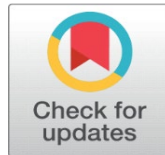


# IMPACT OF SUB-COMPONENTS OF THE GLOBAL GENDER GAP REPORT ON INDIA'S GENDER EQUALITY: AN EMPIRICAL STUDY

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**Received** 10 February 2026  
**Accepted** 03 April 2026  
**Published** 06 May 2026

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**DOI**  
[10.29121/shodhkosh.v7.i7s.2026.7949](https://doi.org/10.29121/shodhkosh.v7.i7s.2026.7949)

**Funding:** This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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## ABSTRACT

Gender parity has increasingly become a central parameter for assessing national development, prompting renewed attention to the factors shaping a country's gender gap performance. This study investigates the influence of the Global Gender Gap Index (GGGI) sub-indices on India's overall GGGI score over a recent twenty years period from (2006-2025). Using a comprehensive econometric framework, the analysis first assesses the normality and stationarity characteristics of the variables. A multiple regression model is then employed to quantify the contribution of each sub-index Economic Participation and Opportunity (EPAO), Educational Attainment (EA), Health and Survival (HAS), and Political Empowerment (PE) to the aggregate index. Diagnostic evaluations, including the correlation matrix, Variance Inflation Factor (VIF), and Tolerance statistics, are conducted to detect potential multicollinearity. The stability of model parameters is examined through the CUSUM test, and a series of residual diagnostics are performed to validate the reliability of the model. The results indicate that while the variables are initially non-stationary, stationarity is achieved after second differencing as confirmed by ADF (Augmented Dickey Fuller test) and PP (Phillips-Perron) tests. The estimated coefficients are found to be statistically significant and the regression parameters remain stable throughout the period under review. Although no substantial multicollinearity issues are observed, evidence of autocorrelation and heteroscedasticity is detected in the residuals. The findings underscore that India's overall GGGI score is systematically shaped by its sub-index scores highlighting the pivotal role of sector-specific gender disparities in determining the nation's broader gender gap trajectory.

**Keywords:** Gender Gap, Inequality, EPAO, EA, HAS, PE

## 1. INTRODUCTION

The world is still struggling to reach gender parity as a crucial precondition to reach sustainable development, as the World Economic Forum (2023) indicates. The Global Gender Gap Index (GGI), which the Forum has introduced in 2006 first, offers an all-encompassing structure to track and compare gender-related inequalities on the country level. It assesses disparities between men and women in four fundamental dimensions, which are Economic Participation and Opportunity, Educational Attainment, Health and Survival, and Political Empowerment (Hausmann, Tyson, and Zahidi,

2006). All these aspects combine to contain key elements of social and economic equality, and their aggregate result also helps to obtain the overall GGI, in which a 1 signifies complete gender parity.

It is especially important to consider these sub-indices in terms of a large and fast developing economy as in the case of India. Despite the impressive economic growth experienced in the country in recent years, the country has been performing unequally in relation to realization of gender parity. The Global Gender Gap Report 2023 categorizes India as the 127 th out of 146 countries with a rating of approximately 0.643 which means that the gender gap has only been addressed by about 64.3 percent. Despite the positive results in terms of educational advancement and health, the economic engagement and especially the labor force participation continue to be inconsistent, and women participation in politics, in terms of being represented in leadership roles, remains low (Chaudhary and Verick, 2017). These inequalities underscore the fact that special policy interventions and inclusive growth policies are necessary to have equal and balanced development.

