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THE AID-GROWTH PARADOX: AN EMPIRICAL INVESTIGATION OF THE ROLE OF FOREIGN ASSISTANCE IN INDIA'S ECONOMIC PERFORMANCE

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Abstract: This study investigates the relationship between foreign aid and economic growth in India using time series data from the past 50 years (1973 to 2022). The study employs various macroeconomic variables, including Gross Domestic Product (GDP), Net Official Development Assistance (ODA) received, Foreign Direct Investment (FDI) net inflows, General Government Final Consumption Expenditure, Exports of Goods and Services, Imports of Goods and Services, and Tax Revenue. Time series techniques such as the Johansen cointegration test, the Vector Error Correction Model (VECM), the Granger Causality test, regression analysis, and diagnostic tests have been used for empirical analysis. In this study, the data has been partitioned into 3 time periods i.e. 1973-1990, 1991-2000, and 2001-2022. The adjusted R-squared of the VECM model revealed that almost about 89% of the variance in GDP implied a strong relationship. However, the Granger Causality test indicates no significant predictive relationship between GDP and foreign aid in either direction. Regression analysis demonstrates that the model fit is strong and positive.

Keywords: Economic growth, Foreign aid, Foreign direct investment (FDI), Gross domestic product (GDP), Vector error correction model (VECM), India

1. Introduction

In the early 20th century, many third-world countries required foreign aid to alleviate debt, poverty and hunger. Even today, some developing countries continue to rely on foreign aid to address these challenges. After gaining independence in 1947, India began receiving foreign aid, which grew significantly in both nature and scale over the decades. During this period, India received substantial aid from Western countries and the Soviet Union. The United States emerged as a major donor, primarily providing food aid through its Public Law (PL-480) program. According to India's Ministry of Finance, the country received approximately $1.7 billion in foreign assistance between 1951 and

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1960. During this time, foreign aid played a crucial role in supporting India's poverty alleviation and Green Revolution initiatives.

For the period between 1960 and 2000, India received more than $63 billion in multilateral aid from the World Bank and other institutions, according to a World Bank report. After the economic reforms of 1991, India tried to grow its GDP through foreign direct investment (FDI) and trade, and this trend gradually moved the country away from foreign aid dependency. However, foreign aid continued to be allocated to social sector development. India eventually limited bilateral aid to five major donor countries: the UK, USA, Russia, Germany, and Japan.

After rapid economic growth from the early 2000s, India became less dependent on foreign aid. Net Official Development Assistance (ODA) to India has fluctuated in recent years—officially, $3.17 billion in 2015, $3.09 billion in 2017, and $2.68 billion in 2019, according to the Organisation for Economic Co-operation and Development (OECD).[1] World Bank data shows that foreign aid made up less than 0.1% of India's Gross National Income (GNI) in 2019. Ministry of External Affairs reports have also indicated that India has since become a donor country, dispensing aid to its neighbouring countries and parts of Africa.

Foreign aid to India has shifted towards sectors such as infrastructure development, agricultural advancement, and social services. For example, the Bhakra Nangal Dam, one of India's first multifunctional river valley projects, was partially funded by World Bank loans. Aid for agricultural development also played a critical role in the Green Revolution, with technological transfers and agricultural research largely financed by the US Agency for International Development (USAID).

This study endeavours to empirically test the aid-growth relationship in India by employing time series data stretching over five decades (1973 to 2022). The research attempts to investigate how foreign aid affects India's GDP by employing the advanced econometric techniques of the Vector Error Correction Model (VECM), Granger causality tests, and multiple regression analysis and their effect on other macroeconomic variables such as FDI, government expenditure, trade, and tax revenue.

The increasing trend and growth acceleration of GDP from 1973 to 2022 are shown in this graph. In this graph, firstly the study observes that GDP slightly increased from 1973 to 1990, but foreign aid increased dramatically before declining. After the implementation of India's economic liberalization policies in 1991, the country's GDP growth increased rapidly. It indicates that from 1991 to 2000, an economic plan started to change and more focused on the market. But after 2000 the economy of the country expanded steadily and quickly. While foreign aid continued lower with notable variations from 1991 to 2000, and after 2000 aid showed stable trends with occasional rises. This indicates that the relevance of foreign aid declined during the period of economic expansion. More volatility is shown in foreign aid, which fluctuates significantly over time.

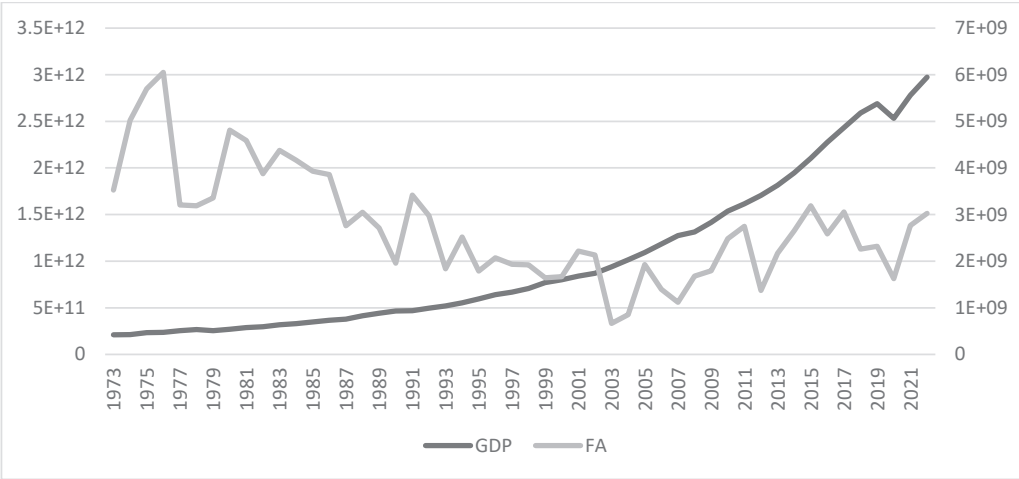
According to this figure, India's dependence on foreign assistance for economic growth has decreased over time. According to the data, the proportionate contribution of foreign aid to GDP decreased as India's economy expanded. This is consistent with economic theories that suggest aid may become less beneficial as nations grow and become more self-sufficient.

1. To analyse the historical trends of foreign aid in India's GDP in different periods.
2. To examine the evolving nature and impact of foreign aid on India's economic development.

[1] Organisation for Economic Co-operation and Development (OECD). Retrieved October 16, 2024, from https://www.oecd.org/

3. To examine the shift of India's foreign aid strategy after 1991 economic reforms.
4. To examine as to how foreign aid relates to India's developmental strategy today.

Figure 1: Trends of India's GDP and Foreign Aid



The implications of the findings presented in this study are both academically and policy-important. The work bridges theoretical perspectives and empirical evidence to the literature on aid effectiveness and economic growth. Moreover, the lessons drawn from India's experience may be useful in devising aid strategies in developing countries that, apart from being poor, are undergoing a structural change. Even more, this research fits in the track of global attempts to increase the benefit given by foreign aid in accordance with the UN Sustainable Development Goals (SDGs).

To conclude, this paper examines the relationship between foreign aid and economic growth in India with a detailed review of its historical and current dynamics. Through a theoretically rigorous empirical framework, the research examines how this relationship occurs and provides insight into the conditions that enable foreign aid to be used as a tool for sustainable development and economic resilience.

2. Literature Review

2.1 Theoretical Literature

There has been considerable debate in the economic literature on conditions under which foreign aid leads to higher economic growth. In the Harrod–Domar growth model, foreign aid is perceived to be closing the savings-investment gap and thereby contributes to increasing economic growth through increased capital formation (Harrod, 1939; Domar, 1946). This view echoes Rostow (1960), who argues that aid can help an economy go through the "take-off" to modernization phases of economic growth. However, the dual gap model (Chenery and Strout, 1966) extended this perspective by stressing foreign exchange constraints and thus allowed aid's effectiveness to be conditional on how the recipient utilizes the aid within its economy.

The aid, however, is also taken to show the perpetuation of structural inequalities and dependency (Frank, 1967; Amin, 1974) through dependency theory. In this view, foreign aid is often used to sustain the establishment of donor nations and avoid self-sustenance in recipient countries. However, the resurgence of neoclassical economics in the 1980s drew attention to the

policy environment of recipient nations. Burnside and Dollar (2000) contend that only if aid has accompanying appropriate fiscal, monetary, and trade policies do they promote growth and advocate conditionality-based aid disbursements. However, critics claim that when conditionality is present, policies often become misalignments of policies that diminish the effectiveness (Easterly, 2003) of aid.

Mosley's (1987) micro-macro paradox on aid suggests that successful micro-level projects are not linked to positive macro growth impacts owing to systemic problems such as corruption and weak institutions. North (1990) and Acemoglu and Robinson (2012), institutional economists, stress that effective, inclusive institutions are crucial to well-targeted aid for sustainable growth and that the lack of good governance is associated with inefficiencies and rent-seeking.

As endogenous growth theories (Romer, 1986; Lucas, 1988) allow for investments in human capital, innovation, and infrastructure to create a framework within which aid could potentially enhance long-term growth, one only must consider the period characterised as aid-induced. Furthermore, like trade-driven growth models (Krugman, 1991; Grossman and Helpman, 1991), export promotion and trade liberalization are emphasized. These models confirm that aid and trade are complementary, and that aid complements existing trade policies by addressing infrastructure deficits and reducing trade costs.

2.2 Empirical Literature

Aid-growth studies have been conducted empirically, with mixed results. Burnside and Dollar (2000) show that aid has a positive effect on growth in developing countries with good policies. Sahoo and Sethi (2013) showed foreign aid played a significant role in India's economic growth between 1975 and 2010, particularly when such foreign aid was supplemented by domestic investment and trade liberalization. This analysis has been expanded by Jena and Sethi (2021), who find a positive long-run relationship between foreign aid and economic growth in South Asia, including India, and emphasize the importance of effective aid utilization.

Other studies focus on the composition of aid. In his work, Mavrotas (2002) pointed out that the forms of aid have different effects on macroeconomic outcomes like capital formation and infrastructure investments. Chervin and van Wijnbergen (2010) show that aid volatility hurts consumption and growth and stresses the role of stable aid.

These findings correspond closely with India's experience. Foreign aid was used extensively during its early development stages to fill its infrastructure deficits and aid agricultural modernization (Bansal and Pasricha, 2010). For instance, a very successful example of aid-based development was that of the Bhakra Nangal Dam, which is a dam, funded by aid, that contributed much to the development of the economy. But since post-1991 economic liberalization, under the leadership of such economists as P. Chandra and the late R.F. D'Retto, India shifted from aid dependence to reliance on foreign direct investment and trade (Saxena and Kapoor, 2013). Sharma and Kautish (2021) emphasize the continued relevance of the role of macroeconomic policies, and aid must be aligned with the domestic priority.

The theoretical framework on which the research is grounded is based on classical growth models, dependency theory, endogenous growth theories, and trade-driven growth models. These provide us with a nice lens to look at the whole range of the role of foreign aid in the Indian development journey. The study also integrates its findings into a discussion of the 'Aid Growth Paradox', making contributions to the continuing debate about the efficacy of foreign assistance in fostering sustainable growth.

3. Research Methodology

In this study, we use a half-century period to examine the impact of foreign aid on economic growth in India. Time series data are sourced from the World Development Indicators. All analyses are conducted using EViews 10, a statistical software. First, we describe the descriptive statistics of the whole data for the entire variables. Summary statistics in the form of means, standard deviations, minimums, and maximums are reported, and pairwise correlations of all variables are provided to detect possible multicollinearity problems and preliminary relationships.

We also examine the stationarity of the time series data using tests such as the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test. The data are differenced to make them stationary if needed. We then determine the optimal lag length of the VAR model using criteria such as the Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and Hannan-Quinn Information Criterion (HQIC). To examine the long-run relationships between the variables we use the Johansen cointegration test. If cointegration is found, a Vector Error Correction Model (VECM) is estimated to capture both long-run relationships and short-run dynamics. The error correction term, long-run coefficients, and short-run dynamics are analyzed.

We also conduct tests for model adequacy, including the residual normality test (e.g., the Jarque-Bera test), the heteroskedasticity test (e.g., White test), the serial correlation test (e.g., Breusch-Godfrey LM test), and the model stability test (e.g., CUSUM test). Additionally, the causal relationships between variables, particularly between foreign aid and economic growth, are investigated. Where appropriate, additional regression analyses are conducted to supplement the VECM results or to further explore specific relationships.

3.1 Data and Variables

The study employs seven variables, which are described in Table 1. When collecting data for these variables from the World Development Indicators, it was observed that the data were reported in different units. To ensure consistency, we converted the data for certain variables, such as foreign aid, FDI, and tax revenue, into constant 2015 US$, as detailed in Table 1 and discussed below.

Foreign Aid

The data for "Net ODA received (constant 2021 US$)" were collected and converted into constant 2015 US$. This conversion was made using the "GDP deflator (base year varies by country) for the United States" to calculate an adjustment factor. The following formula was used.

*Net ODA (constant 2015 US$) = Net ODA (constant 2021 US$) * (2015 GDP deflator) / (2021 GDP deflator)*

FDI

The data for "Foreign direct investment, net inflows (BOP, current US$)" were collected and converted into constant 2015 US$ using the "GDP deflator (base year varies by country) for the United States." The formula for this conversion is as follows:

*FDI (constant 2015 US$) = FDI (BOP, current US$) * (2015 GDP deflator / Current year GDP deflator)*

Tax Revenue

The data for "Tax revenue (current LCU)" was collected and converted into constant 2015 US$ using two steps:

I. *Tax Revenue (constant 2015 LCU) = Tax Revenue (current LCU) * (2015 GDP deflator / Current year GDP deflator) of India*

II. *Tax Revenue (constant 2015 US$) = Tax Revenue (constant 2015 LCU) / official exchange rate (LCU per US$) for 2015.*

Table 1: Variable Definitions and Units

Variables	Meaning	Convert Unit
GDP	Gross Domestic Product (constant 2015 US$)	Constant 2015 US$
FA	Net official development assistance received (constant 2021 US$)	Constant 2015 US$
FDI	Foreign direct investment, net inflows (BOP, current US$)	Constant 2015 US$
CE	General government final consumption expenditure (constant 2015 US$)	Constant 2015 US$
EX	Exports of goods and services (constant 2015 US$)	Constant 2015 US$
IM	Imports of goods and services (constant 2015 US$)	Constant 2015 US$
TAX	Tax revenue (current LCU)	Constant 2015 US$

Source: World Bank (undated)

3.2 Econometric Model

To empirically investigate the relationship between foreign aid and economic growth in India, we specify the following econometric model. The model, in this study, has GDP as the dependent variable and foreign aid (FA), foreign direct investment (FDI), government consumption expenditure (CE), exports (EX), imports (IM), and tax revenue (TAX) as independent variables. The time series data are non-stationary at levels but become stationary after the first differencing. The model accounts for both long-run and short-run dynamics, using the first differences of the variables. This makes sure that our regression analysis is valid and thus we will not suffer from spurious results because of non-stationarity.

The model is structured as follows:

$$GDP = \beta_0 + \beta_1 * FA + \beta_2 * FDI + \beta_3 * CE + \beta_4 * EX + \beta_5 * IM + \beta_6 * TAX + e$$

For the short-run analysis, we apply the first difference transformation:

$$\Delta GDP = \beta_0 + \beta_1 * \Delta FA + \beta_2 * \Delta FDI + \beta_3 * \Delta CE + \beta_4 * \Delta EX + \beta_5 * \Delta IM + \beta_6 * \Delta TAX + e$$

Here, Δ represents the first difference of the variables. These changes hold the short-run adjustments, but they do not alter the long-run relationships analyzed through cointegration techniques.

4. Data Analysis and Interpretation

To examine the impact of Foreign Assistance on India's economic performance, descriptive statistics is first used to know the initial overview of central tendencies, and then other techniques are employed.

4.1 Descriptive Statistics

The descriptive statistics for the economic variables are presented in Table 2. The mean GDP of $1.01 trillion, coupled with a substantial standard deviation, reflects significant variations in GDP throughout the research period, likely highlighting India's notable economic growth. However, the Jarque-Bera statistic of 8.091639, with a p-value of 0.017495, suggests that the GDP data may not follow a normal distribution, which could potentially affect some statistical calculations. Foreign aid has a mean of $2.76 billion, with a standard deviation indicating considerable fluctuations in foreign

aid over time. According to the Jarque-Bera test result and a p-value of 0.080007, the FA data appear to be closer to a normal distribution compared to GDP. In contrast, the Jarque-Bera statistic for FDI also indicates a non-normal distribution.

The mean of government consumption expenditure is $111 billion, and the large standard deviation suggests significant fluctuations in consumption expenditure over the years, possibly reflecting varying levels of government investment and infrastructure development. Exports have a mean of $172 billion, and their high standard deviation points to substantial fluctuations and growth in exports over the research period. The mean for imports is $204 billion, with high variability, similar to exports, indicating India's increasing integration into global trade. The government's average tax revenue stands at $110 billion, and the large standard deviation denotes substantial variations in tax revenue over the years, likely corresponding to changes in government policy and economic conditions.

Table 2: Descriptive Statistics

Variables	Mean	Maximum	Minimum	S.D.	Jarque-Bera	Prob.	Obvs
GDP	1.01E+12	2.97E+12	2.10E+11	8.21E+11	8.091639	0.017495	50
FA	2.76E+09	6.05E+09	6.65E+08	1.19E+09	5.051294	0.080007	50
FDI	1.43E+10	5.94E+10	-1.13E+08	1.83E+10	8.015319	0.018176	50
CE	1.11E+11	3.12E+11	1.96E+10	8.73E+10	7.206996	0.027228	50
EX	1.72E+11	6.77E+11	9.03E+09	1.94E+11	8.13974	0.01708	50
IM	2.04E+11	7.26E+11	9.69E+09	2.26E+11	7.562251	0.022797	50
TAX	1.10E+11	3.36E+11	1.78E+10	1.00E+11	10.9085	0.004278	50

Source: Researchers' computations

4.2 Correlation Analysis

Table 3 presents the correlation analysis between macroeconomic variables, including foreign aid, GDP, FDI, CE, EX, IM, and tax revenue, for different periods. These economic indicators are correlated, reflecting the strength and direction of relationships among these economic indicators. FA indicates a negative and significant correlation with all macroeconomic variables including the GDP in the first period. This means that the other macroeconomic variables are inversely related to foreign aid. FDI is moderate to highly correlated when compared with the other variables, while CE, EX, IM, and TAX are highly correlated to other variables except FA. During the second period, the correlation of FA remains strongly negative, while FDI continues to have moderate to strong positive correlations. CE, EX, IM, and TAX maintain their strong positive correlations with other variables. In the third period, FA is positively related to all the variables of the model, which shows that the relationship with GDP and other variables has changed in some way. Notably, all variables show strong positive correlations with each other during this period.

For the overall period, FA shows a negative correlation with all variables, while the remaining variables FDI, CE, EX, IM, and TAX consistently display strong positive correlations. This trend highlights that while FA was negatively correlated with other variables in the earlier periods, it eventually became positively correlated, though the overall relationship between FA and the other variables, including GDP, remains negative.

