effective to improve the status of women. No-doubt studies have been carried out on gender inequality, but less emphasis has been ravelled with respect to hindrances and implications of gender inequality. Hence, understanding the nature of gender inequality will not only promote sound awareness among African countries, but also ignite government efforts as well as NGOs toward effective interventions for reduction of gender inequality especially in the economic and political realms where women are made worse off by the sociocultural milieu. The methodological approach to this paper was based on reviews of published multiple documents to draw up statistical profile of the situation of women in selected countries of low human Development index in SSA to show the existence of gender inequality. The paper found among all the 12 low human development countries and SSA region examined that gender indicators such as human development index, expected years of schooling, mean years of schooling, estimated gross national per capita, share of seats in parliament, population with at least secondary education and labour-force participation rate are all in favour of men. The paper concludes with recommendations to narrow the gender gaps.

A study on Gender Equality, Human Development, and PISA Results over Time by Janine Anne Campbell, Joseph McIntyre and Natalia Kucirkova (2021), found that a change in gender equality is empirically more important than economic factors. The authors found that this was counter to the prevailing belief (Meyer and Schiller 2013; Rowley et al. 2019) that economic factors are the most important enabling conditions in education, and that an improvement in human development is the most consistent predictor of improved PISA scores. Our findings indicate that investments in health and education – human capital endowments – shape the ability of men and women to reach their full potential. Though many studies have been carried out to understand the impact of economic growth on human development and gender. However, there seems a two-way relationship exists between the two which remains unexplored. The present paper is an attempt to understand the same. There are no studies to understand the relationship between growth, gender and human development. The present study is an attempt to fill this gap.

Research methodology

The secondary data collected from UNDP has been used in the present study. The time period chosen for the study is 1990-2021. Variables used in the study are GNI, HDI, GDI, GII, Life expectancy, literacy rate, women's political participation, women's labour force participation, etc. Statistical tools such as compound annual growth rate, coefficient of correlation and regression analysis have been used for the study. Other measures of central tendency and skewness and kurtosis have been used. Data has been analysed using E views.

The robust least squares model is used here. This model provides estimates of the coefficients while accounting for potential outliers or violations of certain assumptions. It is robust to deviations from normality and heteroscedasticity. The robust least squares model estimates the relationship between dependent and independent variables. Attempt is made to understand a two-way relationship between human development and gender equality, gender equality and growth and human development and

economic growth. Per capita GDP($PPP) is used as an indicator of growth. Schwarz criterion is used for model selection.

Granger causality is a statistical concept and technique used to determine whether one time series can predict or forecast another time series. In order to check the causality, the definition given by Granger has been used in this paper. xi causes yi if the prediction of yi based on knowledge of the past values of xi and yi. where $e1t$ and $e2t$ are white noise and p refers to the lag length. The null hypothesis of the Granger test is that the variable yt does not affect xt. J-B diagnostic test is used to understand if the residual data are normally distributed.

Results

UNDP introduced three human development measures in 2010 Human Development Report, which it has since continued to estimate and report on annually. These measures are the Human Development Index (HDI), the Inequality-adjusted Human Development Index (IHDI), and the Gender Inequality Index (GII). Anand and Sen treat gender inequality as one of several possible inter-group inequalities, and then base their analysis on the assumption common in economics that individuals and societies have, ceteris paribus, an aversion to inequality. If two societies had the same average achievement but different levels of inter-group inequality in that achievement, aversion to inequality would mean that the society with the lower inter-groups inequality should be socially preferable to one having the same average achievement but larger inequality. GDI also consists of the three measures. It is therefore important to understand the relationship between the two indicators if one influences the other. It is therefore important to understand this two-way relationship between HDI & GDI.

Table-1 Descriptive Statistics

	EYS	GDI	GNIPC	HDI	LE	LEF	LFPRF	MYS	PRF
Mean	9.878340	0.783656	3695.884	0.541250	64.99773	66.26133	27.20306	4.737490	9.692817
Median	9.782452	0.788500	3324.838	0.538500	65.20390	66.63490	30.44800	4.583023	9.287547
Maximum	12.34372	0.852000	6650.054	0.645000	70.90980	72.39540	31.95500	6.655109	13.48601
Minimum	7.996358	0.707000	1768.859	0.434000	58.65160	59.53660	18.60300	2.781576	7.341772
Std. Dev.	1.614105	0.050727	1606.193	0.073333	3.860613	4.162188	4.479586	1.254880	1.983095
Skewness	0.153098	-0.145316	0.523024	0.069407	-0.035101	-0.090719	-0.632497	0.138070	0.423489
Kurtosis	1.371090	1.648845	1.941571	1.584328	1.750668	1.659178	1.731537	1.811350	2.065192
Jarque-Bera	3.662807	2.546782	2.952650	2.697860	2.087677	2.440965	4.278942	1.985524	2.121650
Probability	0.160189	0.279881	0.228476	0.259518	0.352101	0.295088	0.117717	0.370552	0.346170

Sum	316.1069	25.07700	118268.3	17.32000	2079.927	2120.363	870.4980	151.5997	310.1701
Sum Sq. Dev.	80.76536	0.079771	79975516	0.166710	462.0343	537.0380	622.0673	48.81641	121.9126
Observations	32	32	32	32	32	32	32	32	32

The above table provides information on the descriptive statistics. The J-B statistics indicate that none of the variable is non-stationary. Thus, this data set is fit for further analysis.