## 2. LITERATURE REVIEW

The growing interest in gender differences in the labor market has been driven by the need to understand how productivity impacts wages and the readiness for competition (Gneezy, Haruvy, Roth, 2003; Sutter, Glätzle-Rützle, 2010; Niederle, Segal, Vesterlund, 2013). Research on gender differences in the labor market suggests that men tend to dominate competitive environments, which is reflected in wage disparities (Balafoutas, Kerschbamer, Sutter, 2012). However, it is argued that targeted policy interventions are crucial for narrowing or eliminating these gender gaps, depending on their nature and presence in different fields, to help women achieve greater success in the labor market (Sutter, Glätzle-Rützle, 2010). Women continue to face discrimination in areas such as top positions, business, politics, public and private sectors, types of employment, salaries, and career advancement. Furthermore, organizations are increasingly considering the gender of job applicants from the perspective of talent management (Edeh et al., 2022). Research has focused on reducing the gender gap at the regional level (Boffey, 2017; Cascella, Williams, Pampaka, 2021; Koengkan et al., 2022). Significant progress in addressing gender disparities has been made in regions such as the Middle East, North Africa, South Asia, and Sub-Saharan Africa. However, the gap between countries remains largely unchanged (Dilli, Carmichael, Rijpma, 2018). While the Middle East and North Africa have seen notable improvements in women's health and education, progress in employment and legal equality, particularly in areas like women's participation in politics and civil society, has been slower (Dalacoura, 2019). For example, Boffey (2017) found a "wide and persistent" employment gap in the EU, with 40% of women working full-time compared to 56% of men. Although the income gap has narrowed, women still earn, on average, 20% less than men, and there are significant disparities across the EU. An international study (Mateos et al., 2020) explored the impact of gender inequality on life expectancy across 152 countries, showing a direct connection between gender equality and the gender gap in life expectancy in Europe and the Americas, where greater equality leads to a smaller gap. In contrast, African countries showed the opposite pattern. The regression model used factors such as gross national income (GNI), democratic status, and rural population. Dilli and colleagues (2018) introduced a historical approach to the gender equality index, emphasizing that economic development and long-standing institutional and historical factors are key barriers to achieving gender "convergence." Bose (2015) identified gender-oriented social institutions (such as laws on violence, family codes, civil liberties, and property rights) and implicit gendered political and economic structures (such as IMF debt, armed conflict, former colonies, and electoral democracy) as influential factors in shaping gender regimes (patriarchal structures) at the regional level. The methodology used to calculate the Global Gender Gap Index includes four key determinants or sub-indices that highlight the reasons behind unequal opportunities for women in the modern world. In Mehdi (2020), the authors explored the stochastic efficiency of dominance to assess the sensitivity of the index. They found that two factors, Educational Attainment and Health and Survival, contributed the most to reducing the gender gap. Shifting the weight of the index toward these components lowered the average index level for four groups of countries based on income. In contrast, focusing on Economic Participation and Political Empowerment raised the gender gap, with low-income countries performing better than the two middle-income groups. The authors also examined gender inequality in the four dimensions of the Global Gender Gap Index and discovered that low-income countries face the largest gender gap in economic participation and opportunities, while high-income countries experience the largest gender gap in political opportunities (Koca, 2022). A group of Ukrainian researchers analyzed the relationship between gender equality and factors such as regional location, economic development, unemployment, the shadow economy, education, and research support using parallel regression methods (Stavytskyy et al., 2020). They concluded that the gender gap is gradually

narrowing, with internal factors represented by the sub-indices being the main contributors. Dorius and Firebaugh (2010) noted a reduction in gender inequality across the four traditional dimensions of the Gender Gap Index, attributing this decline to various religious and cultural traditions. According to WEF experts in 2022, key factors contributing to the global gender gap include the underrepresentation of women in leadership and management roles (with the political empowerment sub-index at 22%), the wage gap, occupational segregation, and the marginalization of women from high-skill jobs (with the economic participation and opportunity sub-index at 60.3%) (WEF, 2022). Testing 144 countries across 14 indicators in four areas of gender inequality revealed that countries have nearly eliminated gender gaps in health and life expectancy, halved the gap in economic participation and educational achievement, but still have not closed the gaps in political empowerment (Koca, 2022).

### 3. RESEARCH GAP

It is evident from the above comprehensive review of literature that most existing studies focus on specific dimensions of the Global Gender Gap Report. However, they do not adequately capture the overall impact or causal linkages in the context of individual countries such as India. Hence, by employing suitable theoretical frameworks and empirical methods, the present study aims to address these gaps and contribute meaningful insights to the existing body of research.

### 4. OBJECTIVE

This study has the following objective:

- 1) To examine the impact of the sub-indices of the Global Gender Gap Report (GGGR) on the overall Gender Gap score.

#### Data & Study Period

This study utilizes annual Indian data on the GGGR and its sub-indices for the period 2006 to 2025, sourced from the official World Economic Forum (WEF) website. The annual figures are subsequently converted into quarterly data and transformed into logarithmic form for analysis.