Table 3: Correlation Analysis

Year		GDP	FA	FDI	CE	EX	IM	TAX
1973-1990	GDP	1.000000						
	FA	-0.663906	1.000000					
	FDI	0.653822	-0.537942	1.000000				
	CE	0.992132	-0.660863	0.691781	1.000000			
	EX	0.962540	-0.633980	0.634637	0.948178	1.000000		
	IM	0.964832	-0.628325	0.661319	0.973596	0.922714	1.000000	
	TAX	0.991226	-0.673412	0.681696	0.995384	0.939932	0.962047	1.000000
1991-2000	GDP	1.000000						
	FA	-0.762871	1.000000					
	FDI	0.851940	-0.738639	1.000000				
	CE	0.980780	-0.709383	0.763975	1.000000			
	EX	0.982871	-0.751594	0.834769	0.958606	1.000000		
	IM	0.987903	-0.797214	0.859863	0.965494	0.968942	1.000000	
	TAX	0.952402	-0.622757	0.838174	0.920471	0.961356	0.916513	1.000000
2001-2022	GDP	1.000000						
	FA	0.611766	1.000000					
	FDI	0.777682	0.474164	1.000000				
	CE	0.993896	0.609202	0.802827	1.000000			
	EX	0.962892	0.624864	0.771829	0.953837	1.000000		
	IM	0.943943	0.603827	0.804014	0.947601	0.984580	1.000000	
	TAX	0.988874	0.528489	0.792475	0.984736	0.937338	0.923964	1.000000
Overall 1973-2022	GDP	1.000000						
	FA	-0.38223	1.000000					
	FDI	0.925498	-0.33975	1.000000				
	CE	0.997389	-0.40606	0.92964	1.000000			
	EX	0.985446	-0.33276	0.929292	0.979478	1.000000		
	IM	0.981025	-0.35194	0.93958	0.979447	0.99529	1.000000	
	TAX	0.993447	-0.34899	0.926562	0.989584	0.976113	0.971676	1.000000

Source: Researchers' computations

4.3 Unit Root Test

In Table 4 we present the results of two different types of unit root tests for all variables i.e. the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) (Gujarati, D. N., & Porter, D. C. 2009). In both tests, the null hypothesis posits that the series contains a unit root, indicating non-stationarity, while the alternative hypothesis suggests that the series is stationary, with no unit root present.

Table 4: Unit Root Tests: ADF and PP

Variables	Level		1st Difference		Order of Integration
	ADF	PP	ADF	PP	
GDP	5.484003	8.099364	-4.387067*	-4.420635*	I (1)
FA	-2.503321	-2.377039	-8.399007*	-12.63724*	I (1)
FDI	-0.825535	-0.625794	-7.937604*	-8.315829*	I (1)
CE	4.690066	6.278543	-3.107176**	-3.024137**	I (1)
EX	3.101939	3.576306	-4.997108*	-4.997108*	I (1)
IM	1.962257	2.681775	-5.503514*	-5.466953*	I (1)
TAX	3.142102	2.657518	-4.271295*	-4.297547*	I (1)

Notes: Test critical values: 1% level -3.574446, 5% level -2.923780, and 10% level -2.599925; *, **, and *** stand for statistical significance at the 1%, 5%, and 10% levels, correspondingly.
Source: Researchers' computations

The test statistics are compared with the critical values listed at the bottom of the table. However, the study observes that for GDP and all other variables, the test statistics from both the ADF and PP tests are greater than the critical values at the level form, indicating non-stationarity. Subsequently, the first differences in the data were calculated to assess stationarity. At the first difference, the t-statistics for all variables, except for CE, were found to be more negative than the critical values at the 1% significance level, indicating that these variables are integrated of order 1, denoted as I (1). This finding implies that all the series require differencing once to achieve stationarity.

4.4 Co-integration Test

Before examining the cointegration test, it is essential to first assess the VAR lag selection criteria. The study identified four lag lengths, as presented in Table 5. In all four selection criteria—Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-Quinn Information Criterion (HQ)—the asterisk (*) indicates the lag order selected in the fourth position. The lag interval for the first differences ranges from 1 to 4 (Mohapatra et al., 2016).

Table 5: VAR Lag Order Selection Criteria

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-7997.484	NA	3.3e+142	348.0211	348.2993	348.1253
1	-7719.530	459.2290	1.6e+138	338.0665	340.2927	338.9005
2	-7607.266	151.3119	1.2e+137	335.3159	339.4900	336.8796
3	-7507.548	104.0538	2.0e+136	333.1108	339.2328	335.4041
4	-7383.987	91.32780*	2.1e+135*	329.8690*	337.9389*	332.8920*

Notes: * Indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion.
Source: Researchers' computations

Following the selection of the optimal lag length, the Johansen Cointegration Test was conducted, utilizing two tests: the Trace test, as shown in Table 6, and the Maximum Eigenvalue test, presented in Table 7. The value of the trace statistic exceeds the critical value, and the p-value is less than 5%, this indicates the presence of cointegration. In Tables 6 and 7, the Trace and Maximum Eigenvalue tests show that for "None", "At most 1", "At most 2", "At most 3", and "At most 4",

the trace statistic values exceed the critical values, and the corresponding p-values are also less than 5%, leading to the rejection of the null hypothesis of no cointegrating equations. This suggests that cointegration exists among five variables. However, the last two trace statistic values, i.e., "At most 5" and "At most 6", are less than the critical values, and its p-values are greater than 0.05, which fails to reject the null hypothesis of no cointegration for these cases.

Table 6: Johansen Co-integration Test of Trace Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.965706	446.4119	125.6154	0.0001
At most 1 *	0.886998	294.6361	95.75366	0.0000
At most 2 *	0.873804	196.5204	69.81889	0.0000
At most 3 *	0.758385	103.3741	47.85613	0.0000
At most 4 *	0.460337	39.45559	29.79707	0.0029
At most 5	0.201092	11.69909	15.49471	0.1719
At most 6	0.034849	1.596167	3.841466	0.2064

Notes: The Trace test indicate 5 cointegrating equations at the 0.05 level.
* Denotes rejection of the hypothesis at the 0.05 level.
**MacKinnon-Haug-Michelis (1999) p-values.
Source: Researchers' computations

Table 7: Johansen Co-integration Test of Maximum Eigenvalue Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.965706	151.7758	46.23142	0.0000
At most 1 *	0.886998	98.11569	40.07757	0.0000
At most 2 *	0.873804	93.14628	33.87687	0.0000
At most 3 *	0.758385	63.91853	27.58434	0.0000
At most 4 *	0.460337	27.75650	21.13162	0.0051
At most 5	0.201092	10.10292	14.26460	0.2053
At most 6	0.034849	1.596167	3.841466	0.2064

Notes: The Max-Eigenvalue test indicate 5 cointegrating equations at the 0.05 level.
* Denotes rejection of the hypothesis at the 0.05 level.
**MacKinnon-Haug-Michelis (1999) p-values.
Source: Researchers' computations

Overall, the results of each test indicate multiple cointegrating relationships among the variables, reflecting long-run equilibrium relationships within the system. This finding suggests a highly interconnected economic framework with stable long-run associations among the examined variables.

4.5 VECM Model

The Vector Error Correction Model (VECM) is an econometric tool employed to analyze both long-run and short-run relationships among multiple time series variables that are cointegrated. As above mentioned, the trace and maximum eigenvalue tests indicate that 5 cointegrating equations are significant at 0.05 level.

4.5.1 VECM Model for Long-Run

Table 8 presents the long-run cointegrating equation, where GDP (-1) is normalized to 1. Foreign aid has a coefficient value of 70.87982 and a t-stat of 8.84, this justifies the positive and significant. This means a positive relationship between foreign aid and GDP in the long run. specifically, for every unit increase in foreign aid, GDP is expected to rise by approximately 70.88 units, holding all other factors constant. The empirical success of foreign aid to impact long-term GDP growth in India depends on evolving policy framework, governance quality, and institutional efficiency. Foreign aid, which was general resource supplementation during the 1991 economic reform, became targeted and project support in the infrastructure, health care, and education sectors which were notable success stories. The long-run equation can be expressed as follows:

GDP (-1) = -70.87982 FA (-1) + 29.58758 FDI (-1) + 9.937535 CE (-1) + 6.378162 EX (-1) - 4.823512 IM (-1) - 7.258388 TAX (-1) + 3.62E+11

FDI is negative and statistically significant (technically, the estimated coefficient value of FDI is -29.58758 and t-stat is -7.59). It means that if FDI increases, GDP is expected to decrease in the long-run. The reasons for this finding could be profit repatriation, the crowding out of domestic investment, or a concentration of investments in sectors with limited spill-over effects. The coefficients for government final consumption expenditure (CE) and export (EX) are negative and significant, suggesting a negative long-run relationship between consumption expenditure and GDP and between export and GDP. Conversely, the coefficient of import (IM) is positive and significant, which indicates that, in the long-run, increases in imports are associated with increases in GDP. While this may seem counterintuitive, it could reflect that imported capital goods and technologies play a role in fostering economic growth. Additionally, the coefficient for tax revenue is positive and highly significant. This finding suggests a strong positive long-run relationship between tax revenue and GDP. This relationship may indicate that the government's capacity to invest in public goods and services is likely to contribute to economic growth. Lastly, the large negative constant (-3.62E+11) suggests that factors not included in the model may have a substantial impact on GDP in the long-run.

Table 8: Vector Error Correction Model Results for Long-Run

Variable	Coefficient	Std. Error	t-Statistic
Cointegrating Equation			
GDP (-1)	1	-	-
FA (-1)	70.87982	-8.01997	[8.83792]
FDI (-1)	-29.58758	-3.89431	[-7.59765]
CE (-1)	-9.937535	-0.44206	[-22.4800]
EX (-1)	-6.378162	-0.75469	[-8.45141]
IM (-1)	4.823512	-0.82186	[5.86898]
TAX (-1)	7.258388	-0.6977	[10.4033]
C	-3.62E+11	-	-

Source: Researchers' computations

4.5.2 VECM Model for Short-Run

As shown in Table 9, the coefficient for the Error Correction Term (CointEq1) is -0.440709, which

is negative and statistically significant, as the t-statistic value exceeds 1.96. It shows that the model is strong, and it will converge to its stable state in the future. According to the coefficient value, nearly 44.07% of every long-term relationship disequilibrium is resolved in a single period. The coefficients for FA and exports are positive but insignificant, and this implies that GDP growth changes in the current year are not influenced by changes in exports or foreign aid of the previous year. Foreign aid has an immediate impact in the long-run but its effects in the short-run might not be felt, if the policy is not completely implemented on time, or fails to be properly managed, or resources are allocated inefficiently. If a country mainly exports low-value-added goods, exports may not effectively stimulate economic growth.

On the other hand, at the 1% level, the FDI coefficient is statistically significant and negative. According to this finding, GDP is predicted to fall by roughly 9.88 units in the coming years for every unit rise in FDI. Yet FDI shows negative results, and this might be because of poor allocation of FDI, or its poor linkage to the domestic economy, or institutional challenges.

Table 9: Vector Error Correction Model Results for Short-Run

Variable	Coefficient	Std. Error	t-Statistic
Error Correction			
CointEq1	-0.440709	-0.19529	[-2.25665]
D (GDP (-1))	-0.276708	-0.32428	[-0.85330]
D (FA (-1))	16.99068	-10.84	[1.56740]
D (FDI (-1))	-9.882882	-3.64482	[-2.71149]
D (CE (-1))	-1.706236	-2.94779	[-0.57882]
D (EX (-1))	0.753061	-1.21122	[0.62174]
D (IM (-1))	-0.053475	-0.82784	[-0.06460]
D (TAX (-1))	5.82004	-2.27055	[2.56327]
C	6.34E+10	-2.30E+10	[2.71434]

Notes: R-squared: 0.962732; Adj. R-squared: 0.890680; F-statistic: 13.36160; Log-likelihood: -1110.822; Akaike AIC: 50.70318; Schwarz SC: 51.90762

Source: Researchers' computations

The CE, IM, and GDP all have negative but not statistically significant coefficients in the short-run dynamics. This implies that the percent change in GDP in the current year is not strongly determined in the short-run by the change in GDP, imports and consumer expenditure in the previous year. Inefficiencies in public spending, i.e., spending which is either on non-productive activity or on administrative expenses that directly contribute to economic growth may adversely affect the CE. The insignificance of these variables suggests that they are more likely to show their influence over the long-term rather than the short-term, limited by structural inefficiencies, delayed response and offsetting factors.

In addition, at the 5% level, the TAX coefficient is positive and statistically significant. It means that year-over-year GDP growth is responsive to year-over-year tax income. Moreover, in the short-run, the beneficial contribution of tax revenue may also result from the most efficient ways to collect taxes, which yield little economy-wide distortions in the way decisions are made. For an instance, suppose that the tax system is constructed in such a way that it directly targets incomes, or sectors, that have less elasticity, then one can raise revenue without impeding production or investment. In addition, higher tax income may raise confidence among investors and consumers by indicating solid economic fundamentals and supporting future growth.

The model fitness was reflected through R-squared and adjusted R-squared, with the value of 0.963 and 0.891, respectively. The VECM model demonstrates approximately 89% of the variance in GDP which shows a strong relationship. This implies that the selected variables in the model collectively provide a robust explanation of short-term economic dynamics. Economically, this can be due to the model's ability to account for all important macroeconomic variables such as foreign aid, foreign direct investment, government consumption, exports, imports, and tax revenue which all determine movement in GDP.

4.6 Stability Test

To check the stability of the VECM of the current study, Cumulative sum (CUSUM) and Cumulative sum of squares (CUSUM of squares) tests were applied (Figures 2-5). The CUSUM test will detect any structural change in the model and the CUSUM of Squares test is about the variance of its residuals.

Figure 2: Year 1973-1990 (18 Years)

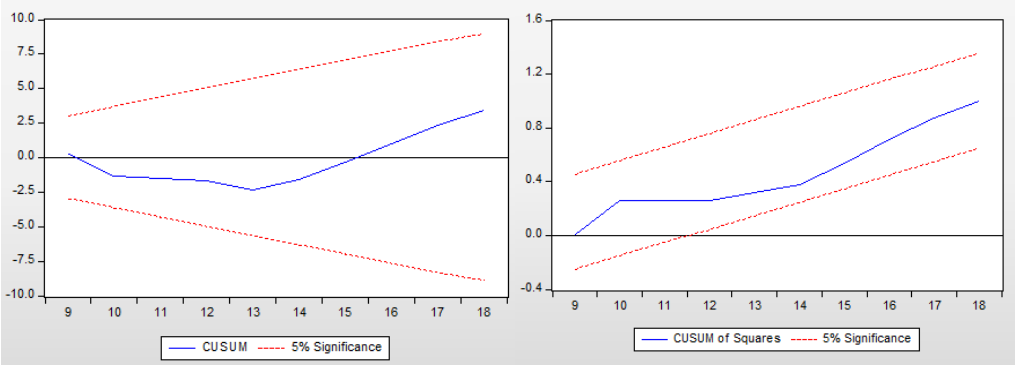


Figure 3: Year 1991-2000 (10 Years)

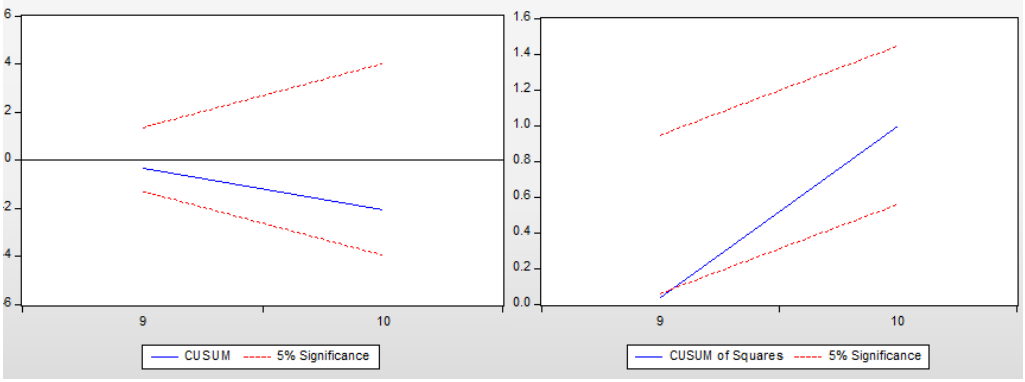


Figure 4: Year 2001-2022 (22 Years)

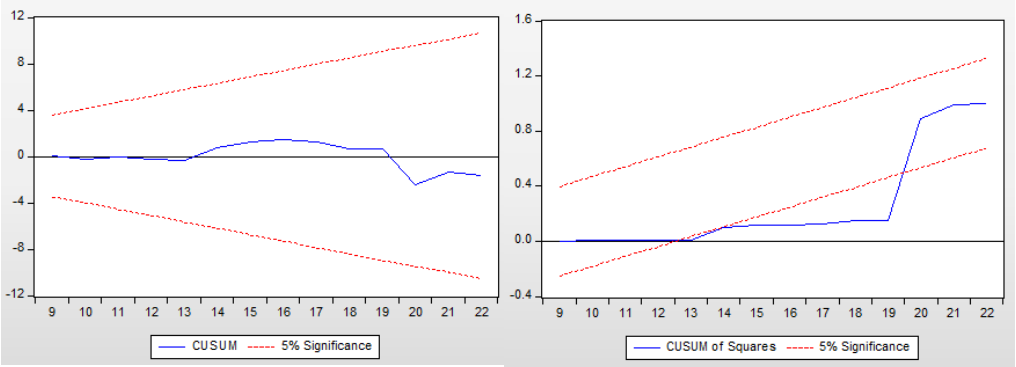
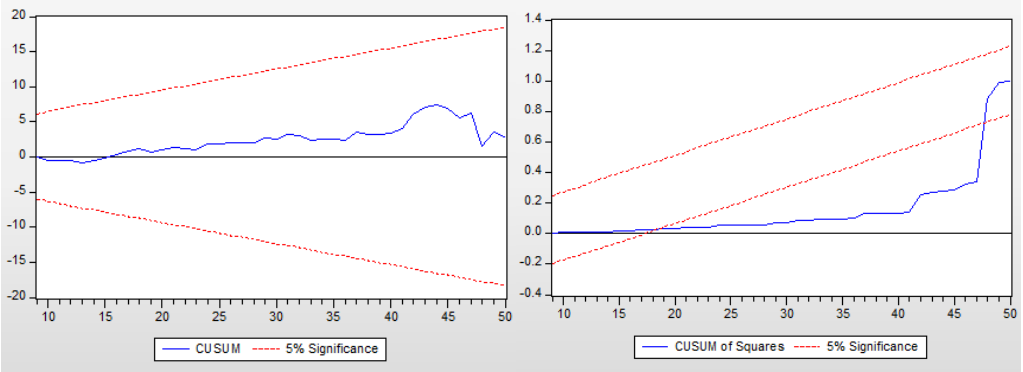


Figure 5: Year 1973-2022 (50 Years)



It also provides some clues as to the stability of the relationship between these variables in the long-run. Such tests are very necessary to validate the reliability of the estimates of the model and to validate the validity of the conclusions regarding the impact of foreign assistance on Indian economic performance. For the periods of 1973-1990 and 1991-2000, the CUSUM and CUSUM of Squares graphs show the lines within the critical boundaries, indicating that the model's parameters were stable. This could reflect that the underlying relationships between the variables in this period were relatively stable, underpinned by effective policies, with no economic actions that can break down these relationships.