Hypothesis Testing

Ho: There is no association between GDI and HDI

H1: There is an association between GDI and HDI

In this study, the independent variable is HDI, which is the explanatory variable, while GDI is the dependent variable. The linear equation that captures the relationship between the dependent variable (GDI) and the independent variable (HDI) is expressed as follows:

To test the above-mentioned hypothesis, a simple regression analysis is conducted. The model for the robust regression model has been prepared as below.

$$GDI = \beta_0 + \beta_1 HDI + \varepsilon \ldots\ldots\ldots (1)$$

Equation-1 represents the GDI is dependent on HDI. The β_0 represents the effects of the factors other than HDI on GDI. While the coefficient of HDI, β_1 represents the unit change in GDI due to HDI.

A robust regression analysis is conducted for the above-mentioned model. The results are as below.

Table 2 Regression Analysis (GDI & HDI)

Dependent Variable: GDI				
Method: Robust Least Squares				
Sample: 1990- 2021				
Included observations: 32				
Method: M-estimation				
M settings: weight=Bisquare, tuning=4.685, scale=MAD (median centered)				
Huber Type I Standard Errors & Covariance				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.411415	0.008504	48.38016	0.0000*
HDI	0.687430	0.015574	44.14089	0.0000*
	Robust Statistics			
R-squared	0.885942	Adjusted R-squared		0.882140
Rw-squared	0.987693	Adjust Rw-squared		0.987693
Akaike info criterion	23.79674	Schwarz criterion		28.15379
Deviance	0.001012	Scale		0.006907
Rn-squared statistic	1948.418	Prob (Rn-squared stat.)		0.000000
	Non-robust Statistics			

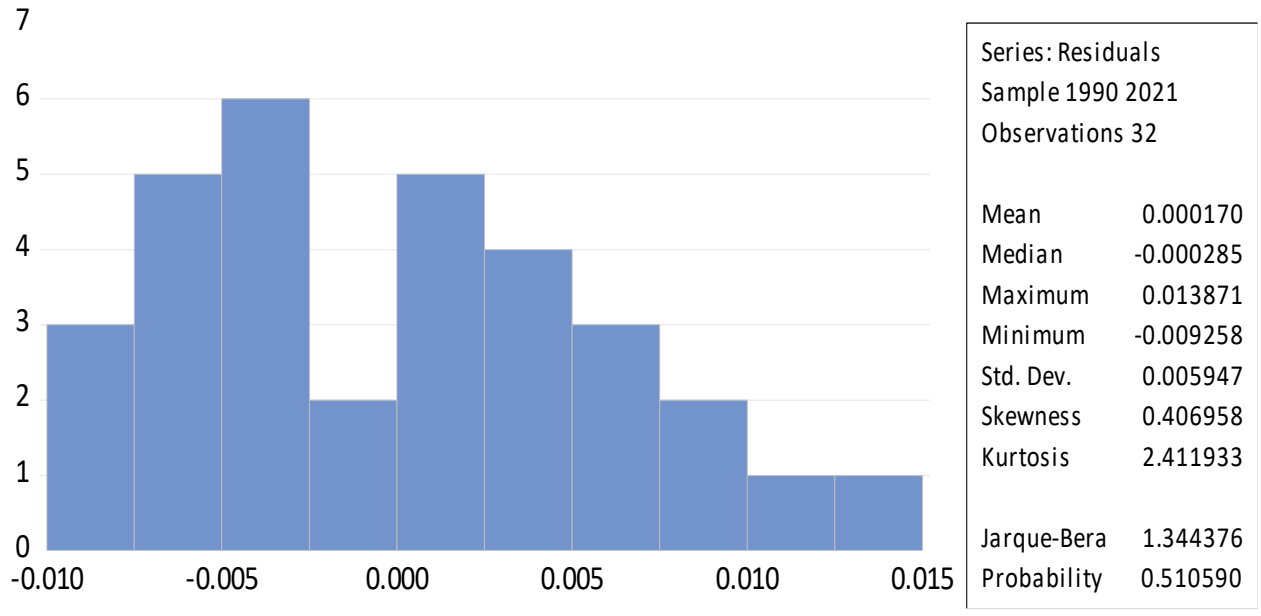
Mean dependent var	0.783656	S.D. dependent var	0.050727
S.E. of regression	0.006047	Sum squared resid	0.001097

* and ** indicate 1 % and 5 % significant level.