#### Hypothesis Formulation

To examine the above stated objective, the study formulated the following hypothesis:

**H<sub>0</sub>:** There is no significant impact of the sub-indices of the Global Gender Gap Report (GGGR) on the overall Gender Gap score.

**H<sub>1</sub>:** There is a significant impact of the sub-indices of the Global Gender Gap Report (GGGR) on the overall Gender Gap score.

### 5. METHODOLOGY

This study uses different statistical techniques to achieve the research objective. First, the Jarque-Bera (J-B) test is applied to check whether the time-series data follow a normal distribution. This test uses information about skewness and kurtosis to examine the shape of the data distribution.

$$\text{J-B TEST} = n \left( \frac{S^2}{6} + \frac{(k-3)^2}{24} \right) \quad (1)$$

Where n = Number of observations

S = Skewness of the residuals

$$\left( S = \frac{\mu_3}{\sigma^3} = \frac{\mu_3}{(\mu_2)^{3/2}} \right) \quad (2)$$

K = Kurtosis of the residuals

$$(K = \frac{\sigma_4}{\sigma^4} = \frac{\mu_4}{(\mu_2)^2}) \tag{3}$$

Then unit root test is conducted to check whether the data are stationary or not. Stationarity means that the mean and variance of the data do not change over time. If the data are not stationary at their level, differencing is used to make them stationary.

$$\Delta Y_t = \alpha + \delta Y_{t-1} + \sum_{i=1}^m \gamma_i \Delta Y_{t-i} + e_t \tag{4}$$

After confirming stationarity, multiple regression analysis is used to study the relationship between the (GGGR) and its sub-indices. The Ordinary Least Squares (OLS) method is applied to estimate the regression coefficients. In this model, GGGR is taken as the dependent variable, while EPAO, EA, HAS and PE are taken as independent variables. The intercept shows the constant term, the beta values show the effect of independent variables on the dependent variable, and the error term represents random disturbances.

$$\text{LGGGR (1)} = \alpha + \beta_1 \text{LEPAO (1)} + \beta_2 \text{LEA (1)} + \beta_3 \text{LHAS (1)} + \beta_4 \text{LPE (1)} + e_i \tag{5}$$

Where,  $\alpha$  represents intercept

$\beta$  represents slope coefficient

$e_i$  is the error term with 0 mean and constant standard deviation

The study uses Durbin-Watson d statistics to check whether autocorrelation exists in the regression residuals as below:

$$d = \frac{\sum_{t=2}^{t=n} (\hat{\mu}_1 - \hat{\mu}_{t-1})^2}{\sum_{t=1}^{t=n} \hat{\mu}_1^2} \tag{6}$$

Autocorrelation occurs when error terms are related to each other over time. Finally CUSUM (Cumulative Sum) test is applied to check whether the regression coefficients are stable over the study period. If the coefficients remain within the critical limits, the model is considered stable and reliable.

## 6. RESULT & ANALYSIS

Table 1

Table 1 Descriptive Statistics										
Var.	Obs.	Mean	Median	Max	Min	Std. Dev.	Skew.	Kurt.	J-B Stat.	p-value
<b>LGGGR</b>	72	0.639	0.644	0.683	0.594	0.027	0.112	1.730	4.992	0.082
<b>LEPAO</b>	72	0.390	0.397	0.459	0.326	0.032	0.148	2.917	0.284	0.868
<b>LEA</b>	72	0.898	0.877	1.000	0.819	0.062	0.148	1.338	8.547	0.014
<b>LHAS</b>	72	0.939	0.937	0.962	0.931	0.008	1.228	4.417	24.13	0.000
<b>LPE</b>	72	0.331	0.323	0.433	0.227	0.073	0.013	1.428	7.419	0.024

\*\*indicates 5% level of significance

The Table 1 presents descriptive statistics and the Jarque-Bera (J-B) normality test results for five variables LGGGR, LEPAO, LEA, LHAS, and LPE based on 72 observations each. Overall, the mean and median values of all variables are close to each other, indicating relative symmetry in their distributions. LGGGR has a mean of 0.639 with low variability (standard deviation of 0.027), slight positive skewness, and platykurtic behavior (kurtosis < 3). The J-B probability value (0.082) suggests that LGGGR is approximately normally distributed at the 5% significance level. LEPAO also exhibits low dispersion and near symmetry, with a kurtosis close to 3 and a high J-B probability (0.868), clearly indicating normality.