While, during the periods of 2001-2022 and 1973-2022, the non-linear line crosses the critical boundaries, indicating structural instability. This instability may be related to important economic events, including the global financial crisis (2008), the high pace of globalization, technological progress, the pandemic of COVID 19, or major changes in domestic policies. Probably, something happened to that economic equilibrium and caused changes in the relationship between variables in the model.

3.7 Diagnostic Test

Table 10 presents the results of diagnostic tests conducted across three time periods (1973-1990, 1991-2000 and 2001-2022), which generally indicate a well-behaved model. The Jarque-Bera test results, with p-values of 0.137, 0.766 and 0.551, respectively, confirm that the residuals are normally distributed across all periods. The Breusch-Godfrey Serial Correlation LM Test shows no evidence of serial correlation, as indicated by p-values well above the 5% significance level (0.956, 0.536 and 0.358). Similarly, the results of the White Heteroskedasticity Test (p-values of 0.856, 0.941 and 0.780) suggest that the assumption of homoscedasticity holds across all periods.

Table 10: Diagnostic Test

Years	Diagnostic Test	F-Stats	P-Value
1973-1990	Jarque-Bera Normality test	3.971256	0.137294
	Breusch-Godfrey Serial Correlation LM Test	0.003282	0.9556
	White Heteroskedasticity Test	0.411461	0.8554
1991-2000	Jarque-Bera Normality test	0.753757	0.685999
	Breusch-Godfrey Serial Correlation LM Test	2.076401	0.3862
	White Heteroskedasticity Test	0.272269	0.9091
2001-2022	Jarque-Bera Normality test	0.728982	0.694550
	Breusch-Godfrey Serial Correlation LM Test	0.838514	0.3765
	White Heteroskedasticity Test	0.431071	0.8462
Overall	Jarque-Bera Normality test	19.44588	0.000060
1973-2022	Breusch-Godfrey Serial Correlation LM Test	1.087921	0.3467
	White Heteroskedasticity Test	1.566885	0.1807

Source: Researchers' computations using EViews

3.8 Granger Causality Tests

The Granger causality test is employed to determine whether a causal relationship exists between two variables. A p-value of less than 0.05 indicates a significant causal relationship. As per the calculation given in Table 11, both p-values for the relationship between FA and GDP are greater than 0.05, suggesting that FA does not Granger-cause GDP and that GDP does not Granger-cause FA. These findings imply that foreign aid leads to impact in the long-run and does not directly drive immediate changes in GDP and nor does GDP determine aid inflows. However, the test identifies significant causality in other areas, such as FDI influencing GDP, and CE responding productively to GDP changes. These results highlight the function of indirect avenues through which help could be delivered, such as strengthening institutional frameworks, promoting domestic investment, and enhancing fiscal capacity through higher tax collection. The absence of causality between foreign aid and GDP indicates a strategic imperative for aid utilization, demonstrating that it plays a complementary role with domestic economic policies and addresses structural inefficiencies.

It finds that the observed causality patterns in imports, exports and tax revenues imply that trade and fiscal strategies can help magnify the overall development impact of foreign assistance. The findings provide important clues as to how macroeconomic variables simultaneously work to leverage foreign aid and sustain economic growth. Furthermore, trade and growth models relate as well.

The causality between exports and GDP posited from the Granger test implies that export promotion and trade liberalization in India have played a role in India's growth story. This growth can be complemented by aid in such a way that if it strategically aligned with trade policy, it can

address infrastructure deficits and promote competitiveness. Yet one critical determinant of aid's efficacy, as reflected in the theoretical emphasis on policy coherence and alignment with local context, so often ignored in conditionality-based aid, remains a strong one. The interplay of these theoretical dimensions is illustrated by India's experience of its transition from an aid recipient to a donor nation. The declining importance of aid in post-liberalization India's economic expansion is corroborated with the theory of dependence that demonstrates that the utility of aid declines with the growing self-reliance of the beneficiary country. The influence of this trajectory of endogenous growth mechanism and trade-driven policies on sustaining economic performance is also evidenced.

Table 11: Pair-wise Granger Causality Tests

Null Hypothesis:	Obs.	F-Statistic	Prob.
DFA does not Granger Cause DGDP	47	0.44729	0.6424
DGDP does not Granger Cause DFA		0.05052	0.9508
DFDI does not Granger Cause DGDP	47	1.76013	0.1845
DGDP does not Granger Cause DFDI		4.37209	0.0188
DCE does not Granger Cause DGDP	47	0.06710	0.9352
DGDP does not Granger Cause DCE		11.6630	9.E-05
DEX does not Granger Cause DGDP	47	4.80142	0.0132
DGDP does not Granger Cause DEX		1.17826	0.3178
DIM does not Granger Cause DGDP	47	1.59773	0.2144
DGDP does not Granger Cause DIM		1.13728	0.3304
DTAX does not Granger Cause DGDP	47	0.10256	0.9028
DGDP does not Granger Cause DTAX		12.9440	4.E-05
DFDI does not Granger Cause DFA	47	1.38105	0.2625
DFA does not Granger Cause DFDI		0.37832	0.6873
DCE does not Granger Cause DFA	47	0.10283	0.9025
DFA does not Granger Cause DCE		0.86818	0.4271
DEX does not Granger Cause DFA	47	0.22342	0.8007
DFA does not Granger Cause DEX		0.01514	0.9850
DIM does not Granger Cause DFA	47	0.27412	0.7616
DFA does not Granger Cause DIM		0.01819	0.9820
DTAX does not Granger Cause DFA	47	0.01720	0.9830
DFA does not Granger Cause DTAX		1.88874	0.1639
DCE does not Granger Cause DFDI	47	0.61209	0.5470
DFDI does not Granger Cause DCE		1.22939	0.3028
DEX does not Granger Cause DFDI	47	4.61395	0.0154
DFDI does not Granger Cause DEX		3.69221	0.0333
DIM does not Granger Cause DFDI	47	1.14893	0.3267
DFDI does not Granger Cause DIM		1.59023	0.2159
DTAX does not Granger Cause DFDI	47	4.45352	0.0176
DFDI does not Granger Cause DTAX		0.88173	0.4216
DEX does not Granger Cause DCE	47	19.8916	8.E-07
DCE does not Granger Cause DEX		0.65438	0.5250
DIM does not Granger Cause DCE	47	10.3149	0.0002
DCE does not Granger Cause DIM		1.78264	0.1807

Contd...

Table 11 contd...

Null Hypothesis:	Obs.	F-Statistic	Prob.
DTAX does not Granger Cause DCE	47	2.91857	0.0650
DCE does not Granger Cause DTAX		10.1194	0.0003
DIM does not Granger Cause DEX	47	0.47801	0.6233
DEX does not Granger Cause DIM		3.10059	0.0555
DTAX does not Granger Cause DEX	47	0.50009	0.6100
DEX does not Granger Cause DTAX		1.45879	0.2441
DTAX does not Granger Cause DIM	47	2.33479	0.1093
DIM does not Granger Cause DTAX		0.67803	0.5131

Source: Researchers' computations

3.9 Regression Analysis

The regression analysis presents extensive insights as to how India's economic growth is correlated with foreign aid and macroeconomic indicators. Results across the three time periods differ, but the findings show comparative patterns that capture the changing nature of aid and other growth pursuers. As previously mentioned, our data is stationary at the first difference, and thus, the data at the first difference is utilized for the regression analysis. Table 12 presents the results of the regression analysis across three periods, as well as for the overall period, consistent with the correlation analysis.

Table 12: Regression Analysis

Years	Variables	Coefficient	Std. Error	t-Statistic	Prob.	
1973-1990	C	1.09E+10	6.03E+09	1.806951	0.1009	R-squared 0.445972 Adj. R-squared 0.113556 F-statistic 1.341607 Prob (F-statistic) 0.324321 D.W. stat 1.863199
	DFA	-1.554652	2.733713	-0.568696	0.5821	
	DFDI	-17.39392	20.01740	-0.868940	0.4053	
	DCE	-2.205348	3.629993	-0.607535	0.5570	
	DEX	1.579004	2.688610	0.587294	0.5700	
	DIM	0.344188	1.515314	0.227140	0.8249	
	DTAX	4.159568	2.149811	1.934853	0.0818	
1991-2000	C	2.78E+10	5.66E+09	4.905171	0.0391	R-squared 0.934607 Adj. R-squared 0.738429 F-statistic 4.764075 Prob (F-statistic) 0.183629 D.W. stat 1.241278
	DFA	-1.002035	5.306238	-0.188841	0.8676	
	DFDI	-5.253912	2.725982	-1.927347	0.1938	
	DCE	1.157132	0.889718	1.300561	0.3231	
	DEX	0.537970	0.561508	0.958081	0.4391	
	DIM	-0.269009	0.503409	-0.534376	0.6465	
	DTAX	1.850662	0.792327	2.335731	0.1446	
2001-2022	C	7.93E+09	2.41E+10	0.329380	0.7467	R-squared 0.741529 Adj. R-squared 0.630756 F-statistic 6.694114 Prob (F-statistic) 0.001664 D.W. stat 2.355123
	DFA	17.08579	17.00440	1.004786	0.3321	
	DFDI	-2.370869	1.267698	-1.870216	0.0825	
	DCE	4.726986	1.559527	3.031039	0.0090	
	DEX	1.265492	0.596930	2.120000	0.0524	
	DIM	-0.372206	0.469450	-0.792855	0.4411	
	DTAX	1.954891	0.886266	2.205760	0.0446	

Contd...

Table 12 contd...

Years	Variables	Coefficient	Std. Error	t-Statistic	Prob.	
1973-2022	C	4.34E+09	6.20E+09	0.699991	0.4878	R-squared 0.817103 Adj. R-squared 0.790974 F-statistic 31.27282 Prob (F-statistic) 0.000000 D.W. stat 2.271585
	DFA	5.526822	5.497421	1.005348	0.3205	
	DFDI	-2.178437	0.755843	-2.882129	0.0062	
	DCE	4.877435	0.783006	6.229120	0.0000	
	DEX	1.382993	0.310224	4.458053	0.0001	
	DIM	-0.379339	0.273559	-1.386680	0.1729	
	DTAX	1.801386	0.464702	3.876428	0.0004	

Source: Researchers' computations

Results show that foreign aid has statistically no relationship with GDP for most periods, indicating that its direct impact on India's economic growth was quite marginal. That also coincides with India's evolution from being an aid-dependent country to a country where domestic savings and investment assume importance. However, the third period (2001-2022) shows a positive coefficient, though insignificant, which shows that aid still plays a marginal supportive role, maybe in targeted sectors such as social services and infrastructure. However, since the weak statistical significance suggests that aid is no longer a main driver of growth, foreign assistance is following a path of diminishing returns as economies grow and diversify.

The results showed that FDI was significantly and negatively related to GDP in the overall period and some subperiods. This counterintuitive finding would allow for such potential challenges with FDI as profit repatriation by multinational corporations, crowding out domestic investments, or consolidating in sectors with limited spillover effects. This highlights the importance of policies to strengthen the absorptive capacity of the economy towards channelling FDI into product innovating, job-creating, and technology-transferring sectors. The result shows a fascinating positive and significant relationship between government consumption expenditure and GDP, suggesting that public spending plays a major role in growth. Particularly so, the third period of economic growth was quite dependent on the resulting government investment in infrastructure, health and education. The findings underscore the key role of fiscal policy in the economy as a means of boosting aggregate demand and promoting long-term development.

GDP response to exports is positive and statistically significant, especially in the case of liberalization and the post-liberalization period. This result is the result of India's successful integration into the global economy because of trade liberalization and export promotion policies. The growth of exports is an important part of the growth models based mostly on trade, as the growth from exports facilitates growth via comparative advantage, productivity, and technology transfer. Generally, imports fall with GDP but are not statistically different. Recognizing imports as a source of drain for domestic production, however, does not necessarily mean that they constitute either threats or aid to domestic production. The mixed results suggest a complex role of imports, now moderated by the extent and choice of imports, both to development goals.

We find a strong and positive relationship between tax revenue and GDP, which testifies to the role of government capacity in mobilizing domestic resources. Increased tax revenue means you spend it on growing and developing things like running schools and healthcare, among other various infrastructure and services. And that works like a virtuous cycle. This finding serves as an important reminder regarding the critical role of good taxation systems in sustaining economic performance, given the growing lack of importance of foreign aid.

The results of the regressions provide a fine-grained picture of the fast-emerging growth

dynamics of India, wherein foreign aid has been on the wane while trade, public investment, and domestic resource mobilization have been on the ascendance. FDI effectiveness also needs to be raised by eliminating obstacles, particularly in terms of structure, and ensuring that FDI is following the national priorities. Just like exports will continue to act as a main engine of India's growth, we will continue to rely on government expenditure on infrastructure and human capital to sustain India's economic performance.

5. Conclusions

Against the backdrop of fifty years (1973-2022), this work studies the complex relationship between foreign aid and economic growth in India using various econometric techniques, including the Granger causality test, the Vector Error Correction Model (VECM), and regression analysis. The results help to continue the current discussion about the "Aid Growth Paradox" by pointing out how foreign assistance has shaped India's economic performance as it evolves.

This research thus finds that foreign aid has had a mixed impact on Indian economic growth. The VECM results indicate a positive long-run relationship; that is, with a rise in foreign aid by a unit, there is a significant rise in GDP; however, the Granger causality test infers that foreign aid does not predict GDP in either direction. This fits with the famous micro-macro paradox, which posits that aid may be successful at a project level, yet its aggregate effect is watered down by institutional weakness and wastefulness of resources.

The regression analysis further emphasizes the declining importance of foreign aid as India moved from a country dependent on foreign aid to one based on domestic savings, foreign direct investment, and foreign trade. Aid has been extremely significant in the initial stages of development but has played a much lesser role in recent times, reflecting the country's increasing self-reliance and its integration into the world economy. This trajectory is consistent with the dependency theory's argument that aid loses utility as countries develop and the importance of endogenous growth mechanisms rises via investment in human capital, innovation, and infrastructure.

Further insights into India's growth dynamics come from the other macroeconomic variables. The strong relationship between exports and GDP verifies the positive effect of trade liberalization and export promotion on the growth of the economy under trade-driven growth theories. On the contrary, the relationship between FDI and GDP is at variance with conventional wisdom and throws up legitimate questions regarding the ability of the Indian economy to absorb investment and guide FDI toward sectors with greater spillovers.

The findings have critical implications for policymakers. The results also emphasize the importance of considering aid utilization as a strategic commodity, taking a national 'aid' view for aid to be aligned with country priorities, and overcoming systemic bottlenecks such as institutional inefficiencies and governance obstacles. The second is the negative relationship between FDI and GDP, which suggests that foreign investment is not targeted at high-growth areas, nor does it lead to quality investment, and thus requires policy measures aimed at increasing the quality and impact of foreign investment through the improvement of regulatory infrastructure and the level of investment in high-growth areas.

Additionally, this study shows that the strong positive relationship between exports and GDP indicates the importance of an open trade regime and investment in export-oriented industries. The key findings also draw attention to the central role of government expenditure and government revenue in driving economic growth, which suggests that fiscal policy forms a powerful instrument for development if its objectives are aligned with a longer horizon.

This research contributes to the theoretical and empirical literature by providing a comprehensive analysis of the aid-growth relationship in the context of a large and rapidly evolving economy. Building on time series data and utilizing robust econometric techniques, the study fills the gap between the micro-level success of a project and macroeconomic outcomes to provide useful insights on the conditions under which aid can be effective. The study also supports the call for considering context-specific factors (institutions, trade policies, and composition of aid) in evaluating the impact of foreign assistance. The nuanced findings also expose the limitations of 'one shoe fits all' types of approaches to aid effectiveness and suggest more nuanced strategies that might fit better the specific characteristics of recipient countries.

While this research has contributions, it is limited in ways that open future research possibilities. Aggregate relationships are analyzed, and the focus is on the aggregate distribution of aid and its differential impact across regions within India. Less well understood and likely to be investigated by future studies are these dimensions, which help to fill in the picture of how aid has affected regional disparities and inclusive growth. More specifically, further interest ought to be shown to the counterintuitive relationship between aid and FDI, as their divergence may exhibit plausible reasons for the relationship between the two. FDI, domestic investment, and other aspects could also be researched in terms of their synergy and trade-off and how they influence economic outcomes.

This study lends further support to the salience of the 'Aid-Growth Paradox' in Development Econometrics. Foreign aid could be catalytic, only under the right conditions, and this ultimately will be determined by the framework of the recipient country's institutions, policy environment, and ability to leverage external resources for long-term growth. The case study of India is compelling as it demonstrates exactly how a country may transition from dependence on aid to being self-reliant by building domestic capabilities and becoming integrated within a global economy. The lessons that this study generates are extremely helpful for understanding how foreign assistance can achieve the greatest impact under different circumstances.

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COMMERCIAL VIABILITY OF DISCOMS OF GUJARAT AND RAJASTHAN: A COMPARATIVE ANALYSIS

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Abstract: Despite the introduction of power sector reforms since the late 1990s, aspects of commercial viability have gained scant attention and concern. Most of the power distribution companies across India have experienced the pangs of commercial inefficiency with their annual balance sheets depicting losses. This study aims to draw a comparative analysis of the commercial viability of power distribution companies (DISCOMs) in Gujarat whose DISCOMs have been performing consistently well, and Rajasthan where opposite has been the case. Besides relying on other key secondary sources of information, analytical exercises in the paper are based on statistics provided by the Power Finance Corporation of India (PFCI) for the last ten years. The study also compares major interventions adopted by the selected seven DISCOMs to achieve commercial viability.

Keywords: Electricity distribution, DISCOMs, Indian power sector, Rajasthan, Gujarat

1. Introduction

Though the Indian power sector has made significant advances in rural and household electrification during the post-independence period, the operational dynamism of power supplying agencies, *viz.* State Electricity Boards (SEBs), remained largely plagued with inefficiencies: a range of technical, operational and commercial inefficiencies crept in over time (Kannan and Pillai, 2000). In fact, it was the advent of power sector reforms in the late 1990s that was considered a panacea for all the ills of the Indian power sector, which resulted in the unbundling of the erstwhile state electricity boards into power corporations, individually responsible for generation, transmission and distribution of electricity—the latter operation being the responsibility of the DISCOMs. At present, there is a total number of 109 DISCOMs, including state-owned, private power supply companies and joint ventures between the state and private sector in the Indian power sector which are operating at varied levels of operational performance.[1]

The focus of the present study is confined to the state-owned DISCOMs of two western states

[1] Government of India, Unstarred question number 70 raised in the Parliament, answered on July 20, 2023; https://sansad.in/getFile/loksabhaquestions/annex/1712/AU70.pdf?source=pqals accessed in June 2024.

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of India, *viz*. Gujarat and Rajasthan. While the electricity sector of Gujarat is lauded as a benchmark for other states in the literature, with its low levels of aggregate technical and commercial (AT&C) losses and well-established feeder segregation system, the electricity sector of Rajasthan has been underperforming since its unbundling and had to be bailed out of debt numerous times by both the centre and the state (Sareen, 2017a).

This paper focusing on examining the commercial aspect of DISCOMs in Gujarat and Rajasthan has a two-fold objective: first, it draws a comparative account of commercial performance among Gujarat and Rajasthan DISCOMs during the recent past; secondly, it enlists key interventions that have a significant bearing on the commercial performance of DISCOMs. Analytical insights are drawn based on secondary data received from agencies like Power Finance Corporation of India (PFCI), departmental websites and annual reports of DISCOMs along with other government portals.[2]

Including this introductory section, there are seven sections in this paper. Section two elaborates on power sector reforms and various issues surrounding the operational efficiency of the Indian DISCOMs. Section three provides a comparative state and section four examines the operational performances of Gujarat and Rajasthan DISCOMs. Section five elaborates on key interventions having a bearing on commercial viability. Section six brings forth pressing issues in service provisions and the final section concludes the study.