The table above explores the relationship between the GDI and the HDI. It reveals a positive correlation between the GDI and the HDI. The HDI has a statistically significant impact on GDI. The coefficient in the model suggests a positive association between the HDI and GDI. The coefficient of HDI is 0.69 indicates that for every one-unit increase in HDI, GDI is expected to increase by 0.69 at a 1 per cent significance level. The value of R^2 indicates that approximately 89 % of the variance in the GDI can be explained by HDI. It means 89 % of the variation in GDI can be accounted for by changes in HDI. The remaining 11 % of the variation is attributed to other factors not included in the model. A value of Rw-square is 0.98 is considered to be good, and the high change in GDI is attributed to HDI. The lower values of the AIC and Schwarz criterion indicate a better fit of the model, suggesting that the model provides a satisfactory representation of the data. The Rn squared statistic is used to measure the overall goodness of fit of the model. Accordingly, the value of the Rn-squared statistic is found to be 1948.42, with a corresponding p-value of less than 0.000, indicating that the model's fit is statistically significant.

The below diagnostic test provides that residual data are normally distributed. The J-B statistics shows the acceptance of normality of residual data.

Diagram I



Granger Causality

Table 3 Granger Causality test for HDI & GDI

Null Hypothesis:	Obs	F-Statistic	Prob.
HDI does not Granger Cause GDI	30	2.60877	0.0935***
GDI does not Granger Cause HDI		1.06552	0.3597

* , ** and *** indicate 1 % ,5 % and 10% significant level.

The above table provides the Granger causality test for HDI and GDI. It shows that the hypothesis of HDI does not Granger cause GDI is rejected at 10% significant level. It means that there is a direct and positive causation between HDI and GDI. It also indicates the acceptance of hypothesis that GDI does not Granger cause HDI. Thus, there unidirectional causation from HDI to GDI but not from GDI to HDI.

Hypothesis Testing

Ho: There is no association between HDI and GDI

H1: There is an association between HDI and GDI

The robust least squares model is a regression model that provides estimates of the coefficients while accounting for potential outliers or violations of certain assumptions. It is robust to deviations from normality and heteroscedasticity. The robust least squares model estimates the relationship between dependent and independent variables. In this study, the independent variable is represented by GDI, which is the explanatory variable, while HDI is the dependent variable. The linear equation that captures the relationship between the dependent variable (HDI) and the independent variable (GDI) is expressed as follows:

To test the above-mentioned hypothesis, a simple regression analysis is conducted. The model for the robust regression model is as follows:

Here, GDI is taken as the independent variable while the HDI is the dependent variable.

$$HDI = \beta_0 + \beta_1 GDI + \varepsilon \ldots\ldots\ldots (2)$$

Equation-2 considers HDI as dependent on the GDI. The β_0 represents the effects of the factors other than GDI on HDI. While the coefficient of GDI, β_1 represents the unit change in HDI due to change in GDI.

A robust regression analysis is conducted for the above-mentioned model. The results are as below.

Table 4 Regression Analysis (HDI & GDI)

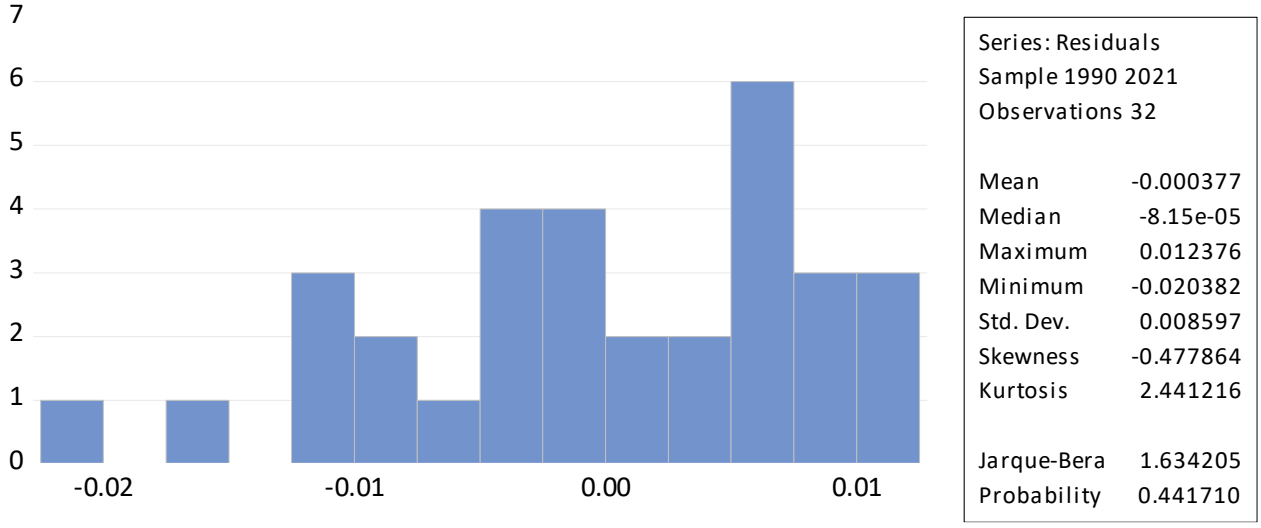
Dependent Variable: HDI				
Method: Robust Least Squares				
Included observations: 32				
Method: M-estimation				
M settings: weight=Bisquare, tuning=4.685, scale=MAD (median centered)				
Huber Type I Standard Errors & Covariance				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.582524	0.025934	-22.46193	0.0000*
GDI	1.434495	0.033026	43.43476	0.0000*
	Robust Statistics			
R-squared	0.868951	Adjusted R-squared		0.864583
Rw-squared	0.988151	Adjust Rw-squared		0.988151
Akaike info criterion	29.44319	Schwarz criterion		33.21554
Deviance	0.002067	Scale		0.008869
Rn-squared statistic	1886.578	Prob(Rn-squared stat.)		0.000000
	Non-robust Statistics			
Mean dependent var	0.541250	S.D. dependent var		0.073333
S.E. of regression	0.008747	Sum squared resid		0.002295