LEA, LHAS, and LPE deviate from normality. LEA shows moderate dispersion and platykurtic distribution, but its J-B probability (0.014) indicates rejection of the null hypothesis of normality. LHAS displays strong positive skewness and leptokurtic behavior (kurtosis of 4.417), and its J-B statistic is highly significant ( $p = 0.000$ ), confirming substantial departure from normality. Similarly, LPE exhibits moderate variability, slight positive skewness, platykurtic characteristics, and a J-B probability of 0.024, implying non-normal distribution. Thus, while LGGGR and LEPAO satisfy the normality assumption, LEA, LHAS, and LPE do not, which has implications for the choice of econometric techniques in further analysis. (Sarma & Das, 2025)

**Table 2**

Table 2 Unit Root Test								
	ADF				PP			
	LEVEL		1st DIFFERENCE		LEVEL		1st DIFFERENCE	
	t-stats	Prob	t-stats	Prob	t-stats	Prob	t-stats	Prob
<b>LGGGR</b>	-0.10	0.95	-6.236	0.00	-0.09	0.94	-6.252	0.00
<b>LEPAO</b>	0.23	0.97	-6.000	0.00	0.33	0.97	-6.235	0.00
<b>LEA</b>	-1.52	0.51	-6.562	0.00	-1.59	0.48	-6.854	0.00
<b>LHAS</b>	-1.27	0.57	-6.001	0.00	-1.44	0.55	-6.851	0.00
<b>LPE</b>	0.22	0.58	-6.586	0.00	-1.57	0.57	-6.235	0.00

*Significant at 5 percent level.*

*Source: author's own calculation*

Table 2 shows the results of the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root tests conducted to examine the stationarity of the variables LGGGR, LEPAO, LEA, LHAS, and LPE at level and first difference. At the level form, the ADF and PP test statistics for all variables are insignificant, as their probability values are greater than 0.05. This indicates that the null hypothesis of a unit root cannot be rejected at levels. all the variables are non-stationary at level, meaning their mean and variance change over time. After applying the first difference, both ADF and PP test statistics become highly significant for all variables, with probability values equal to 0.00, which are less than the 5 percent significance level. This leads to the rejection of the null hypothesis of a unit root at first difference. Therefore, it can be concluded that all variables become stationary after first differencing. Since the variables are stationary at first difference, they are suitable for further econometric analysis and the unit root test results confirm that the data satisfy the stationarity requirement after transformation, ensuring the reliability and validity of subsequent empirical results.

**Table 3**

Table 3 Multiple regression tests							
Variable	Coefficient	Std. Error	t-Statistic	Prob.	R-squared	F-statistic	Durbin-Watson stat
<b>EPAO</b>	0.250253	0.001692	147.9385	0.0000			
<b>EA</b>	0.250372	0.000975	256.7828	0.0000			
<b>HAS</b>	0.249029	0.005262	47.32552	0.0000	0.999879	136139.1	0.410935
<b>PE</b>	0.250131	0.000584	428.1483	0.0000			
<b>C</b>	0.000536	0.005011	0.106946	0.0000			

*Significant at 5 percent level.*

*Source: author's own calculation*

The regression results in table 3 show that all independent variables EPAO, EA, HAS, and PE have a positive and statistically significant impact on the dependent variable, as their probability values are 0.00, which is less than the 5 percent significance level. This indicates that changes in these variables significantly influence the dependent variable. The constant term (C) is statistically insignificant, suggesting that it does not have a meaningful effect on the dependent variable. the R-squared value of 0.999879 indicates an excellent goodness of fit, meaning that nearly 100 percent of the variation in the dependent variable is explained by the included independent variables. The F-statistic (136139.1) is

highly significant, confirming that the overall regression model is statistically valid. the Durbin–Watson statistic of 0.410935 indicates the presence of positive autocorrelation in the residuals, suggesting that the error terms are correlated over time. Therefore, although the model fits the data very well, corrective measures such as robust standard errors may be required to address the autocorrelation issue.

**Table 4**

Table 4 Multicollinearity test						
	LEPAO	LEA	LHAS	LPE	VIF	TOL
LEPAO	1	-0.682	-0.375	0.047	1.33	0.505
LEA	-0.682	1	0.372	0.368	2.53	0.778
LHAS	-0.375	0.372	1	0.051	1.97	0.442
LPE	0.047	0.368	0.051	1	1.99	0.672

Significant at 5 percent level.