2. Power Sector Reforms and Issues Surrounding Operational Efficiency of the Indian DISCOMS: A Review of Literature

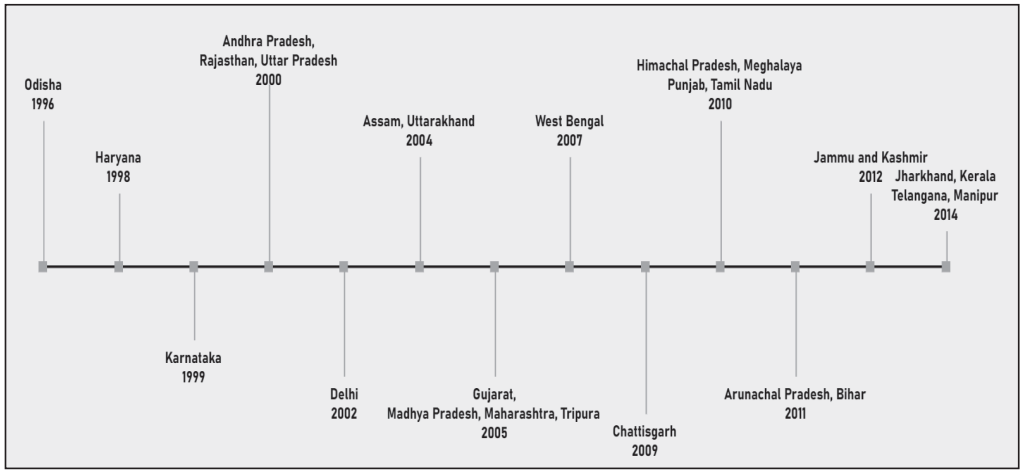
Till the late 1990s, the power sector in India remained under vertically integrated state-owned monopolies. Initially, the state ownership was justified based on the scope and the economies of scale thus generated to be the most suitable way of providing electricity to the vast population which was still poor and lacked access to electricity. Moreover, the state ownership was justified based on the welfare economy principle which states that the state is the custodian of the interest of its people, and therefore, all the segments of the power sector— i.e., generation, transmission and distribution—needed to be under the state control for better coordination among these entities (Gratwick and Eberhard, 2008). However, at the time of economic reforms, the power sector was suffering from high financial losses, technical inefficiencies, peak load shortfalls and electricity supply deficits. (Pargal and Ghosh Banerjee, 2014). To resolve these issues, the first phase of power sector reforms included inviting private and foreign investment in power generation to boost generation capacity. Odisha in 1996 became the first state to dilute state government control over the politically sensitive distribution sector. The state vertically restructured and privatised its power sector and formed an independent body for regulation and determination of tariffs for electricity. Other states also initiated reforms to unbundle their power sector utilities, the timeline of which is depicted in Figure 1. The enactment of the Electricity Act 2003 mandated unbundling and corporatizing utilities and establishing independent regulators to increase efficiency in the power sector of the states. As of 2022, 19 states including Delhi have unbundled; 3 states have separated their transmission companies; and 14 states and UTs have a single utility as a corporation, power department (PD), or SEB.

DISCOMs are termed as 'cash registers' of the power sector, and therefore, to ensure efficiency in the performance of the power sector as a whole, it is imperative that the commercial viability of

[2] "Report on Performance of Power Utilities", Power Finance Corporation (PFC) of India.

the DISCOMs is ensured (Sarangi et al., 2020). Although major states of India have incorporated unbundling processes of their SEBs, operational and financial issues still exist in the distribution of electricity. Bad debts, shortage of funds, poor balance sheet, low return on investment and poor collection efficiency are major issues persisting in major state-owned DISCOMs (Sarangi et al., 2020; Verma et al., 2020).

Figure 1: Timeline of Unbundling of State Electricity Boards in States of India



Source: Based on various web sources

Yet another aspect affecting the performance of DISCOMs is the geography and the consumer mix it caters to. A geographically large state like Rajasthan, with a huge rural population, struggles with ensuring better performance by its DISCOMs. Hilly states, particularly in the north-east, have also had a challenging journey with respect to the reform of their DISCOMs. A homogenous consumer mix makes it more efficient for DISCOMs to fix the tariff and generate revenue and therefore, private distribution companies are more attracted to invest in such areas as compared to a scattered and heterogenous consumer base (Regy et al., 2021). Delhi and Surat witnessed a successful implementation and turnaround of DISCOMs with private distribution licensee models due to their homogenous consumer mix and geography.

To ensure the commercial viability of DISCOMs, state and centre-sponsored subsidies do play an integral role. However, the added burden on state finances and continued reliance on subsidies, disincentivises DISCOMs from introducing any significant structural improvement. The delay in subsidy reimbursements also adds on to the financial woes of DISCOMs. In addition, the cross-subsidisation, where agricultural power tariffs are cross-subsidised by industrial tariffs, varies across states and DISCOMs. On average, Indian industries pay about 12 percent more than the average cost of supplying power, while agricultural consumers pay about 55 percent lower (Bhattacharya and Ganguly, 2017). Overall, energy subsidies have resulted in excessive and inefficient energy use, contributing to price volatility and the absence of private investment in the sector (Jain, 2006). Electricity theft is yet another major issue faced by distribution companies. The factors influencing electricity theft includes rampant corruption, the nexus formed between bureaucrats and consumers, and the bandwagon effect where legal connection holders are forced to steal since the neighbours are using the public good, i.e. electricity, at free of cost. The climate change and the increased need

for electricity for irrigation are other reasons for electricity theft by small and medium farmers (Jamil and Ahmad, 2014; Katiyar, 2005).

The global power sector is going through a transition phase where there is a drive to reduce the dependence on fossil fuels. There is a global pressure to switch towards renewable energy demands for the uphauling of existing distribution infrastructure. As a result, the power sector in India and thereby in the states, is bound to transform, with consumers themselves becoming an integral part of the generation and distribution of power (Kale et al., 2018).

Given the hurdles and issues rampant in the operational and commercial viability of DISCOMs, a comparative study of two major western states, *viz.* Gujarat and Rajasthan, can be helpful in highlighting key issues, interventions adopted and the gaps remaining to achieve commercial viability by the DISCOMs in the two states. Besides relying on other key secondary sources of information including the UDAY Portal and RDSS Portal, analytical exercises in the paper are done based on statistics provided by the PFCI for the last ten years.

3. Comparative State of Gujarat and Rajasthan DISCOMs

Despite the introduction of power sector reforms in late 1990s, it took a while for Gujarat to unbundle its state electricity board. It passed Gujarat Electricity Industry (Reorganisation & Regulation) Act in 2005 which led to formation of six companies responsible for generation, transmission and distribution of electricity. Gujarat State Electricity Corporation Ltd. (GSECL) focused on generation and Gujarat Energy Transmission Corporation (GETCO) catered transmission, whereas four regional companies, *viz.* Uttar (UGVCL), Dakshin (DGVCL), Madhya (MGVCL), and Paschim Gujarat Vij Company Limited (PGVCL), focused on distribution. In contrast, Rajasthan carried out its unbundling process much earlier. With the initiation of the Rajasthan Power Sector Reforms Bill (Reform Bill) on 01 June, 2000, power sector reforms were introduced to facilitate and attract investments, bring about improvements in the efficiency of the delivery system, and create an environment for growth for the overall benefit of the people of the state. Under these reforms, the vertically integrated monopoly power utility, Rajasthan State Electricity Board (RSEB), was unbundled into RRVPNL (Rajasthan Rajya Vidyut Prasaran Nigam Limited), RVUNL (Rajasthan Rajya Vidyut Utpadan Nigam Limited), and three DISCOMs, i.e., JVVNL (Jaipur Vidyut Vitaran Nigam Limited), AVVNL (Ajmer Vidyut Vitaran Nigam Limited) and JdVVNL (Jodhpur Vidyut Vitaran Nigam Limited) in July 2000.

3.1 Comparative Profiles of Selected DISCOMs

This section makes a comparison of selected seven DISCOMs based on their customer base, geographical spread and performance ratings. Table 1 presents a comparative profile of selected seven DISCOMs of Gujarat and Rajasthan.

Though Rajasthan has a larger geographical spread, electricity distribution is being managed by three DISCOMs, whereas in the case of Gujarat, there are four DISCOMs. JdVVNL has the largest geographical spread to manage, followed by PGVCL. As both PGVCL and JdVVNL have similar consumer base and topography, these two are most comparable with each other. As regards consumer profile, AVVNL has the largest consumer base, followed by PGVCL. Also, PGVCL has the largest share of agricultural consumers out of all the selected DISCOMs spread over remote areas of Kutch and Saurashtra and a long coastline in Gujarat.

Consumer-wise sale of electricity presented in Figure 2 makes it clear that industrial consumers constitute a majority in DGVCL where the share of agricultural consumers is minimal. In Gujarat, UGVCL accounts for the highest proportion of electricity sales in the agricultural sector, followed by

PGVCL. While UGVCL caters to agricultural consumers having larger landholdings and electricity demand, PGVCL is at a disadvantageous position since the farmers in the region are mostly small-scale farmers, who are further scattered over a large area of Kutch and Saurashtra regions, much similar to the farmers served by JdVVNL (Sareen, 2017b). In Rajasthan, there is not much difference between AVVNL and JVVNL in terms of their consumer-wise sale of electricity. In the case of JdVVNL, a considerably high proportion of electricity sales is accounted for by the agriculture sector.

Table 1: Comparative Profile of DISCOMs in Gujarat and Rajasthan, 2020-21

Parameters	Gujarat				Rajasthan		
	DGVCL	UGVCL	MGVCL	PGVCL	JVVNL	AVVNL	JdVVNL
Districts	7	10	7	12	12	11	10
Area (sq. km.)	23307	49950	23854	109463	72474	87256	182509
Population (in lakh)*		119.1	130.6	170.5	256	229	203
Consumers (in lakh)*	34.34	38.08	27.68	59	61.93	64.89	53.94
Agricultural Consumers (%)	5.93	10.46	5.91	16.98	11.45	10.63	9.34
No. of Villages	3461	4503	4404	5707	15145	15379	14148
Electrified Villages	3461	4503	4404	5707	14776	15272	13917
% of Electrified Villages	100	100	100	100	97.56	99.3	98.36
Performance Ratings[3]							
2016	A+	A+	A+	A+	B-	B	C
2023	A+	A+	A+	A+	C+	C+	B

Note: * 1 lakh = 0.1 million

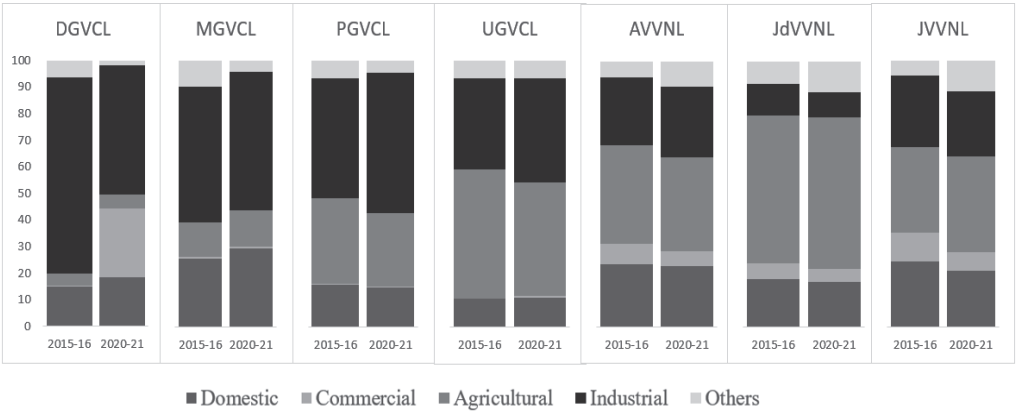
Source: Based on Annual Reports of DISCOMs, 2020-21; and Government of India (2016, 2023)

3.2 Comparative Performance of DISCOMs (Based on Ratings)

Another interesting point of contrast between Gujarat and Rajasthan DISCOMs is found in their performance ratings. Integrated ratings given by the Ministry of Power indicate the operational and financial performance capabilities of DISCOMs. Consumer Service Rating of DISCOMs (CSRD) was conceptualised for the financial year 2020-2021 to undertake rating exercises of DISCOMs based on various key service parameters that have a direct or indirect impact on the existing as well as new potential consumers. The grading ranges from "A+" to "D", with scores such as >90: A+; 80-90: A; 70-80: B+; 60-70: B; 50-60: C+; 40-50: C; and <40: D. It is observed that all four DISCOMs of Gujarat have been performing well consistently in terms of their integrated ratings. All DISCOMs in Gujarat recorded A+ rating, whereas the experience of Rajasthan DISCOMs has been adverse in this respect. There has been a slide in the overall integrated ratings for AVVNL and JVVNL has recorded a slide in their overall integrated ratings.

[3] Since 2012, Integrated Rating Exercise has been executed annually under the aegis of Ministry of Power (MoP) with the aim of evaluating performance of power distribution utilities. MoP has mandated Power Finance Corporation (PFC) to coordinate the rating exercise. The ratings have three main parameters to measure the performance of discoms: i) financial sustainability, which includes metrics such as gap in ACS-ARR (ACS stands for average cost of supply, whereas ARR stands for average revenue realised), days receivables and days payables; ii) performance excellence which includes operational performance metrics, and iii) external environment which includes impact of state government action and regulator action. The ratings are graded from A+ to D.

Figure 2: Break-up of Sales (%) in Million Units to Total Sales by Type of Consumers in Gujarat and Rajasthan, 2015-21



Source: Compiled from PFCI reports, 2015 and 2022

Table 2: Performance of DISCOMs: Consumer Satisfaction Parameters in Gujarat and Rajasthan, 2021-22

DISCOM	UGVCL	MGVCL	DGVCL	PGVCL	AVVNL	JVVNL	JdVVNL
Operational Reliability	A+	A+	A+	B+	A	B	A
Connection and Other Services	A+	A+	D	A+	D	A+	D
Metering, Billing & Collections	D	D	C	D	C+	C+	C+
Fault Rectification & Grievance Redressal	A+	A+	A+	C+	A+	B+	A+
Aggregate Grades 2021-22	B+	B+	B	B	B	B	B
Aggregate Grades 2020-21	B	B	B	C+	B+	B+	B

Source: Based on Government of India (2022)

Similarly, Table 2 depicts ratings of Gujarat and Rajasthan DISCOMs in various consumer satisfaction parameters.[4] It may be observed that in terms of operational reliability, three DISCOMs in Gujarat received A+ ratings whereas in Rajasthan, rating levels have remained relatively lower. In terms of connection and other services, three DISCOMs in closely Gujarat received A+ ratings; in Rajasthan, such rating is received only by JVVNL. In terms of metering, billing and collection, all the DISCOMs in both Gujarat and Rajasthan received poor ratings. Despite having achieved A+ ratings in operational reliability by Gujarat DISCOMs, the aggregate rating is average. This can be attributed to the low ratings achieved in metering, billing and collection criterion by Gujarat, more closely in the sub-category comprising consumers paying digitally, bills generated on the basis of non-manual meter reading, and percent of pre-paid consumers (CSRD Report 2021-22).[5]

[4] https://recindia.nic.in/uploads/files/co-usri-crsd-report-fy-21-22-dt120423.pdf. Accessed in December, 2023.

[5] Consumer Service Rating of DISCOMs (CSRD) Report, 2021-22

4. Commercial Performance of DISCOMs in Gujarat and Rajasthan

Commercially speaking, profitability is a key aspect that reflects the status of the operational performance of DISCOMs. It may be observed from Table 3 that the experience of DISCOMs in this respect has remained much diverse in both Gujarat and Rajasthan. DISCOMs in Gujarat have recorded profits consistently over time, whereas the Rajasthan DISCOMs have remained largely at losses for most of the time-period under consideration.

Among Gujarat DISCOMs, the largest profit of Rs. 189 crore was recorded by PGVCL in 2020-21 (see Table A1 in the Appendix).[6] Even though PGVCL has been suffering from huge losses due to rampant electricity thefts, with a record annual loss of Rs. 1,400 crore, DISCOM has been able to book profits throughout the reference period except in 2015-16 with a loss of Rs. 17 crore.[7]

All three DISCOMs in Rajasthan have remained in losses over time with a few expectational years when they have recorded a profit, *viz*. 2017-18 and 2021-22 for AVVNL, 2017-18 for JdVVNL and 2017-19 and 2021-22 for JVVNL. This can be attributed to the spill-over effect generated by the UDAY scheme which was introduced in 2015-16 to reduce the debt burden of DISCOMs in India. However, the DISCOMs in Rajasthan were not able to sustain their profits and Thus registered losses for subsequent years.

Two prime factors influence the profitability status of DISCOMs: first is the magnitude of aggregate technical and commercial (AT&C) losses and second is the provision of subsidy to the ultimate consumers of electricity. Both these aspects are discussed below.

4.1 Magnitude of AT&C Losses

It may be observed from Figure 3 that among Gujarat DISCOMs, the magnitude of AT&C losses has been relatively high in the case of PGVCL, though they were able to reduce the AT&C losses by more than 25 percent by 2020-21. Among other DISCOMs, the lowest magnitude of AT&C losses is recorded by DGVCL. The experience of Rajasthan DISCOMs has been entirely different as the magnitude of AT&C losses has remained relatively high. Among three DISCOMs, the highest magnitude of AT&C losses is recorded by JdVVNL.[8] Though in the case of AVVNL and JVVNL, there has been a consistent decline in AT&C losses, experience of JdVVNL has been different. Here, AT&C losses recorded a consistent rise between 2017 and 2020. The rise in AT&C losses in JdVVNL was mainly due to its high ACS-ARR gap, i.e., the gap between average cost of supply (ACS) and average revenue realisation (ARR) (Figure 7), and a large share of agricultural consumers (Table 1).

4.2 Tariff Subsidies and DISCOMs

The state governments provide tariff subsidies to DISCOMs after the subsidies are billed to the consumers. There is a time delay in subsidies billed and received from the state government. This delay adds on to the financial burdens of DISCOMs and the same is discussed in this section.

Figure 4 presents the status of selected DISCOMs based on per unit subsidy billed and subsidy

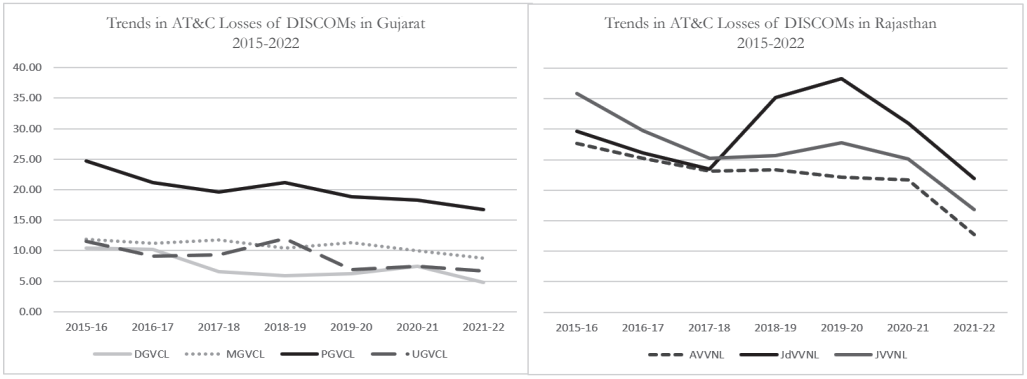
[6] 1 crore = 100,00,000

[7] https://timesofindia.indiatimes.com/city/rajkot/pgvcl-loses-1-4k-cr-to-power-theft/articleshow/89553649.cms. Accessed in December, 2023.