* and ** indicate 1 % and 5 % significant level.

The table above explores the relationship between the HDI and the GDI. It reveals a positive correlation between the HDI and the GDI. The GDI has a statistically significant impact on the dependent variable, the HDI. The coefficient in the model suggests a positive association between the GDI and the HDI. The coefficient of GDI has been to be 1.43 indicates that for every one-unit increase in the GDI, the HDI is expected to increase by 1.43 at a 1 per cent significance level. The value of R^2 indicates that approximately 87 % of the variance in the HDI can be explained by the GDI. It means 87 % of the variation in HDI can be accounted for by changes in the GDI. The remaining 13 % of the variation is attributed to other factors not included in the model. A value of Rw-square is 0.98 is considered to be good, and the high change in HDI is attributed to GDI. The lower values of the AIC and Schwarz criterion indicate a better fit of the model, suggesting that the model provides a satisfactory representation of the data. The Rn squared statistic is used to measure the overall goodness of fit of the model. Accordingly, the value of the Rn-squared statistic is found to be 1886.58, with a corresponding p-value of less than 0.000, indicating that the model's fit is statistically significant.

The below diagnostic test provides that residual data are normally distributed. The J-B statistics shows the acceptance of normality of residual data.

Diagram 2



Hypothesis Testing

Ho: There is no association between HDI and GNIPC

H1: There is an association between HDI and GNIPC

The robust least squares model is a regression model that provides estimates of the coefficients while accounting for potential outliers or violations of certain assumptions. It is robust to deviations from normality and heteroscedasticity. The robust least squares model estimates the relationship between dependent and independent variables. In this study, the independent variable is represented by GNIPC, which is the explanatory variable, while the HDI is the dependent variable. The linear equation that captures the relationship between the dependent variable (HDI) and the independent variable (GNIPC) is expressed as follows:

To test the above-mentioned hypothesis, a simple regression analysis is conducted. The model for the robust regression model has been prepared as below. Here, GNIPC is taken as the independent variable while the HDI is considered as the dependent variable.

$$HDI = \beta_0 + \beta_1 GNIPC + \varepsilon \ldots\ldots\ldots (3)$$

Equation-3 represents the HDI is depending on the GNIPC. The β_0 represents the effects of the factors other than GNIPC on HDI. While, the coefficient of GNIPC, β_1 represents the unit change in HDI due to GNIPC.

A robust regression analysis is conducted for the above-mentioned model. The results are as below.

Table 5 Regression Analysis (HDI & GNIPC)