Source: author's own calculation

The table 4 presents the correlation matrix along with Variance Inflation Factor (VIF) and Tolerance (TOL) values to examine multicollinearity among the independent variables. The correlation coefficients show moderate relationships among some variables, such as a negative correlation between LEPAO and LEA and a positive correlation between LEA and LHAS. However, none of the correlations are excessively high. The VIF values for all variables are below the critical threshold of 10, and the tolerance values are well above 0.10. These results indicate that multicollinearity is not a serious problem in the model, and the regression estimates are reliable.

**Table 5**

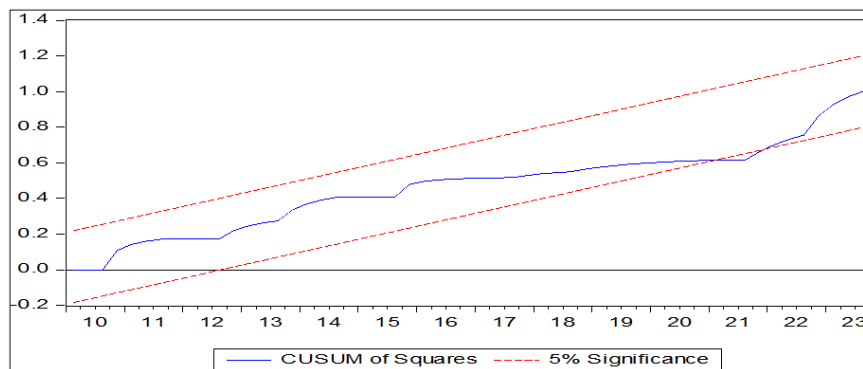
Table 5 Parameter tests					
BGLM TEST		BPG HET. TEST		NORMALITY TEST	
Obs*R-squared	Prob	Obs*R-squared	Prob	J.B TEST	Prob
44.29155	0.00001	1.908999	0.0326	4.3187	0.1153

Significant at 5 percent level.

Source: author's own calculation

The table 5 reports the results of diagnostic tests conducted on the regression residuals. The Breusch Godfrey LM (BGLM) test shows a significant Obs\*R-squared value with a probability of 0.00001, indicating the presence of autocorrelation in the residuals. Similarly, the Breusch Pagan Godfrey (BPG) heteroskedasticity test is significant at the 5 percent level ( $p = 0.0326$ ), suggesting that the residuals suffer from heteroskedasticity, meaning the variance of errors is not constant. However, the Jarque Bera normality test is insignificant ( $p = 0.1153$ ), implying that the residuals are normally distributed, which is desirable for regression analysis.

**Figure 1**



**Figure 1** Cusum test

Figure 1 shows the outcome of CUSUM test. Here, the plots of the CUSUM test of the recursive residuals lies in between two red lines that means the parameters of the regression equation are stable

## 7. CONCLUSION

This study examined the determinants of the Global Gender Gap Index (GGI) by analyzing the role of its key sub-indices using time-series econometric techniques. The unit root test results (ADF and PP) revealed that all variables were non-stationary at their level form but became stationary after first differencing, indicating that the variables are integrated of order one, I(1). This justified the use of regression analysis on transformed data and ensured the reliability of the empirical findings. The multiple regression results showed that Economic Participation and Opportunity, Educational Attainment, Health and Survival, and Political Empowerment have a positive and statistically significant impact on the overall gender gap index. The very high R-squared value suggests that these sub-indices collectively explain almost the entire variation in the gender gap index, confirming that progress in gender equality is strongly driven by improvements in these dimensions. Multicollinearity diagnostics indicated no serious multicollinearity among the explanatory variables, as reflected by acceptable VIF and tolerance values. However, residual diagnostic tests revealed the presence of autocorrelation and heteroskedasticity, although the residuals were normally distributed. This suggests that while the model is statistically strong, robust estimation techniques may further improve efficiency. The findings confirm that narrowing gender gaps in economic, educational, health, and political domains is crucial for achieving overall gender parity. Policymakers should therefore adopt targeted and dimension-specific interventions to ensure balanced and sustainable progress toward gender equality.

## CONFLICT OF INTERESTS

None.

## ACKNOWLEDGMENTS

None.

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