[8] JdVVNL has entered into Distribution & Franchisee Agreement in 2017 with Bikaner Electricity Supply Limited, fully owned subsidiary of the Calcutta Electric Supply Corporation (CESC) for a period of 20 years. This has helped in reduction of AT&C losses in the DF area from 16.82% in FY2021 to 15.62% in FY2022 (Press Release, JdVVNL, 20 January 2023).

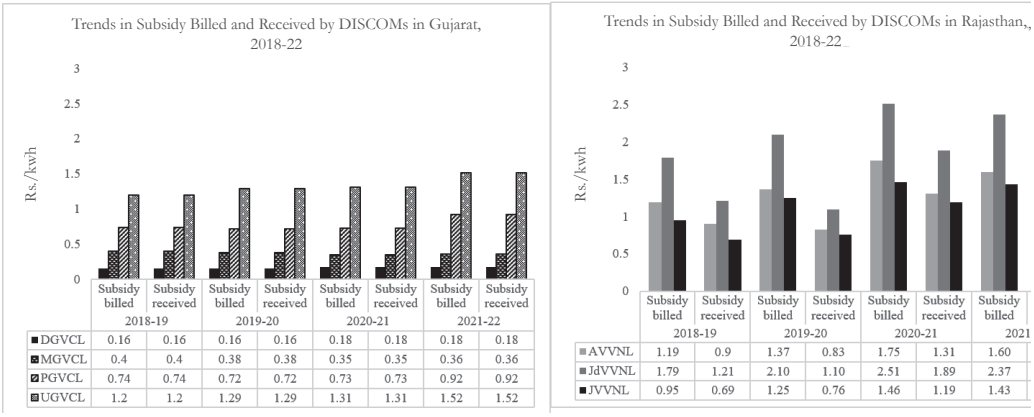
received from state governments for the years 2018-22. At the onset, it is clear that the per unit subsidy billed and received by DISCOMs in Gujarat is much lower than that of Rajasthan, varying between Rs. 0.16 and Rs. 0.92 per unit for three DISCOMs in Gujarat. UGVCL is the only exception which is attributed to its high agricultural consumer base. In comparison, per unit subsidy billed and received by DISCOMs in Rajasthan varies between Rs. 0.95-2.67 per unit in the reference period and has also shown an increasing trend. There is a gap between subsidy billed and received for DISCOMs in Rajasthan, which shows that delayed payments from the state government is contributing to the financial burden of the DISCOMs in Rajasthan.

Figure 3: Comparative Trend of AT&C Losses in Gujarat and Rajasthan DISCOMs



Source: Based on PFCI reports, 2018, 2022 and 2023

Figure 4: Subsidy Billed and Received in Gujarat and Rajasthan DISCOMs



	Subsidy billed	Subsidy received	Subsidy billed	Subsidy received	Subsidy billed	Subsidy received	Subsidy billed	Subsidy received
	2018-19		2019-20		2020-21		2021-22	
DGVCL	0.16	0.16	0.16	0.16	0.18	0.18	0.18	0.18
MGVCL	0.4	0.4	0.38	0.38	0.35	0.35	0.36	0.36
PGVCL	0.74	0.74	0.72	0.72	0.73	0.73	0.92	0.92
UGVCL	1.2	1.2	1.29	1.29	1.31	1.31	1.52	1.52

	Subsidy billed	Subsidy received	Subsidy billed	Subsidy received	Subsidy billed	Subsidy received	Subsidy billed
	2018-19		2019-20		2020-21		2021
AVVNL	1.19	0.9	1.37	0.83	1.75	1.31	1.60
JdVVNL	1.79	1.21	2.10	1.10	2.51	1.89	2.37
JVVNL	0.95	0.69	1.25	0.76	1.46	1.19	1.43

Source: Based on PFCI reports, 2022 and 2023

Table 3 shows per unit revenue realised by type of consumers in selected DISCOMs of Gujarat and Rajasthan for two time periods- 2015-18 and 2018-21. There has been a decline in per unit average revenue for agricultural consumers in MGVCL, UGVCL, AVVNL and JVVNL. In all other consumer categories, there has been an increase in average revenue realisation by the DISCOMs.

Table 3: Consumer-wise Realisation of Average Revenue Per Unit

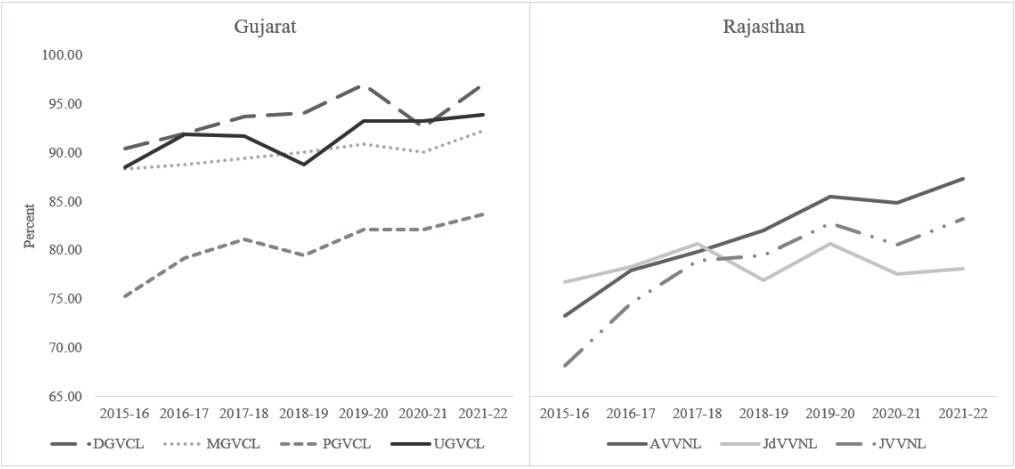
DISCOMs		Domestic	Commercial	Agricultural	Industrial	Others	All
DGVCL	2015-18	5.32	5.74	0.72	6.93	3.47	6.27
	2018-21	5.57	5.85	0.73	8.52	3.56	6.56
	% Change	4.70	1.92	1.39	22.94	2.59	4.63
MGVCL	2015-18	5.30	5.82	0.72	6.73	2.90	5.24
	2018-21	5.56	6.09	0.50	7.24	4.10	5.74
	% Change	4.91	4.64	-30.56	7.58	41.38	9.54
PGVCL	2015-18	5.18	5.69	0.66	6.95	2.17	4.52
	2018-21	5.48	5.99	0.70	7.18	2.14	4.99
	% Change	5.79	5.27	6.06	3.31	-1.38	10.40
UGVCL	2015-18	5.14	5.93	0.58	6.99	3.45	3.61
	2018-21	5.43	6.18	0.57	7.15	2.39	3.9
	% Change	5.64	4.22	-1.72	2.29	-30.72	8.03
AVVNL	2015-18	4.76	7.73	0.55	7.33	5.64	4.20
	2018-21	5.35	8.62	0.54	7.76	6.02	4.72
	% Change	12.39	11.51	-1.82	5.87	6.74	12.38
JdVVNL	2015-18	4.90	7.63	0.65	6.92	5.89	3.01
	2018-21	5.56	8.31	0.68	7.39	5.98	3.37
	% Change	13.47	8.91	4.62	6.79	1.53	11.96
JVVNL	2015-18	4.94	7.43	0.61	7.21	5.76	4.52
	2018-21	5.79	8.44	0.35	7.57	6	4.78
	% Change	17.21	13.59	-42.62	4.99	4.17	5.75

Source: Compiled from PFCI reports, 2018 and 2022

Two prime aspects influence the commercial performance of DISCOMs. These are a) billing of electricity sales and b) collection of receipts from the customers. Secondary data provided by PFCI gives DISCOM-wise statistics on trends in billing efficiency and collection efficiency.

Figure 5 reflects comparative trends in billing efficiency for Gujarat and Rajasthan DISCOMs. It may be observed that, among Gujarat DISCOMs, the worst performer in terms of billing efficiency has been the PGVCL which has recorded consistently a relatively low levels of billing efficiency over time. DGVCL has emerged as the best performer among Gujarat DISCOMs.

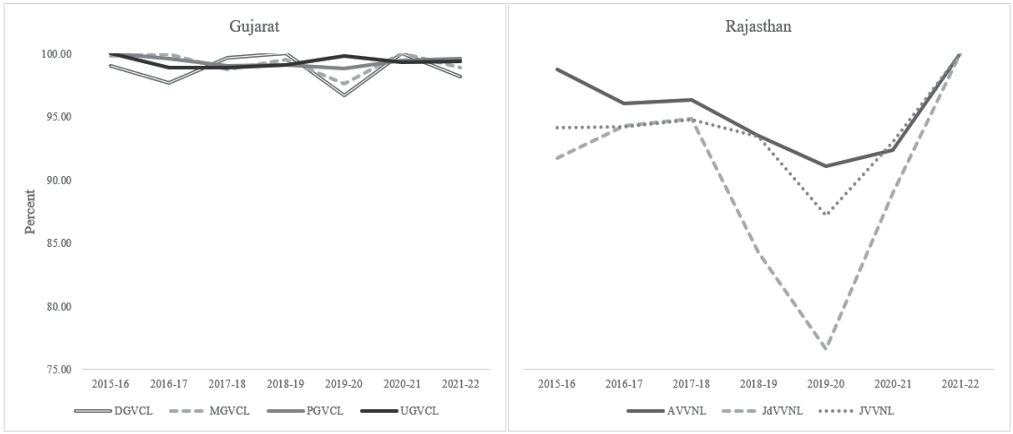
Figure 5: Trends in Billing Efficiency of DISCOMs in Gujarat and Rajasthan, 2015-22



Source: Compiled from PFCI Reports, 2018-2023

It may also be observed that Rajasthan DISCOMs have recorded relatively low levels of billing efficiency over time. Both AVVNL and JVVNL have recorded a consistent improvement in billing efficiency, whereas JdVVNL has recorded a static performance over time in this respect.

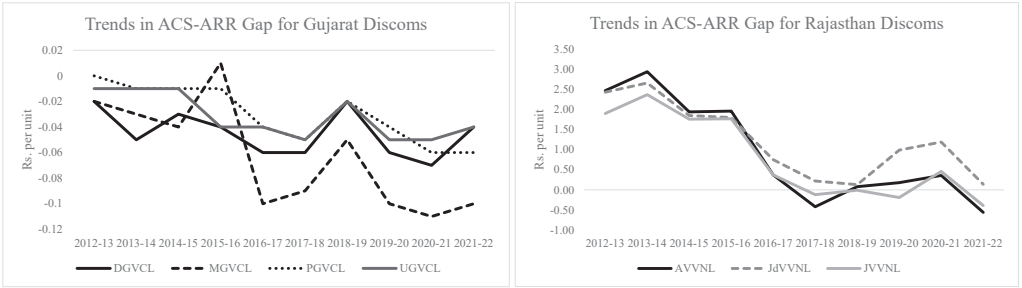
Figure 6: Trends in Collection Efficiency of DISCOMs in Gujarat and Rajasthan, 2015-22



Source: Compiled from PFCI Reports, 2018-2022

Figure 6 reflects recent trends in the collection efficiency of Gujarat and Rajasthan DISCOMs. It may be observed that in the case of Gujarat, all four DISCOMs have recorded more than 95 percent collection efficiency which is not the case with Rajasthan DISCOMs. In Rajasthan, JdVVNL has recorded consistent collection inefficiency. According to the tariff order no. RERC 1843/20, "due to shortfall in receipt of tariff subsidy from the GoR, the collection efficiency of the Discoms decreases drastically, in accordance with the MoP formula".[9] The ratio of subsidy received against subsidy booked for JdVVNL declined from 87.74 percent in 2017-18 to 67.79 percent in 2018-19 and then to 52.67 percent in 2019-20 (PFCI Reports, 2018-2022).

Figure 7: Trend in ACS-ARR Gap for Gujarat and Rajasthan, 2012-22



Source: Compiled from PFCI Reports, 2018-2022

[9] The formula given by the Ministry of Power to calculate collection efficiency uses Adjusted Revenue from Sale of Energy on Subsidy Received basis. The larger the of subsidies not received from Government of Rajasthan, the lower the collection efficiency.

Figure 7 shows a comparative trend in ACS-ARR gaps of DISCOMs in the two states. While Gujarat DISCOMs have been able to maintain a negative gap, i.e., surplus, Rajasthan DISCOMs shave shown consistent decline in the gap and were able to barely touch a negative gap in the year 2017-18 attributed to interventions under UDAY scheme. Further discussion on this is carried out in section 5.2.

5. Key Interventions Having Bearing on Commercial Viability

There has been a concerted effort over time at both the centre and the state level to enhance the commercial viability of the Indian DISCOMs. In addition, several interventions have been made even at the DISCOMs level which are then incorporated by other DISCOMs in the state. This section discusses the timeline of various interventions introduced by central, and state governments to improve the commercial viability of DISCOMs in the two states.

5.1 Major Interventions for Commercial Viability of DISCOMs

Major trends in recent years to enhance commercial viability of DISCOMs have focused on introducing Direct Benefit Transfer schemes for agricultural consumers to reduce electricity theft and increase legal connections, incentivising installation of solar power stations and solar power pumps and inducing innovations and research in power distribution infrastructure and vigilance framework. Table 4 presents a brief chronology of key interventions affecting the commercial viability of Gujarat and Rajasthan DISCOMs. Table 5 further brings out best practices adopted by other DISCOMs that can serve as lessons for Rajasthan and Gujarat.

Table 4: Chronology of Key Interventions Influencing Commercial Viability

Year	Intervention Level	State or DISCOM	Intervention	Key Focus
2005	State	Gujarat	Jyotigram Yojana (JGY)	With an investment of Rs. 1,170 crore, focused rural feeder segregation, or the separation of technical infrastructure by putting in place a parallel network of lines for round-the-clock three-phase electric supply to domestic users and scheduled three-phase electric supply to agricultural users to run pumps.
2006	DISCOM	JVVNL	Feeder Renovation Programme	(i) To reduce distribution losses on 11kV feeders to a level below 15 percent; (ii) To improve quality of power supply; and (iii) making available 24-hour domestic and non-domestic single-phase supply in rural areas to remove the disparity between urban and rural areas. The impact was that JVVNL reported a decline in electricity theft, the program was adopted by other DISCOMs in the state and T&D losses of Rajasthan were reduced by 10.13 percent during 2006-07 and 2007-08[10].
2015	Centre		UDAY	States will take over 75% of the DISCOM debt as on 30 September, 2015 - 50% in FY 2015-16 and 25% in FY 2016-17.
2017	State	Gujarat	Gujarat Power Research and Development Cell	The Cell has initiated research and development activities related to the energy efficiency of the power network and the use of IT to monitor theft and pilferage.

Contd...

[10] Forum of Regulators Report titled "Loss Reduction Strategies", 2008.

Table 4 contd...

Year	Intervention Level	State or DISCOM	Intervention	Key Focus
2019	Centre		PM KUSUM Scheme	To reduce power theft and generate additional income for farmers, a Procurement Based Incentive (PBI) to be given to DISCOMs for buying power from farmers/ developers; renewable energy-based power plants (REPP) of capacity of 500 kW to 2 MW will be set by agricultural consumers, 17.50 Lakh stand-alone solar agriculture pumps and Solarisation of 10 Lakh Grid Connected Agriculture Pumps is to incentivised.
2020	Centre	–	Atma Nirbhar Bharat	Rs. 90 crore Liquidity Injection for DISCOMs to pay their dues to GENCOs and TRANSCOs.
2021	State	Rajasthan	Mukhyamantri Kisan Mitra Urja Yojana (DBT)	Additional subsidy up to Rs. 1000/- per month (maximum Rs. 12000/- per month) to metered agriculture consumers consuming more than 2000 units per month and 15 HP of flat rate.
2021	Centre	–	RDSS	Aims to reduce Aggregate Technical & Commercial (AT&C) losses to pan-India levels of 12-15% and Average Cost of Supply (ACS)-Average Revenue Realised (ARR) gap to zero by 2024-25; Financial support for Prepaid Smart Metering & System Metering and Training & Capacity Building and other Enabling & Supporting Activities.
2022	Centre	–	LPS Rules (Late payment surcharge & related matters)	Clubbing of all outstanding dues, including Principal, Late Payment Surcharge etc. into a consolidated amount which can be paid in interest-free Equated Monthly Instalments (EMIs), penalties for not making payments, in line with the Re-determined Payment Schedule.
2023	State	Gujarat	Suryashakti Kisan Yojana	Farmers will generate electricity for their captive consumption using solar panels provided at subsidised rates and will sell the left-over generated electricity to the Government *via* Grid and earn the income.

Source: Based on Annual Reports of Rajasthan and Gujarat DISCOMs, Various Years

Table 5: Best Practices of Selected DISCOMs

State/DISCOM	Intervention	Key Focus
Maharashtra	Go Green scheme	Consumers are incentivised to opt for e-bill. Such consumers receive Rs. 10 discount per bill, additionally if bill is paid promptly upon receipt, a one percent discount is offered for timely payments (Garg and Shah, 2020).
Maharashtra/Delhi/ Uttar Pradesh/Himachal Pradesh, etc.	kVAh based billing	To encourage consumers to maintain an efficient 'near-unity power factor' in their consumption to reduce losses and improve system stability, power quality and voltage profile for HT and LT consumers with load of more than 20kw, kVAh based billing has been implemented.[11]

Contd...

[11] Maharashtra Electricity Regulatory Commission (MERC), Case No. 195 of 2017, KVAh Billing – MERC Directives/ Ruling, https://www.mahadiscom.in/wp-content/uploads/2020/01/002_ANNEXURE-7_POWER-POINT-PRESENTATION-ON-kVAh-BILLING.pdf

Table 5 contd...

State/DISCOM	Intervention	Key Focus
Haryana	Incentives for timely and digital bill payments	Villages where revenue realisation and digital payments are more than 90 per cent are honoured with a one-time sum of INR 2 lakh for development purpose; on paying six consecutive electricity bills using the digital mode, consumers get a one-time incentive of Rs. 50 (Sharma et al., 2023).
Haryana	Bijli Panchayat for rural areas	The DISCOM staff and district administration create awareness among rural consumers about the concerns related to electricity such as the resolution of billing disputes, meter related concerns, approval for new connections and load extension, etc. as an improved form of consumer grievance redressal (Sharma et al., 2023).

5.2 Impact of UDAY Scheme on DISCOMs

UDAY was formulated and launched by the government in 2015 to ensure financial and operational turnaround and revival of DISCOMs. It aimed at ensuring a sustainable permanent solution to the problems of high AT&C losses, huge accumulated losses and burgeoning outstanding debt of DISCOMs, high-interest pay-outs and large overdue to generation companies. For financial turnaround, states were mandated to take over 75 percent of the DISCOM debt as of Sept 30, 2015: 50 percent in FY 2015-16 and 25 percent in FY 2016-17. Additionally, targets to reduce ACS-ARR gaps were also decided under the Memorandum of Understanding (MoU) signed by the states. Table 6 shows the targets set for ACS-ARR gap and actual achieved by Rajasthan only, as Gujarat DISCOMs did not have any set targets to achieve financial turnaround and reduce ACS-ARR gap under its MoU. All the three Rajasthan DISCOMs were not able to achieve the targeted reduction in gap, however, the DISCOMs did report reduction in the gap over time.