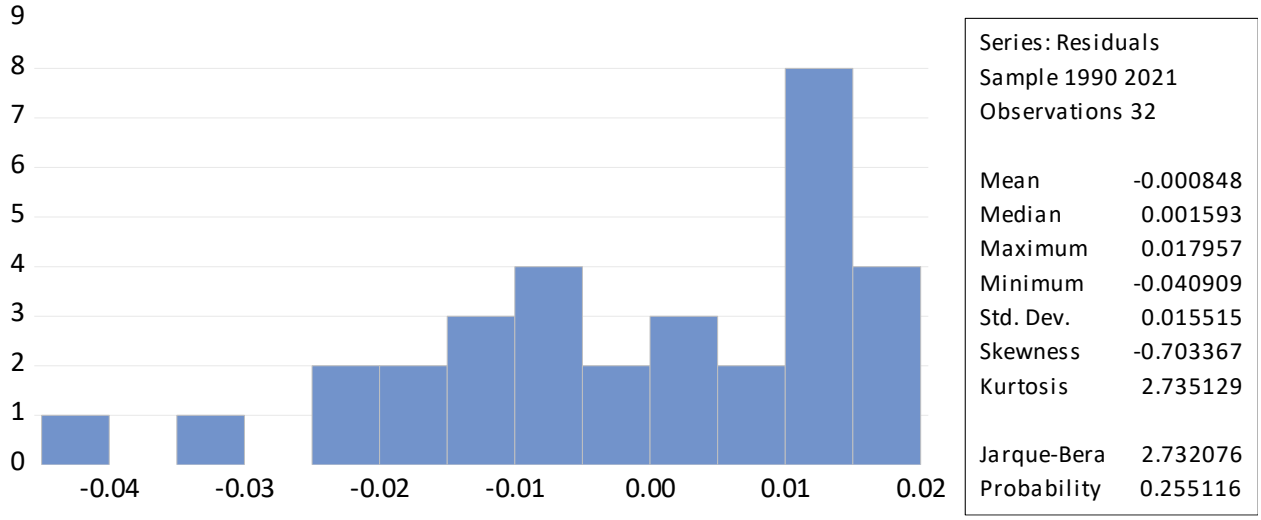
Dependent Variable: HDI				
Sample: 1990 2021				
Included observations: 32				
Method: M-estimation				
M settings: weight=Bisquare, tuning=4.685, scale=MAD (median centered)				
Huber Type I Standard Errors & Covariance				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.373770	0.007356	50.80871	0.0000*
GNIPC	4.55E-05	1.83E-06	24.88726	0.0000*
	Robust Statistics			
R-squared	0.851876	Adjusted R-squared		0.846938
Rw-squared	0.959963	Adjust Rw-squared		0.959963
Akaike info criterion	25.71330	Schwarz criterion		29.93396
Deviance	0.006747	Scale		0.017127
Rn-squared statistic	619.3758	Prob(Rn-squared stat.)		0.000000
	Non-robust Statistics			
Mean dependent var	0.541250	S.D. dependent var		0.073333
S.E. of regression	0.015795	Sum squared resid		0.007485

* and ** indicate 1 % and 5 % significant level.

The table above explores the relationship between the GNIPC and the HDI. It reveals a positive correlation between the GNIPC and the HDI. The GNIPC has a statistically significant impact on the dependent variable, the HDI. The coefficient in the model suggests a positive association between the GNIPC and the HDI. The coefficient of GNIPC is nearly zero indicates that for every one-unit increase in the GNIPC, the HDI is expected to increase but with a very meagre number of 0.0005 at a 1 per cent significance level. The value of R^2 indicates that approximately 85 % of the variance in the HDI can be explained by the GNIPC. It means 85 % of the variation in HDI can be accounted for by changes in the GNIPC. The remaining variation is attributed to other factors not included in the model. The lower values of the AIC and Schwarz criterion indicate a better fit of the model, suggesting that the model provides a satisfactory representation of the data. The Rn squared statistic is used to measure the overall goodness of fit of the model. Accordingly, the value of the Rn-squared statistic is found to be 619.3758, with a corresponding p-value of less than 0.000, indicating that the model's fit is statistically significant.

The below diagnostic test provides that residual data are normally distributed. The J-B statistics shows the acceptance of normality of residual data.

Diagram 3



Granger Causality

Granger causality is a statistical concept and technique used to determine whether one time series can predict or forecast another time series. In order to check causality, the definition given by Granger has been used. xi causes yi if the prediction of yi based on knowledge of the past values of xi and yi. where *e*1*t* and *e*2*t* are white noise and *p* refers to the lag length. The null hypothesis of the Granger test is that the variable *yt* does not affect *xt.*

Table 6 Pairwise Granger Causality Tests (GNIPC & HDI)

Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
GNIPC does not Granger Cause HDI	30	9.40915	0.0009*
HDI does not Granger Cause GNIPC		6.15487	0.0067*

* , ** and *** indicate 1 % ,5 % and 10% significant level.

The above table provides the Granger causality test for HDI and GNIPC. It shows that the hypothesis of HDI does not Granger cause GNIPC is rejected at 1% significant level. It means that there is a direct and positive causation between HDI and GNIPC. It also indicates the rejection hypothesis that GNIPC does not Granger cause HDI. Thus, there bidirectional causation from HDI to GNIPC and from GNIPC to HDI.

Hypothesis Testing

Ho: There is no association between GNIPC and HDI

H1: There is an association between GNIPC and HDI

The robust least squares model is a regression model that provides estimates of the coefficients while accounting for potential outliers or violations of certain assumptions. It is robust to deviations from normality and heteroscedasticity. The robust least squares model estimates the relationship between dependent and independent variables. In this study, the independent variable is represented by HDI, which

is the explanatory variable, while the GNIPC is the dependent variable. The linear equation that captures the relationship between the dependent variable (GNIPC) and the independent variable (HDI) is expressed as follows:

To test the above-mentioned hypothesis, a simple regression analysis is conducted. The model for the robust regression model has been prepared as below. Here, GNIPC is taken as the independent variable while the HDI is considered as the dependent variable.

$$GNIPC = \beta_0 + \beta_1 HDI + \varepsilon \ldots\ldots\ldots (4)$$

Equation-4 represents the GNIPC is depending on the HDI. The β_0 represents the effects of the factors other than HDI on GNIPC. While, the coefficient of HDI, β_1 represents the unit change in GNIPC due to HDI.