Table 6: ACS-ARR Gap Targets under UDAY Scheme and Actual Achieved by Rajasthan DISCOMs, 2015-2018 (Rs. Per Unit of Input Energy)

Particulars	2015-16	2016-17	2017-18	2018-19
JVVNL				
Targeted ACS-ARR Gap	2.04	0.53	-0.11	-0.11
Actual ACS-ARR Gap	1.87	0.37	-0.12	0.03
AVVNL				
Targeted ACS-ARR Gap	2.35	0.39	-0.15	-0.15
Actual ACS-ARR Gap	1.97	0.37	-0.42	0.08
JdVVNL				
Targeted ACS-ARR Gap	1.98	0.32	-0.11	-0.11
Actual ACS-ARR Gap	1.80	0.75	0.22	0.15

Source: Compiled from UDAY portal and PFCI reports

Out of the participating states, Rajasthan DISCOMs have borrowed under UDAY scheme whereas Gujarat participated to improve operational performance of DISCOMs. Along with these, the scheme aimed at improving operational efficiency through compulsory smart metering, up-gradation of transformers and feeding meters, and adoption of energy efficiency measures like the promotion of efficient LED bulbs, agricultural pumps, fans and air-conditioners. The operational milestones were to be achieved in predetermined deadlines: compulsory feeder metering by June 2016, compulsory distribution transformer metering by June 2017, upgrading of transformers and

meters by December 2017, consumer indexing and GIS mapping of losses by September 2018, and smart metering of all consumers by December 2019.

Table 7(a): Targets under UDAY Scheme for Gujarat

Description	Target	Target Achieved	% of Target Achieved*
Feeder Metering (Urban)	3,911	5,096	130.30
Feeder Metering (Rural)	9,324	11,185	119.96
Feeder Segregation	6,560	7,057	107.58
Rural Feeder Audit	9,456	69,087	730.62
DT Metering (Urban)**	26,226	14,724	56.14
DT Metering (Rural)**	1,38,946	3,37,921	243.20
Smart Metering (500 KWh)	2,47,583	0	0

Note: * as of December 2017; ** DT stands for distribution transformer.
Source: UDAY Portal

Table 7(b): Targets under UDAY Scheme for Rajasthan

Description	Target	Target Achieved	% of Target Achieved*
Feeder Metering (Urban)	3953	4210	106.50
Feeder Metering (Rural)	19440	20733	106.65
Feeder Segregation	9581	2020	21.08
Rural Feeder Audit	19711	19756	100.23
DT Metering (U)**	66459	16815	25.30
DT Metering (R)**	-	-	-
Smart Metering above 500 KWh	21086	17517	83.07

Note: * as of December 2017; ** DT stands for distribution transformer.
Source: UDAY Portal

Tables 7(a) and 7(b) show the overall performance of two states under UDAY scheme. While Gujarat has overperformed in all the criteria of operational performance, the state lags in smart metering targets. Conversely, Rajasthan was able to achieve 83.07 percent of the target under smart metering by December 2017. Rajasthan DISCOMs also lagged in feeder segregation and DT metering targets set under the scheme.

Considering the financial turnaround target of UDAY for Rajasthan DISCOMs, the state government opted for the option of Bonds to be issued by DISCOMs for financing current and future losses. However, according to CAG report, despite four attempts, Rajasthan DISCOMs could not issue bonds against state guarantee and as a consequence the Government of Rajasthan did not arrange funds as committed in the MoUs signed under UDAY.[12] Thus, the DISCOMs could not manage to finance the projected losses amounting to approximately Rs. 8185 crore and also could

[12] https://cag.gov.in/uploads/download_audit_report/2024/Report-No.-1-of-the-year-2024-Performance-Audit-on-Implementation-of-Ujwal-DISCOM-Assuraance-Yojana-in-Rajasthan-for-the-year-ended-31-March-2021-066a0f2cf213657.27582322.pdf#page=21.09. Accessed on 25 September 2024.

not convince the state government to accept the claim of loss subsidy of five percent of the loss for the year 2017-18.

6. Pressing Gaps in Service Provision: Areas Yet to be Covered

As per Saubhagya Portal, 100 percent household electrification status has been achieved in both Gujarat and Rajasthan till 31st March, 2019. Nonetheless, there are challenges in the provision of electricity distribution. Annual reports of the DISCOMs reflect that a considerable proportion of electricity consumers belong to the BPL category and experience the problem of affordability. Though these households are provided connections under the Saubhagya scheme, there prevails issues related to payment of monthly recurring electricity charges if their consumption extends beyond a certain limit (Jain, 2018). Similarly, there is a high incidence of power theft and pilferage in both Gujarat and Rajasthan (Katiyar, 2005). To curb such a situation, the introduction of smart metering is devised. The smart metering strategies aim at enhancing energy accounting accuracy, identifying high-loss areas, and streamlining operations. These measures intend to bolster DISCOMs' financial viability and enhance the power sector.

Table 8 depicts the latest DISCOM-wise status of smart metering. It may be observed that pre-paid smart metering is fully completed in MGVCL and UGVCL. In the case of DGVCL and PGVCL, coverage is only around 40 percent. In none of the Rajasthan DISCOMs, pre-paid smart metering is initiated.

Table 8: DISCOM-wise Status of Smart Metering, 2024

		DGVCL	MGVCL	PGVCL	UGVCL	AVVNL	JdVVNL	JVVNL
Pre-Paid Smart Metering*	S	4.08	3.30	5.58	3.53	5.43	4.08	4.76
	A	1.69	3.30	2.26	3.53	0.00	0.00	0.00
	A (%)	41.40	100	40.43	100	0	0	0
Smart DT Metering*	S	82336	56129	109130	52892	155453	167809	111346
	A	82336	56129	109130	52892	0	0	0
	A (%)	100	100	100	100	0	0	0
Smart Feeder Metering*	S	-	-	-	5229	11007	10322	5799
	A	-	-	-	0	0	0	0
	A (%)	-	-	-	0	0	0	0

Notes: * in millions; S - Sanctioned; A - Awarded; A (%) - Percentage Awarded; DT stands for distribution transformer.
Source: RDSS Portal (https://rdss.powermin.gov.in/). Accessed in January 2024.

Similarly, Gujarat DISCOMs are far ahead than Rajasthan DISCOMS in installing Smart DT Metering. All the DISCOMs in Gujarat have installed fully Smart DT metering whereas it is entirely missing in the case of Rajasthan DISCOMs. Smart feeder metering is also envisaged by UGVCL, AVVNL, JdVVNL and JVVNL, but no concrete achievement is made so far. Other areas where Rajasthan can take examples from Gujarat are given below:

a) In the case of Gujarat, the government signed PPAs with power generating companies Essar Power Gujarat Limited (EPGL), Adani Power Mundra Limited and Tata Power Company

Limited in 2007 to purchase power generated by these companies. Over the years, the three GENCOs signed supplemental PPAs (SPPAs), amending several clauses of the original PPAs (Ghosh, 2024). PPAs lay down various aspects of purchasing power, including prices, as well as technical aspects like gross station heat rate or gross calorific value. Any change in conditions to the originally laid out terms can be modified through SPPAs.

b) Another advantage of Gujarat DISCOMs which led to an increment in their financial performance was that they completed their rural feeder load segregation scheme in 2006. Gujarat initially undertook virtual segregation and later switched to physical segregation to eliminate theft and frequent power outages. To address groundwater issues, Gujarat incorporated feeder segregation into its integrated rural development program. The major advantage of rural load segregation is that it brings transparency to agricultural consumption, resulting in accurate estimates of distribution losses (Khanna et al., 2014).

c) DISCOMs can significantly decrease their power procurement costs by encouraging the use of solar pumps for agriculture. The Suryashakti Kisan Yojana (SKY) scheme of Gujarat DISCOMs is beneficial in reducing the subsidy burden on the state government, reducing cross-subsidy burden, and ensuring daytime power to farmers.

d) Another area where Gujarat DISCOMs were able to turn around their performance was through managerial reforms. In Gujarat, the DISCOMs introduced a performance-incentive scheme, where utilities pay an additional 4 percent of wages to incentivise and encourage workers to outperform targets (The Greater India, 2020).

e) In Gujarat, thefts have been reduced by conducting frequent crackdowns, and by setting up special police stations and courts to deal exclusively with power theft (Regi et al., 2021).

7. Key Conclusions

This study has drawn a comparative account of the commercial performance of DISCOMs in Gujarat and Rajasthan. It has observed wide disparity among Gujarat and Rajasthan DISCOMs. These differences are conditioned by their geographical conditions and consumer mix. Differences in their performance-based ratings provide a vivid example of implicit diversity in their operational performance.

On commercial grounds, there exist significant differences among Gujarat and Rajasthan DISCOMs. Gujarat DISCOMs have remained profitable for most of the time period under consideration, whereas the opposite is the case for Rajasthan DISCOMs which continue to experience commercial losses.

Despite the introduction of power sector reforms, the provision of subsidy to ultimate consumers of electricity is found in the case of both Gujarat and Rajasthan. Nonetheless, there exist differences between the two in terms of the reimbursement of subsidies by the state government to the DISCOMs. In the case of Gujarat DISCOMs, it has been, most often, at par and on time, whereas in the case of Rajasthan DISCOMs, subsidy reimbursement by the state government has remained not only inadequate but there have also been significant delays in fund transfer.

The study has also provided a comparative account of various central, state and DISCOM-level interventions that are introduced over time in both Gujarat and Rajasthan to enhance commercial viability and improve commercial performance. Besides this, the study has also identified key pressing gaps in service provision. Foremost among these is the gap in the installation of pre-paid smart metering and smart DT metering which has remained largely absent in the case of Rajasthan

DISCOMs. Gujarat DISCOMs have been installing these pre-paid smart meters and smart DT meters. In fact, it is this difference in effective monitoring of the sale of electricity that defines the differences in the commercial performance of DISCOMs in Gujarat and Rajasthan. So, the study suggests that Rajasthan DISCOMs should derive lessons from Gujarat DISCOMs and install these pre-paid smart meters and smart DT meters to enhance their commercial efficiency. Study has also highlighted certain best practices from Maharashtra and Haryana DISCOMS which are of significance for both the states.

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APPENDIX

Table A1: Profitability Status of DISCOMs in Gujarat and Rajasthan

DISCOMs		2012 -13	2013 -14	2014 -15	2015 -16	2016 -17	2017 -18	2018 -19	2019 -20	2020 -21	2021 -22
Gujarat											
DGVCL	Profit	25	52	51	57	93	94	39	115	126	95
	Profit/unit	0.018	0.037	0.025	0.034	0.057	0.054	0.02	0.058	0.072	0.038
MGVCL	Profit	21	19	29	43	79	93	33	58	56	103
	Profit/unit	0.021	0.02	0.029	0.048	0.089	0.096	0.033	0.059	0.056	0.084
PGVCL	Profit	11	10	11	-17	37	137	75	83	189	97
	Profit/unit	0.004	0.004	0.004	-0.008	0.016	0.052	0.026	0.03	0.066	0.03
UGVCL	Profit	14	14	17	72	67	101	37	58	74	78
	Profit/unit	0.007	0.007	0.008	0.041	0.035	0.048	0.016	0.025	0.031	0.03
Rajasthan											
AVVNL	Profit	-3905	-4843	-3593	-3504	-337	1199	-187	-392	-840	1441
	Profit/unit	-2.465	-2.936	-1.94	-2.641	-0.243	0.768	-0.107	-0.221	-0.453	0.688
JdVVNL	Profit	-4285	-5299	-4146	-3274	-1029	30	-373	-2772	-3606	-457
	Profit/unit	-2.431	-2.661	-1.855	-1.96	-0.577	0.016	-0.184	-1.289	-1.621	-0.188
JVVNL	Profit	-4161	-5503	-4735	-4463	-616	943	37	613	-1548	1389
	Profit/unit	-1.902	-2.374	-1.762	-2.477	-0.314	0.415	0.015	0.239	-0.603	0.497

Note: Profit is in Rs. crore and Profit/Unit is in Rs./Unit.
Source: PFCI Reports, 2015-2022.

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FACETS OF GENDERED OCCUPATIONAL SEGREGATION IN THE URBAN LABOUR MARKET OF UTTAR PRADESH

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Abstract: Gender inequality is a universal phenomenon. Aspects of gender inequality exist everywhere and manifest themselves differently in each context. It is caused by multiplicity of factors. Despite marked progress in women's participation in economic activities, important challenges persist for women in obtaining productive jobs and better remuneration and in urban labour market. Occupational segregation is one important dimension of gender disparity and takes place when an occupation or a certain part of it tends to be dominated by individuals of a particular gender or other personal characteristic. It is pertinent to understand magnitude and nature of the existence of such practice for informed policy making because it could arise due to underlying preference of women for certain occupations or due to exclusion of women from certain occupations. Gender discrimination at the workplace could also be reflected in the nature of work distribution and valuation of the skills and the technology used by men and women. ILO notes that "[t]hroughout most regions and many occupations, women are paid less money than men for the same job. In majority of countries, women's wages represent between 70 and 90 percent of men's wages, with even lower ratios in some Asian and Latin American countries" (ILO, 2009). Often women are slotted into lower wage rate jobs and men are assigned higher wage rate jobs. In this connection, an attempt would be made in the present study to analyse the survey data for determining the prevailing gender discrimination in urban labour market. We would also examine the inequalities in terms of the occupations and earnings between male and female workers in urban sector.

Keywords: Urban labour market, Occupational segregation, Gini index, Entropy indices.

1. Introduction

Over the years, there has been a rise in the number of women pursuing higher education in India, which has contributed to a higher participation rate in the workforce. However, compared to men, they are less likely to secure employment in formal business settings. Presently, women are absorbed in occupations that once were male domain; however, their participation is lower in some professions, pointing towards occupational segregation. Additionally, gendered segregation has

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significant economic implications, as it determines the prevailing labour market inefficiency and rigidity (Sparreboom, 2014). Nonetheless, gender segregation has a bearing on the status of both women and men, workplace environment, individual experiences, and even earnings (Charles and Grusky, 2004; Burchell et al., 2014), and hence establishes along with recreating gender hierarchy in society (Kreimer, 2004).

In an extensive empirical study, Kundu (2003) pointed towards the existing discrimination by gender and category (racial) in the Indian labour market. Several studies by Kleiner (Kleiner, 1998; Phomphakdy and Kleiner, 1999; Kapur and Kleiner, 2000; Carton and Kleiner, 2001) and Shepherded (1995) show innumerable factors such as age, religion, race, gender, colour and disability to operate in tandem in workplaces. It is essential to recognise that segregation is not exclusively a negative phenomenon; for instance, there is a correlation between heightened segregation and improved employment opportunities for women. In many cases, segregation may serve as a safeguard for women's jobs. For instance, Burchell et al. (2014) observed that women's employment tends to be more secure due to their prevalent roles in public services.

Gendered occupational segregation is a significant rigidity that has pervaded the labour market and the economy, thus creating hindrances to its functioning and response to changes. This brings forth the situation where women get excluded not only from male-dominated occupations but also men get excluded from occupations that are female-dominated. Individuals of different genders are anticipated to engage in diverse professions, finding their places across various companies and sectors. Research indicates that males typically receive higher wages than females, are often tasked with more intricate assignments, and frequently oversee the tasks performed by females, as described by Reskin and Bielby in their 2005 study. They are absorbed into top positions of their organisation's job hierarchies. Anker and ILO (2001) highlighted how gender segregation affects the employment status of women, especially in developing nations, frequently resulting in their marginalisation from opportunities for paid work. Research conducted by England (2010) found that professions primarily filled by women tend to have lower average pay than those with more male representation (England, 2010).

Economic studies identify two primary theories to explain the prevailing wage disparities in the labour market. The initial theory suggests 'compensating differentials', while the other theory revolves around the 'crowding effect' (England et al., 2007). It is often argued that positions offering greater comfort, reduced stress, and more pleasant working conditions tend to offer lower salaries. Men tend to maximise their income by choosing jobs with fewer amenities. However, studies point out that the 'compensating differentials' do not completely explain existing gender pay gaps in the labour market (England et al., 2007). On the other hand, the famous crowding hypothesis stresses that jobs in which women dominate offer lesser pay as they are 'crowded' or are in excess supply, which dampens the wages amongst female-dominated occupations (Bergmann, 1974).

Sociologists provide perspectives that differ from those of economists. They introduce ideas such as devaluation and queuing to explain why women in female-dominated fields often earn less than men in similar roles. The devaluation concept emphasises how patriarchal gender biases play a role, with jobs typically performed by women seen as less valuable and thus deserving lower wages. This notion aligns with the 'comparable worth' theory, which posits that women's lower earnings are linked to their prevalence in sectors dominated by female workers. Moreover, the 'devaluation hypothesis' examines the impact of societal values and institutional norms on wage structures based on the assumption that society values men more highly and assigns women primarily to domestic

roles. In contrast, the 'queuing perspective' describes labour markets as composed of labour queues where employers rank workers and workers sort themselves into job queues. This hypothesis posits that individuals of both genders aim for jobs with better remuneration. However, a singular 'career ladder' is believed to exist predominantly for males, resulting in employers' tendency to favour men for various roles. Consequently, while employers might prefer to hire men for high-paying roles, they often hire women for lower-paying positions due to men's reluctance to accept lower-wage jobs and pursue better opportunities elsewhere.

In most of the Indian states, gender-based occupational segregation is an outcome of deep-rooted social norms, economic inequality, and inadequate policy interventions. Women are workig in different professional jobs in the states that have higher literacy and relatively high income (or, are relatively highly industrialised), such as Kerala, Maharashtra and Karnataka; on the contrary, states like Bihar and Uttar Pradesh (UP) still restrict female workforce participation due to socio-cultural constraints. According to a study conducted by the International Labour Organization (ILO, 2013), female participation in the labour force in Uttar Pradesh (UP) is already very low at 33.6%, with the majority of women engaged in low productivity agricultural activities that offer low incomes. Within the labour market, there is a clear-cut contrast in participation rates between genders, with female participation of 27.3% compared to male involvement of 79.2% among those aged 15-59 years during the 2021-22 period (Periodic Labour Force Survey, i.e., PLFS, 2021-2022).

Though rural UP has achieved some closing of the gender wage gap that has prevailed for a long time, but the gap between males and females is on the rise in urban UP. According to PLFS 2020-2021 in urban UP, 20 per cent women are engaged in skilled agriculture and fishery work as compared to the national figure of 6.7 percent, followed by 15.5 percent women in craft and related trade work which is equivalent to the national figure while less than 10 percent women are working as clerks, plant and machine operators and technicians.1 This further underlines high gender segregation in occupational distribution in the state. It is a clear reflection of nation-wide patterns. Women face numerous challenges that span both economic and social spheres *(The Hindu*, 2024). The prevailing social customs assign the role of primary earners to men, while women are typically relegated to the roles of homemakers and caregivers. In this context, females are relegated to roles with lower salaries because opportunities for better-paying jobs are scarce, a situation attributed to patriarchal structures and biases from employers (England et al., 2007; Levanon et al., 2009).

This division significantly restricts women's empowerment, access, and prospects within the workforce. In UP, the majority of women work in low-paying occupations such as agriculture, household work, textiles, and teaching, whereas occupation related to construction, transport, technology and engineering are largely dominated by their male counterparts. Addressing gendered occupational segregation in the state requires systematic study to understand the type and extent of occupational segregation between male and females. Within this context, the present paper explores various aspects of gender-based occupational segregation in the urban workforce of Uttar Pradesh, employing data from the PLFS for the years 2017-18 and 2020-21.

This paper is structured into five main parts, starting with an introduction. The subsequent part details the study's data sources and methodology, while the third part examines the various facets of gender segregation. The fourth part focuses on the findings and discussions. Finally, the concluding section presents the study's conclusions and suggests future directions.

[1] https://iwwage.org/wp-content/uploads/2023/04/UP_Factsheet.pdf

2. Data Source and Methodology

For this research, data provided in the first and recent round of the PLFS survey (2017-18 and 2020-21) conducted by the NSSO has been used along with the 'one' digit code of the national industrial classification (NIC) of occupation 2004, to bring forth the existence of gender (male-female) dimensions in the choice of occupation across the age groups, social groups, income groups, education level, marital status, etc. of an employee. In this paper, two types of segregation measures viz., local segregation and overall segregation has been used. Local segregation refers to determining the segregation of a particular demographic group (gender, age, caste, etc.) and comparing its distribution to the total employment distribution. By doing so, the measure of local segregation permits an exhaustive analysis of segregation in the labour market by determining the extent to which each subgroup contributes to overall segregation. To measure the local segregation Gini Index, Generalised Entropy Indices and Dissimilarity Index have been used in the analysis. On the other hand, overall segregation provides a single measure that quantifies segregation at a broader level without distinguishing the contributions of individual subgroups. For the computation of overall segregation, Mutual Information Index, Gini Index and Multi-group Dissimilarity Index are used. These two measures differ in their approach and in the interpretation of their outcomes. The Gini Index measures the extent of inequality in the distribution of demographic groups (e.g., men vs. women, ethnic groups, etc.) across occupations. A value of 1 represents maximum inequality, while a value of 0 signifies perfect equality. In other words, the index value = 1, indicating the complete segregation, which means that all females might be concentrated in just one or two occupations (e.g., teachers and nurses). Alternatively, males dominate all other occupations, with females absent entirely. Contrary to this, 'index value = 0' means complete equality (i.e., both genders are proportionally distributed across all occupations) or no segregation.

The segregation curve (basic idea is grounded in the principles of a Lorenz Curve) represents the cumulative distribution of a groups (males and females) across selected occupations. The segregation curve compares the cumulative proportion of one group (horizontal) to the cumulative proportion of another group (vertical). Each point on the curve indicates an occupational level determined by the rising ratio of one group to the other within that occupation. These curves depict the general level of segregation between the two groups across the occupational spectrum. Del Río and Alonso-Villar (2010) developed the local segregation curve to analyse segregation across many demographic groups. This enhanced approach reveals how specific groupings are spread throughout various occupational levels in a heterogeneous community. The line of equality (45-degree line) of the Lorenz Curve indicates the level of segregation. If the segregation (Lorenz) curve is close to the line of equality, the distribution is nearly equal across occupations. The highly bowed or convex segregation curve for females indicates significant segregation. A parallel Lorenz curve to the line of equality means that one group (e.g., males) is overrepresented in a few occupations, whereas a bowed or convex curve for the other group (females) suggests unequal and underrepresentation of females in many occupations.

2.1 Measures of Local Segregation

Gini Index

$$G^g(c^g;t) = \frac{\sum_{i,j} \frac{t_i}{T} \frac{t_j}{T} \left| c_i^g - c_j^g \right|}{2 \frac{C^g}{T}}$$

Here, G^g is used to study local segregation, which is a variant of the conventional Gini index and T = population share. This measure represents an adaptation of the Gini index, intended to assess the level of agreement between predetermined (a priori) and actual (a posteriori) employment distributions across different occupations. In other words, it measures the divergence between expected and actual occupational placements within a target population. A Gini index value of 0 signifies perfect conformity, indicating that the "a posteriori" distribution of individuals across occupations precisely matches the "a priori" distribution. This represents a scenario of no occupational segregation. Conversely, a Gini index 1 implies absolute non-conformity, where the observed occupational distribution completely deviates from the expected distribution. This suggests extreme occupational segregation.

Generalised Entropy Indices

$$GE_a^g(c^g;t) = \begin{cases} \dfrac{1}{a(a-1)} \displaystyle\sum_j \frac{t_j}{T}\left[\frac{\frac{c_j^g}{c^g}}{\frac{t_j}{T}} - 1\right], \text{ and\&if } a \neq 0,1 \\ \displaystyle\sum_j \frac{c_j^g}{C^g} \ln\left(\frac{\frac{c_j^g}{c^g}}{\frac{t_j}{T}}\right), \text{ and} \quad \text{if } a = 1 \end{cases}$$

where the segregation aversion parameter is denoted by a.

Dissimilarity Index (Multi-Group)

$$D^g(c^g;t) = \left(\frac{1}{2}\right) \sum_j \left| \frac{c_j^g}{C^g} - \frac{t_j}{T} \right|$$

The multi-groups index Dg is a variant of the dissimilarity index proposed by Moir and Smith (1979).

2.2 Measures of Overall Segregation

Mutual Information Index

$$M = \sum_g \frac{C^g}{T} \log\left(\frac{T}{C^g}\right) - \sum_j \frac{t_j}{T}\left[\sum_g \frac{c_j^g}{t_j} \log\left(\frac{t_j}{c_j^g}\right)\right]$$

This index can be written as:

$$M = \sum_g \frac{C^g}{T} M^g$$

The formula for M can be expressed as $M^g = \sum_j \frac{c_j^g}{C^g} \log[\frac{c_j^g/C^g}{t_j/T}]$.

When opting for the natural logarithm instead of the base-two logarithm, M is represented as the weighted mean of the local segregation indices. the equation is $M = \sum_g (C^g)/(T) GE_1^g$.

Gini Index

Alonso-Villar and Del Río (2010) proposed that the Gini index integrates the traditional Gini index and the unbounded multigroup Gini index, as Reardon and Firebaugh (2002) suggested. This integration is accomplished through the computation of a weighted average, in which the weights signify the importance of each index in evaluating the particular form of segregation being analysed:

$$G=\sum_{g}\frac{C^{g}}{T}G^{g}$$

Multi-group Dissimilarity Index

$$I_{p}=\sum_{g}\frac{C^{g}}{T}D^{g}$$

3. Different Dimensions of Occupational Segregation

3.1. Gendered Occupational Segregation

The proportion of women in various occupational categories showed substantial variation, leading to a gendered division of labour and emphasising the reality that women tend to be disproportionately represented in the lower echelons of the job hierarchy, where they hold low-wage and unskilled positions like domestic helpers, street cleaners, street vendors, and garbage collectors, as well as provide services such as personal care, housekeeping, sales, and office-and- customer-service-clerks. Women (11.04% in 2020-21) are under-represented in high-skilled and highly-paid jobs but overrepresented in professional (17.55% as against 7.39% males) and associate professional jobs (10.96% females against 5.87% males). It is evident that in UP, more men (18.34%) than women (i.e., 11.04%) work as Legislators, senior officials, and in managerial occupations (Table 1). This category covers occupations such as managers, senior lawyers, doctors, scientists, and officers in various government departments that mostly require graduate/postgraduate degrees. Gupta et al.'s (1998) empirical study, involving 162 managers of both sexes, found that even at the senior level, female managers continue to be treated as "women", reflecting the fact that men perceive women as less committed and capable of doing their jobs. However, the number of employed women and men in such occupations has increased from the levels of 2017-18 when only 8.22% of women and 16.31% of men were engaged in professional or managerial jobs. In the urban labour market, more women than men worked in professional and associate professional occupations (17.55% and 10.96% of women compared with 7.39% and 5.87% of men in 2020-21). More women are employed as professionals in teaching, the life sciences, and the associated health areas. On the other hand, very few women are engaged in management, business, and financial occupations (13.7% female compared to 15.4% male).

Table 1: Occupational Segregation by Sex (2017-18 & 2020-21)

Occupational Category (NIC One Digit)	2017-18	2020-21	2017-18	2020-21
	Males		Females	
Legislators, Senior Officials, and Managers	16.31	18.34	8.22	11.04
Professionals	6.62	7.39	13.91	17.55
Associate Professionals	6.29	5.87	21.75	10.96
Clerks	3.32	3.25	2.94	2.25

Contd...

Table 1 contd...

Occupational Category (NIC One Digit)	2017-18	2020-21	2017-18	2020-21
	Males		Females	
Service Workers and Shop & Market Sales Workers	18.53	16.69	13.42	14.12
Skilled Agricultural and Fishery Workers	4.11	4.91	7.37	12.64
Craft and Related Trades Workers	19.96	15.57	16.11	15.75
Plant and Machine Operators and Assemblers	8.62	7.35	2.1	1.48
Elementary Occupations (labourers)	16.26	20.63	14.19	14.21
Total	100	100	100	100

Source: Computed from PLFS, 2017-18 and 2020-21

However, more women are working in service-related occupations (Table 1), which include personal care, home health, nursing assistants, cooks, and food service staff-related occupations (13.42% in 2017-18 and 14.12% women in 2021). Our analysis reveals that most women employed work in professional and associate professional occupations, followed by service/sales workers, and craft and trade workers in 2017-18 and 2020-21.

In urban areas of Uttar Pradesh, the occupational distribution of men and women reveals a strong presence of male workers in areas such as driving, mobile plant operation, and general management, among others, where female involvement is minimal. Within the urban workforce, the presence of women in roles such as machine operation and assembly, trade-related positions, and manual labour in sectors like mining, construction, and manufacturing is below 3% and 8%, respectively, as indicated in Table 2.

Table 2: Distribution of Males and Females in Each Occupation in Urban Uttar Pradesh

Usual Occupation (NIC Two Digit)	Male (2017-18)	Female (2017-18)	Male (2020-21)	Female (2020-21)
Agricultural, Fishery and Related Labour	58.91	41.09	59.34	40.66
Corporate Managers	92.97	7.03	91.20	8.80
Customer Services Clerks	92.79	7.21	86.24	13.76
Drivers and Mobile Plant Operators	100.00	0.00	99.65	0.35
Extraction and Building Trades Workers	97.47	2.53	95.21	4.79
General Managers	100.00	0.00	89.75	10.25
Labourers in Mining, Construction, Manufacturing	91.28	8.72	96.92	3.08
Legislators & Senior Officials	94.34	5.66	100.00	0.00
Life Science and Health Associate Professional	57.45	42.55	73.64	26.36
Life Science and Health Professionals	59.19	40.81	77.75	22.25
Machine Operators and Assemblers	91.94	8.06	88.48	11.52
Market Oriented Skilled Agricultural and	81.69	18.31	62.31	37.69
Metal, Machinery, and Related Trades Work	95.92	4.08	99.63	0.37
Models, Sales Persons, and Demonstrators	95.04	4.96	94.63	5.37
Office Clerks	89.48	10.52	91.60	8.40
Other Associate Professionals	87.39	12.61	94.92	5.08
Other Craft and Related Trades Workers	83.33	16.67	75.52	24.48
Other Professionals	87.77	12.23	88.91	11.09

Contd...

Table 2 contd...

Usual Occupation (NIC Two Digit)	Male (2017-18)	Female (2017-18)	Male (2020-21)	Female (2020-21)
Personal and Protective Service Workers	80.81	19.19	73.35	26.65
Physical and Engineering Science Associates	97.25	2.75	96.88	3.12
Physical, Mathematical, and Engineering S	92.44	7.56	87.69	12.31
Precision, Handicraft, Printing, and Rela	74.78	25.22	93.46	6.54
Sales and Service Elementary Occupations	88.60	11.40	81.34	18.66
Stationary-Plant and Related Operators	91.09	8.91	97.34	2.66
Subsistence Agricultural and Fishery Work	55.58	44.42	47.17	52.83
Teaching Associate Professionals	43.59	56.41	56.20	43.80
Teaching Professionals	63.05	36.95	54.11	45.89
Total	87.66	12.34	86.29	13.71

Source: Computed from PLFS 2017-18 and PLFS 2020-21data

Figure 1: Gendered Occupational Segregation Curve, 2017-18 and 2020-21

Figure 1A

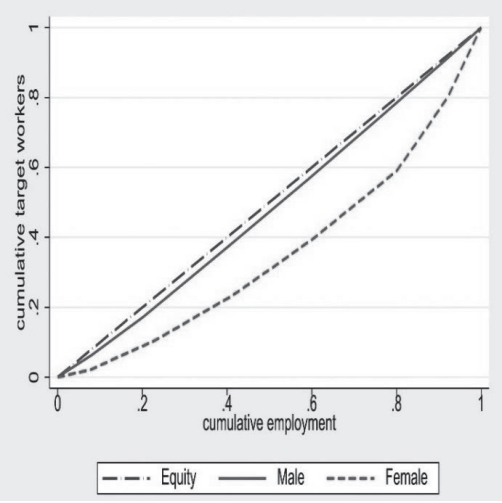


Figure 1B

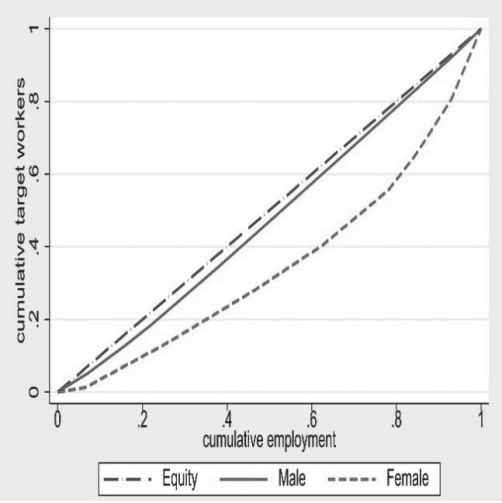


Figure 1 presents an illustration of neighbourhood-level segregation by employing local metrics and segregation curves. The diagrams in Figures 1A and 1B showcase the segregation patterns for both male and female populations within the 15-59 age brackets in the urban employment sector of Uttar Pradesh. These illustrations depict the overall percentage of employment on the horizontal axis against the cumulative percentage of people, distinguishing between men and women, on the vertical axis.

Segregation curves depict the representation of a specific group's percentage across each cumulative decile of the total workforce. Taking the male population as an instance, the initial decile on their segregation curve accounts for 10% of the overall employment, encompassing occupations where male presence is comparatively rare. Throughout the years analysed, the curve for male employees consistently surpasses that of their female counterparts, signifying a closer alignment with the line of parity. This pattern demonstrates a higher degree of occupational segregation among

women than men. Any segregation index aligned with the curves above would confirm that women face greater occupational segregation. Furthermore, the data implies a more limited participation of women in the workforce, particularly noticeable in urban areas, as their curve significantly deviates from the baseline at various points of cumulative employment percentages.

Table 3 showcases the indicators for the overall division of genders within the workforce, encompassing the multi-group dissimilarity index (Ip), the mutual information index (MI), and the multi-group Gini coefficient (G). The table further breaks down the roles of both male and female employees in contributing to this division in the urban regions of Uttar Pradesh. The figures suggest a more noticeable division of occupations in the urban employment sectors. According to the MI index, the division is particularly more substantial among female employees, responsible for 86% and 83% of the overall gender division for the fiscal years 2017-18 and 2020-21, respectively. Conversely, the division seen in male employees is comparatively lower, with them contributing 14% and 17% for the corresponding time frames.

Table 3: Overall segregation: Gender

	Ip	MI	Gini
Overall Segregation: Gender	0.05	0.02	0.07
Female (2017-18)	0.50	0.86	0.50
Male (2017-18)	0.50	0.14	0.50
Overall Segregation: Gender	0.06	0.03	0.08
Female (2020-21)	0.50	0.83	0.50
Male (2020-21)	0.50	0.17	0.50

Source: Computed from PLFS data, 2017-18 and 2020-21

Table 4 showcases a variety of local segregation metrics (Dg, Gg and GEa g with a = 0.1, 0.5, 1, and 2), demonstrating that segregation indices are more pronounced for women than men. In terms of the distribution of occupations, it is observed that male employees tend to have a more balanced distribution across different fields compared to their female counterparts, who experience higher levels of segregation. The broader occupational engagement of men reduces discrimination within the job market. The concept of "devaluation perspective" is particularly pertinent in understanding the greater occupational segregation faced by women compared to men. This situation is shaped by the undervaluing of women and the challenges that stem from this issue. England discusses the "devaluation" of female labour, describing it as "the undervaluing of care-related occupations such as childcare, teaching, and the provision of healthcare services" (England et al., 2007).

Occupations predominantly held by women, including childcare, health care, and education roles, typically offer lower wages than jobs that demand similar levels of skill, risk, and effort. England's 2010 study on the American workforce sheds light on "the reasons behind the uneven progress within the gender system, its disproportionate impact on certain groups, and its varied effects across different life aspects". She points out that cultural stigmas and the systemic undervaluation of women's contributions and activities deter men from pursuing lower-paid, traditionally female roles (such as homemaking) in favour of other jobs commonly held by women. Conversely, women are often driven by economic needs to seek employment in fields traditionally dominated by men. This dynamic has led to a more significant shift in the circumstances of women compared to men, with the changes being more pronounced among different socioeconomic classes. Women with the potential to earn higher incomes are significantly more inclined to work for financial reasons.

Table 4: Indices of Local Segregation

Indices	Female (2017-18)	Male (2017-18)	Female (2020-21)	Male (2020-21)
Employment Share	0.1234	0.8766	0.1371	0.8629
D^g	0.2106	0.0297	0.2255	0.0358
$GE^g(.10)$	0.1473	0.0037	0.164	0.0055
GE^g (.50)	0.1464	0.0036	0.1612	0.0054
GE^g (1)	0.1496	0.0035	0.1647	0.0052
GE^g (2)	0.1709	0.0034	0.1931	0.0049
G^g	0.2929	0.0412	0.2981	0.0474

Source: Computed from PLFS data, 2017-18 and 2020-21

3.2. Gender Occupational Segregation by Age

This section addresses gender segregation in the workplace across age groups. Individuals are classified into ages 15-30, 31-45, and 46-59. Overall, segregation in these age groups is minimal, with boys and girls nearly equally represented. The younger age group (15-30) contributes most to gender segregation (Table 5). It is worth noting that the middle age group of employees, i.e., 31-45 years old, leads both the male and female workforce, with this age group accounting for the most significant percentage share of the workforce (47% females and 41% males in 2017-18 and 44% females and 39% males in 2020-21 in table 6). Furthermore, middle-aged workers exhibit the lowest segregation for both males and females. In a nutshell, the age distribution of female workers was not significantly different from male workers.

According to reports, Uttar Pradesh is one of the top states in the proportion of young people in the total population, demonstrating the state's demographic dividend. Changes in educational levels (positive) cause changes in the occupational structure of the labour force, so examining occupational variations by gender, education, and age is a very relevant exercise to pursue.