A robust regression analysis is conducted for the above-mentioned model. The results are similar to the previous exercise of evaluating the impact of GNIPC on HDI.

Hypothesis Testing

Ho: There is no association between GNIPC and GDI

H1: There is an association between GNIPC and GDI

The robust least squares model is a regression model that provides estimates of the coefficients while accounting for potential outliers or violations of certain assumptions. It is robust to deviations from normality and heteroscedasticity. The robust least squares model estimates the relationship between dependent and independent variables. In this study, the independent variable is represented by GNIPC, which is the explanatory variable, while the GDI is the dependent variable. The linear equation that captures the relationship between the dependent variable (GDI) and the independent variable (GNIPC) is expressed as follows:

To test the above-mentioned hypothesis, a simple regression analysis is conducted. The model for the robust regression model has been prepared as below. Here, GNIPC is taken as the independent variable while the GDI is considered as the dependent variable.

$$GDI = \beta_0 + \beta_1 GNIPC + \varepsilon \ldots\ldots\ldots (5)$$

Equation-5 represents the GDI is depending on the GNIPC. The β_0 represents the effects of the factors other than GNIPC on GDI. While, the coefficient of GNIPC, β_1 represents the unit change in GDI due to GNIPC.

A robust regression analysis is conducted for the above-mentioned model. The results are as below.

Table 7 Regression Analysis (GDI & GNI PC)

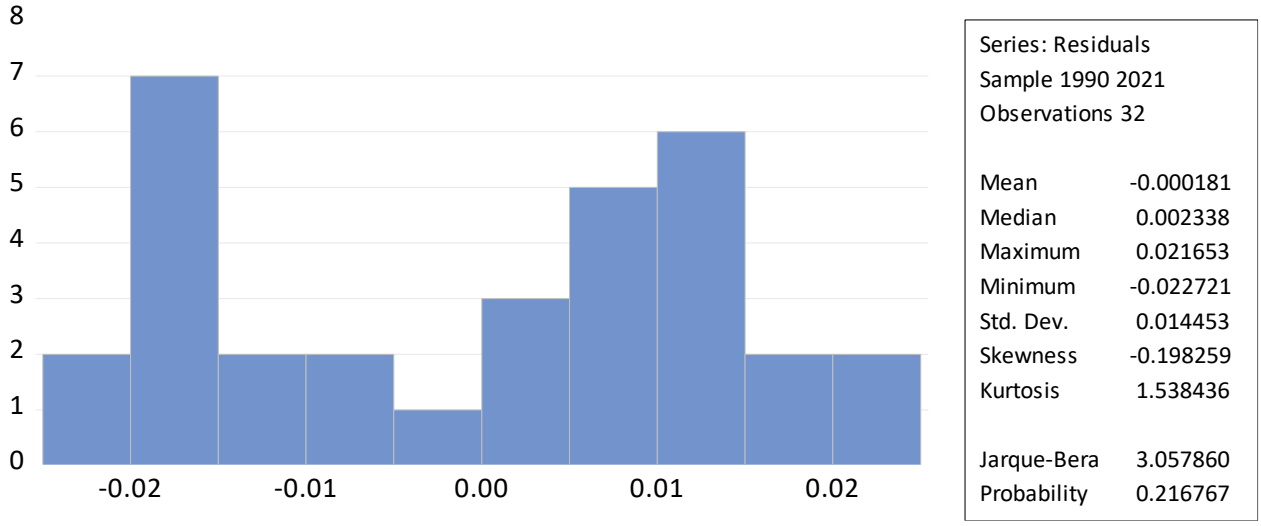
Dependent Variable: GDI				
Included observations: 32				
Method: M-estimation				
M settings: weight=Bisquare, tuning=4.685, scale=MAD (median				
centered)				
Huber Type I Standard Errors & Covariance				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.671605	0.007224	92.96661	0.0000*
GNIPC	3.04E-05	1.80E-06	16.89716	0.0000*
	Robust Statistics			

R-squared	0.848962	Adjusted R-squared	0.843927
Rw-squared	0.920528	Adjust Rw-squared	0.920528
Akaike info criterion	21.16861	Schwarz criterion	25.65311
Deviance	0.006202	Scale	0.018201
Rn-squared statistic	285.5139	Prob(Rn-squared stat.)	0.000000
	Non-robust Statistics		
Mean dependent var	0.783656	S.D. dependent var	0.050727
S.E. of regression	0.014693	Sum squared resid	0.006477

* and ** indicate 1 % and 5 % significant level.

The table above explores the relationship between the GNIPC and the GDI. It reveals a positive correlation between the GNIPC and the GDI. The GNIPC has a statistically significant impact on the dependent variable, the GDI. The coefficient in the model suggests a positive association between the GNIPC and the GDI. The coefficient of GNIPC has been to be nearly zero indicates that for every one-unit increase in the GNIPC, the GDI is expected to increase but with a very meager number of 0.0003 at a 1 per cent significance level. The value of R^2 indicates that approximately 85 % of the variance in the GDI can be explained by the GNIPC. It means 85 % of the variation in GDI can be accounted for by changes in the GNIPC. The remaining variation is attributed to other factors not included in the model. The lower values of the AIC and Schwarz criterion indicate a better fit of the model, suggesting that the model provides a satisfactory representation of the data. The Rn squared statistic is used to measure the overall goodness of fit of the model. Accordingly, the value of the Rn-squared statistic is found to be 285.5139, with a corresponding p-value of less than 0.000, indicating that the model's fit is statistically significant.
The below diagnostic test provides that residual data are normally distributed. The J-B statistics shows the acceptance of normality of residual data.

Diagram 4



Granger Causality

Granger causality is a statistical concept and technique used to determine whether one time series can predict or forecast another time series. In order to check causality, the definition given by Granger has been used. xi causes yi if the prediction of yi based on knowledge of the past values of xi and yi. where

*e*1*t* and *e*2*t* are white noise and *p* refers to the lag length. The null hypothesis of the Granger test is that the variable *yt* does not affect *xt.*

Table 8 Pairwise Granger Causality Tests

Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
GNIPC does not Granger Cause GDI	30	1.74234	0.1957
GDI does not Granger Cause GNIPC		3.05325	0.0651***

* , ** and *** indicate 1 % ,5 % and 10% significant level.

The above table provides the Granger causality test for GDI and GNIPC. It shows that the hypothesis of GDI does not Granger cause GNIPC is rejected at 10% significant level. It means that there is a direct and positive causation between GDI and GNIPC. It also indicates the acceptance of the hypothesis that GNIPC does not Granger cause GDI. Thus, there unidirectional causation from GDI to GNIPC is observed.

Hypothesis Testing

Ho: There is no association among GDI and HDI, GNIPC, LE, LEF, LFPRF, MYS, PRF

H1: There is an association between GNIPC and HDI, GNIPC, LE, LEF, LFPRF, MYS, PRF

The robust least squares model is a regression model that provides estimates of the coefficients while accounting for potential outliers or violations of certain assumptions. It is robust to deviations from normality and heteroscedasticity. The robust least squares model estimates the relationship between dependent and independent variables. In this study, the independent variable is represented by HDI, which is the explanatory variable, while the GNIPC is the dependent variable. The linear equation that captures the relationship between the dependent variable (GNIPC) and the independent variable (HDI) is expressed as follows:

To test the above-mentioned hypothesis, a simple regression analysis is conducted. The model for the robust regression model has been prepared as below. Here, GNIPC is taken as the independent variable while the HDI is considered as the dependent variable.

$GDI = \beta_0 + \beta_1 HDI + \beta_2 LE + \beta_3 LEF + \beta_4 LFPRF + \beta_5 MYS + \beta_6 GNIPC + \beta_7 PRF + \varepsilon$ ……(6)

Equation-6 represents the GDI is depending on the host of independent variables such as GNIPC, HDI, LE (Life Expectancy), LEF (Life Expectancy of Female), LFFPRF (Labour Force Participation Rate of Female), MYS (Mean Year of Schooling), PRF (Participation Rate of Female). The β_0 represents the effects of the factors other than all the independent variables included in the model on GDI. While, the coefficient of HDI, β_1 represents the unit change in GDI due to HDI, the coefficient of LE, β_2 represents the unit change in GDI due to LE, the coefficient of LEF, β_3 represents the unit change in GDI due to LEF, the coefficient of LFPRF, β_4 represents the unit change in GDI due to LFPRF, the coefficient of MYS, $\beta_5$represents the unit change in GDI due to MYS, the coefficient of GNIPC, β_6 represents the unit change in GDI due to GNIPC, the coefficient of GNIPC, β_6 represents the unit change in GDI due to GNIPC and the coefficient of PRF, β_7 represents the unit change in GDI due to PRF. The term ε is an error term.

A robust regression analysis is conducted for the above-mentioned model. The results are as below.

Table 9 Regression Analysis (GDI & HDI)

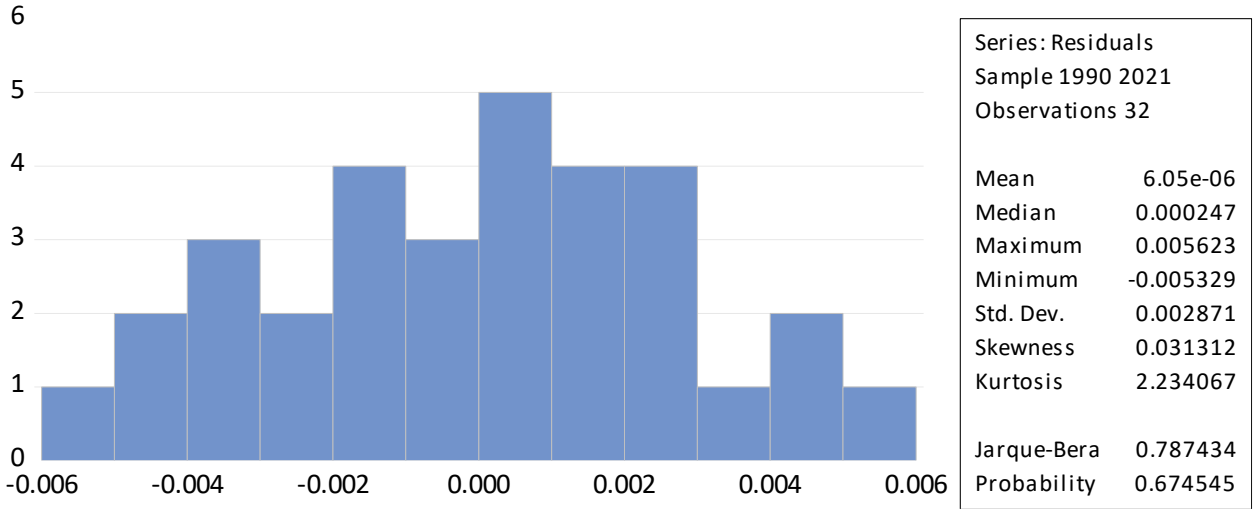
Dependent Variable: GDI				
Method: M-estimation				
M settings: weight=Bisquare, tuning=4.685, scale=MAD (median centered)				
Huber Type I Standard Errors & Covariance				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.426345	0.056090	7.601138	0.0000*
HDI	0.647916	0.214029	3.027238	0.0025*
LE	-0.010289	0.005800	-1.773864	0.0761
LEF	0.008183	0.006454	1.267917	0.2048
LFPRF	0.002040	0.000543	3.753374	0.0002*
MYS	0.018827	0.007493	2.512750	0.0120**
GNIPC	-5.27E-06	3.34E-06	-1.578589	0.1144
PRF	0.000820	0.001947	0.421288	0.6735
	Robust Statistics			
R-squared	0.894700	Adjusted R-squared		0.863987
Rw-squared	0.997061	Adjust Rw-squared		0.997061
Akaike info criterion	31.97051	Schwarz criterion		49.15704
Deviance	0.000237	Scale		0.003328
Rn-squared statistic	6476.709	Prob(Rn-squared stat.)		0.000000
	Non-robust Statistics			
Mean dependent var	0.783656	S.D. dependent var		0.050727
S.E. of regression	0.003263	Sum squared resid		0.000256

* , ** and *** indicate 1 % ,5 % and 10% significant level.

The table above explores the relationship between the GDI and the host of the independent variables included in the model. It reveals a positive correlation between the GDI and most of the independent variables except LE and GNIPC but they found insignificant. The HDI has a statistically significant impact on the dependent variable, the GDI. The coefficient in the model suggests a positive association between the HDI and the GDI. The coefficient of HDI is found to be 0.65 which is significant at 1 % significant level. It means that a unit change in HDI is positively increasing GDI by 0.65. The coefficient of LFPRF is also found positive and significant at 1% significant level with the value of 0.002. It indicates that a unit change in LFPRF has positive increment in GDI by 0.002. While, the coefficient of MYS is also found significant at 5 % significant level with the value of 0.019. It shows that a unit change in MYS has positive and significant effect on GDI by 0.019. The value of R^2 indicates that approximately 89 % of the variance in the GDI can be explained by the all-independent variables. The remaining variation is attributed to other factors not included in the model. The lower values of the AIC and Schwarz criterion indicate a better fit of the model, suggesting that the model provides a satisfactory representation of the data. The Rn squared statistic is used to measure the overall goodness of fit of the model. Accordingly, the value of the Rn-squared statistic is found to be 6476.709, with a corresponding p-value of less than 0.000, indicating that the model's fit is statistically significant.

The below diagnostic test provides that residual data are normally distributed. The J-B statistics shows the acceptance of normality of residual data.

Diagram 5



Conclusions

This study attempts to examine the two way relationship between human development and economic growth, human development and gender development and vice versa. The study found a direct and positive relationship between HDI and GDI. However, it is found that GDI does not affect HDI. Thus, there is a unidirectional relationship between HDI to GDI but not from GDI to HDI. The GNIPC has a statistically significant impact on HDI. There is a direct and positive causation between HDI and GNIPC. It also indicates that GNIPC has an impact on HDI. Thus, there bidirectional causation from HDI to GNIPC and from GNIPC to HDI.

The GNIPC has a statistically significant impact on GDI. But GNIPC does not affect GDI. Hence, there unidirectional causation from GDI to GNIPC is observed. This would also mean that rise in Gross national income will not bring gender inequality. There are other factors responsible for gender equality. A unit change in LFPRF has positive increment in GDI. A unit change in MYS has positive and significant effect on GDI. The value of R^2 indicates that approximately 89 % of the variance in the GDI can be explained by the all-independent variables. The remaining variation is attributed to other factors not included in the model. Unit change in MYS has positive and significant effect on GDI.

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