Figures 2A, 2B, 3A and 3B display the local segregation curves by gender and age groups in various occupational categories for te year 2017-18 and 2020-21. The labour force participation rate of male and female workers is categorised into three age groups viz., 15-30 years (young), 31-45 years (middle-aged), and over 46-59 years (elderly). The curves for female workers across all age groups are notably different from zero compared to male workers. Among elderly female workers, the highest level of segregation is observed, while middle-aged female workers exhibit the lowest segregation for different age groups. Similarly, the segregation curve shows middle-aged male workers' occupational segregation to be the lowest in the labour market.

Table 6 shows the local segregation indexes that support these findings. Individuals aged 31-45, also known as the middle-aged group, comprise most of the labour force (47% females and 41% men in 2017-18, 44% females and 39% males in 2020-21). These professionals make up a sizable proportion compared to the younger age group. Analysis shows that elderly female workers are more segregated than middle-aged and young female workers. The findings demonstrate that segregation is higher among elderly (46-59) workers, showing that female workers are much more segregated than male workers. Younger and middle-aged male workers, on the other hand, experience less segregation than older male workers (Table 6).

However, occupational segregation increased in 2020-21 for the younger labour force, particularly among females. This finding aligns with Khan et al.'s (2023) study of Pakistan, which shows a significant degree of occupational segregation for female and male workers. Young and

middle-aged female workers confronted higher segregation in the labour market during the 2017-18 and 2020-21 PLFS surveys.

Table 5: Occupation Gender Segregation by Age Groups

	Ip	M	Gini
Female (2017-18)	0.11	0.05	0.15
15-30 year	0.40	0.38	0.41
31-45 year	0.19	0.10	0.18
46-59 year	0.41	0.52	0.41
Male (2017-18)	0.08	0.02	0.09
15-30 year	0.48	0.42	0.45
31-45 year	0.18	0.07	0.19
46-59 year	0.34	0.51	0.36
Female (2020-21)	0.15	0.08	0.20
15-30 year	0.45	0.50	0.45
31-45 year	0.25	0.18	0.26
46-59 year	0.30	0.32	0.29
Male (2020-21)	0.08	0.02	0.10
15-30 year	0.47	0.49	0.46
31-45 year	0.21	0.15	0.24
46-59 year	0.32	0.36	0.30

Source: Computed from PLFS data, 2017-18 and 2020-21

Table 6: Local Segregation by Age Groups

Contribution to Overall Segregation	Population Share	D^g	GE^g (0.10)	GE^g (0.50)	GE^g(1)	GE^g(2)	G^g
Female (2017-18)							
15-30 year	0.31	0.15	0.07	0.07	0.07	0.07	0.20
31-45 year	0.47	0.05	0.02	0.01	0.01	0.01	0.06
46-59 year	0.23	0.20	0.14	0.13	0.12	0.12	0.27
Male (2017-18)							
15-30 year	0.39	0.09	0.02	0.02	0.02	0.02	0.10
31-45 year	0.41	0.03	0.00	0.00	0.00	0.00	0.04
46-59 year	0.20	0.13	0.05	0.05	0.05	0.05	0.17
Female (2020-21)							
15-30 year	0.33	0.21	0.12	0.12	0.12	0.14	0.27
31-45 year	0.44	0.09	0.05	0.04	0.03	0.03	0.11
46-59 year	0.23	0.20	0.13	0.12	0.11	0.10	0.25
Male (2020-21)							
15-30 year	0.39	0.10	0.02	0.02	0.02	0.02	0.12
31-45 year	0.39	0.04	0.01	0.01	0.01	0.01	0.06
46-59 year	0.22	0.12	0.03	0.03	0.03	0.03	0.14

Source: Computed from PLFS data, 2017-18 and 2020-21

Figure 2A: Male 2017

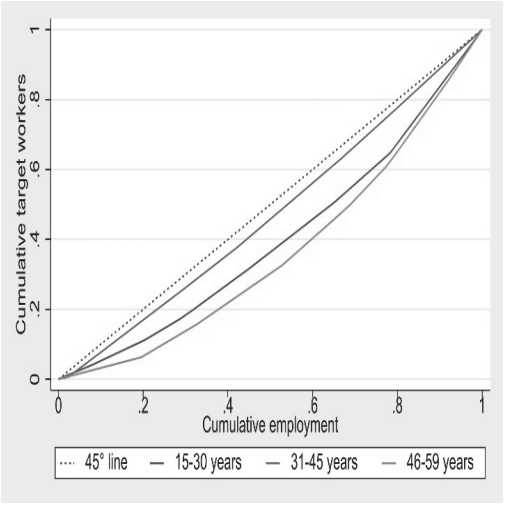


Figure 2B: Female 2017

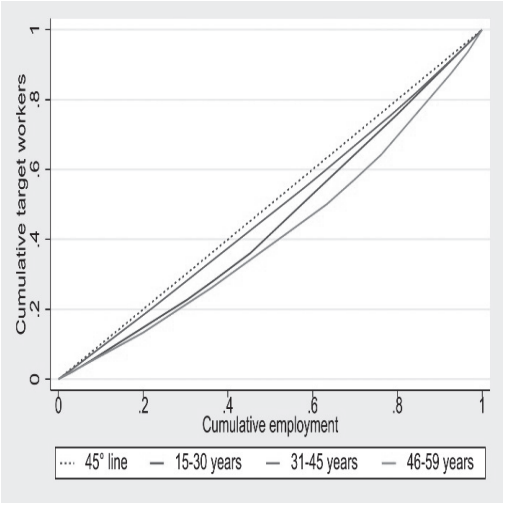


Figure 3A: Male 2020

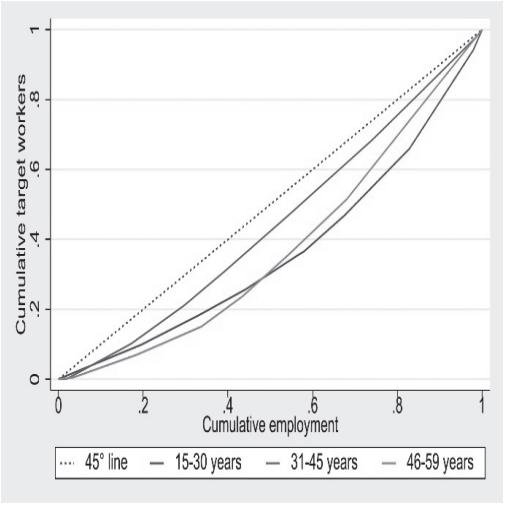
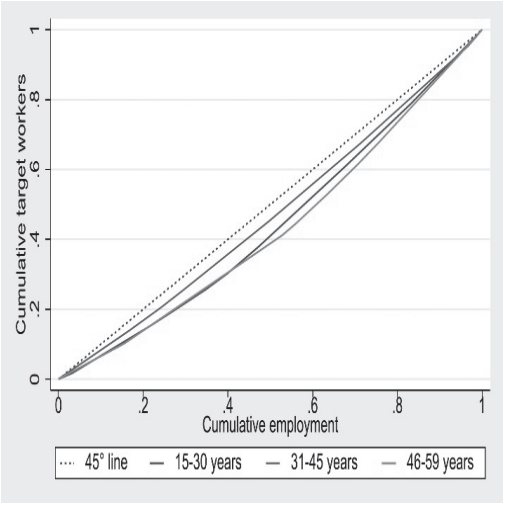


Figure 3B: Female 2020



3.3. Gendered Occupational Segregation by Caste

In India, castes are linked to specific jobs and regulate many individuals' work. The social status of workers influences their job preferences, impacting the overall economy. The Indian caste system intertwines work and identity, with each caste typically tied to a specific traditional occupation considered as their 'dharma'. A social caste hierarchy leads to discrimination, particularly in education and employment, directly impacting the Indian economy. The caste distribution of the workers has been analysed in Table 7 and Table 8, which shows the dominance of OBCs (about 47% and 42% in 2017-18 and 2020-21). It is observed that SCs contribute most to overall segregation in different occupations. The observed higher incidence of segregation amongst the

SC/ST households is due to their higher proportion (8.81% for females and 7.10% for males) being amongst labourers (elementary occupation).

In the services category, except for sales and other services occupations, the general caste category predominates by having a higher share. In 2020-21, the proportion of scheduled caste women workers was relatively high in sales and other services (5.59%). This can be ascribed to the condition that these services comprise several jobs (domestic services, sweeping, etc), which people from the scheduled categories have traditionally done. In the case of 2017-18, a similar picture emerges, the only difference being that OBC women workers were also a part of these services (Table 8). The local segregation curves categorized by gender and caste groups across different occupational categories for the years 2017-18 and 2020-21 are shown in Figures 4A, 4B, 5A and 5B.

Figure 4A: Male 2017

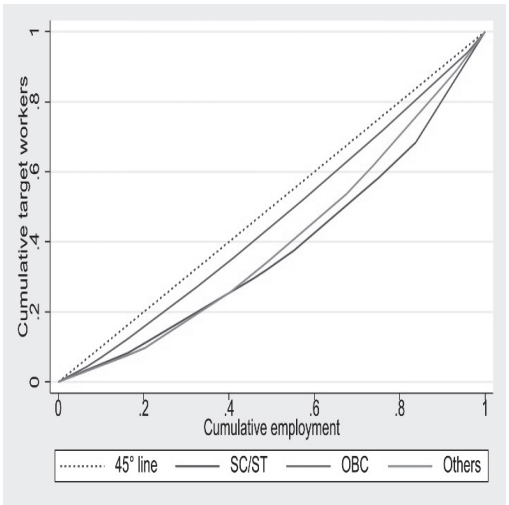


Figure 4B: Female 2017

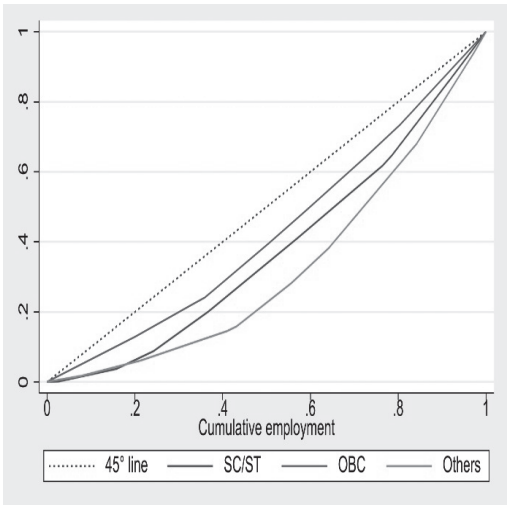


Figure 5A: Male 2020

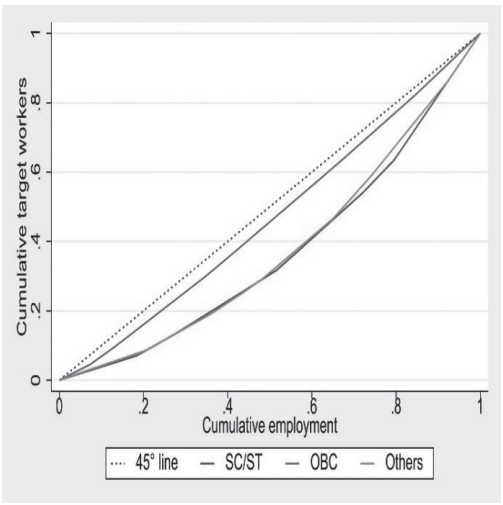
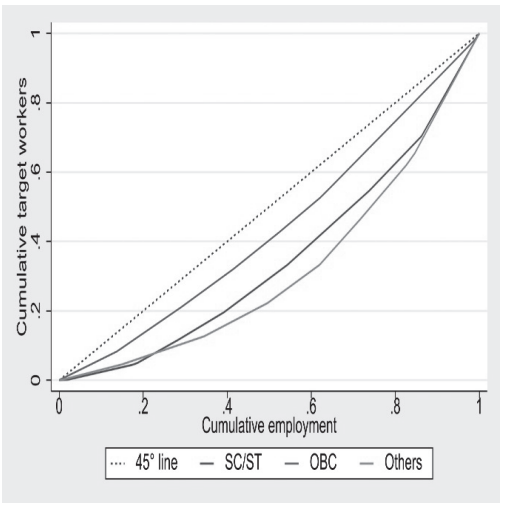


Figure 5B: Female 2020



The existing caste structure impacts the social and gender divisions of labour (Deshpande, 2011: 107). Even when men are considered, the hierarchy remains, with upper castes controlling all the jobs except sales and other services, which are deemed low-paid jobs.

Table 7: Occupation Segregation by Caste Groups

Occupation Segregation by Sex and Caste Groups	Ip	M	Gini
Contribution to Overall Segregation: Caste Groups			
Female (2017-18)	0.18	0.11	0.23
SC/ST	0.23	0.27	0.26
OBC	0.29	0.15	0.28
Others	0.48	0.59	0.47
Male (2017-18)	0.11	0.05	0.15
SC/ST	0.29	0.38	0.28
OBC	0.26	0.13	0.27
Others	0.46	0.49	0.45
Contribution to Overall Segregation: Caste Groups			
Female (2020-21)	0.18	0.11	0.23
SC/ST	0.36	0.43	0.38
OBC	0.26	0.12	0.25
Others	0.38	0.45	0.36
Male (2020-21)	0.12	0.06	0.16
SC/ST	0.33	0.39	0.33
OBC	0.20	0.08	0.21
Others	0.47	0.52	0.47

Source: Computed from PLFS data, 2017-18 and 2020-21

Table 8: Local Segregation Indices by Caste Groups

Local Segregation by Sex and Caste Groups	Population Share	D^g	$GE^g(0.10)$	$GE^g(0.50)$	$GE^g(1)$	$GE^g(2)$	G^g
Female (2017-18)							
SC/ST	0.25	0.17	0.16	0.13	0.12	0.10	0.24
OBC	0.45	0.12	0.04	0.04	0.04	0.03	0.15
Others	0.31	0.27	0.24	0.22	0.20	0.20	0.35
Male (2017-18)							
SC/ST	0.18	0.18	0.09	0.09	0.10	0.11	0.24
OBC	0.49	0.06	0.01	0.01	0.01	0.01	0.08
Others	0.33	0.15	0.07	0.07	0.07	0.06	0.20
Female (2020-21)							
SC/ST	0.30	0.21	0.18	0.17	0.16	0.16	0.30
OBC	0.47	0.10	0.03	0.03	0.03	0.03	0.13
Others	0.23	0.29	0.23	0.22	0.21	0.22	0.36
Male (2020-21)							
SC/ST	0.20	0.20	0.12	0.12	0.11	0.11	0.26
OBC	0.50	0.05	0.01	0.01	0.01	0.01	0.07
Others	0.30	0.19	0.11	0.10	0.10	0.10	0.25

Source: Computed from PLFS data, 2017-18 and 2020-21

4. Occupational Gender Segregation by Education

Education is directly related to the nature of jobs attained by male-female workers. Table 6 portrays gender segregation in education among the women and men workers in different occupations. In urban UP, about 29.85% of women workers in 2017-18 were found to be illiterate, while the share of illiterate men was only 17.03%. In 2020-21, the share of illiterate women increased to 31.97%, while only a slight change could be perceived in the case of men (16.77%). In both periods, illiterate women's share was higher than men's. This indicates that the educational level of women workers tended to be below that of male workers. Almost 12% of male workers were educated up to the secondary level, against 5.03% of female workers. However, the level of education of female workers, who are engaged as professional and associate professionals, educated up to graduation (7.42% and 3.96%, respectively) and post-graduate level (8.77% and 3.77%) was found to be slightly higher than that of male workers. More females have postgraduate university degrees, i.e., 16.04%, compared to 7.12% of males. However, most women in skilled agriculture, craft and related occupations, and elementary occupations (Table 6) were still illiterate. Hence, the relationship between education level and occupation segregation is evident in this analysis. Rawlston and Spriggs (2002) detailed how education could significantly contribute to understanding the division of occupations by gender. Likewise, Andlib and Khan (2018) showed in their research that higher education levels could enhance women's involvement in Pakistan's workforce. To examine the patterns of occupational gender segregation by educational attainment, employees are categorised into two groups: those with lower levels of education (from pre-primary to secondary education) and those with advanced education (beyond secondary school diplomas). The specific segregation patterns for these categories are illustrated in Figures 6A and 6B for males and females, respectively. An analysis of these segregation trends shows that in 2017-18, women with lower educational levels experienced the least segregation, whereas, in 2020-21, illiterate men displayed lower levels of segregation than their counterparts with higher education across all educational groups, as shown in Table 9. Notably, the segregation trend depicted in Figure 9 indicates that low-educated female workers face more segregation than their highly-educated counterparts, suggesting that higher educational attainment leads to more significant workplace segregation challenges for women. Figures 7A and 7B present the local segregation trends for males and females, respectively. The trends within each educational group show that men with lower education levels face the least segregation compared to highly educated men and women. The segregation trends for highly educated women are notably more pronounced than those for low-educated women, indicating a higher level of workplace discrimination for women with higher education. However, direct comparisons between the segregation trends of highly-educated men and low-educated women might not yield precise conclusions due to the intersection of these trends.

Table 10 presents the different indices of local segregation. The findings suggest that female workers with higher education face greater occupational segregation. This contrasts with the assertions made by Del Río and Alonso-Villar (2017), who argued that women possessing lesser educational qualifications face more segregation compared to their highly educated African-American peers. However, all indicators suggest that male workers with lower levels of education face the least segregation. Additionally, the data consistently shows that highly educated male workers experienced less segregation than their less educated female peers during 2017-18. In contrast, the current year has seen a decrease in segregation among less educated and illiterate female workers. Conversely, there has been a rise in segregation among less educated male workers throughout 2020-21. The breakdown of workers in the two categories (Tables 9 and 10) shows that the number of highly educated individuals in the workforce is considerably lower than those with less education.

Table 9: Occupation Segregation by Educational Groups

Occupation Segregation by Sex	Ip	M	Gini
Contribution to Overall Segregation: Education Groups			
Female (2017-18)	0.36	0.37	0.43
Illiterate	0.31	0.35	0.32
Less Educated	0.20	0.17	0.20
Highly Educated	0.50	0.48	0.48
Male (2017-18)	0.21	0.14	0.27
Illiterate	0.24	0.28	0.24
Less Educated	0.28	0.20	0.28
Highly Educated	0.48	0.51	0.48
Contribution to Overall Segregation: Education Groups			
Female (2020-21)	0.32	0.32	0.39
Illiterate	0.32	0.35	0.34
Less Educated	0.20	0.16	0.20
Highly Educated	0.48	0.49	0.46
Male (2020-21)	0.21	0.17	0.29
Illiterate	0.19	0.24	0.20
Less Educated	0.32	0.26	0.31
Highly Educated	0.49	0.50	0.49

Source: Computed from PLFS data, 2017-18 and 2020-21

Table 10: Occupation Segregation Indices by Educational Groups

Local Segregation: Education Groups	Population Share	D^g	GE^g (0.10)	GE^g (0.50)	$GE^g(1)$	$GE^g(2)$	G^g
Female (2017-18)							
Illiterate	0.31	0.36	1.22	0.61	0.41	0.30	0.44
Less Educated	0.24	0.30	0.39	0.32	0.27	0.21	0.35
Highly Educated	0.45	0.40	0.68	0.45	0.39	0.37	0.46
Male (2017-18)							
Illiterate	0.17	0.28	0.33	0.27	0.24	0.22	0.37
Less Educated	0.46	0.13	0.08	0.07	0.06	0.05	0.16
Highly Educated	0.37	0.27	0.21	0.20	0.20	0.21	0.35
Female (2020-21)							
Illiterate	0.36	0.28	0.80	0.44	0.31	0.23	0.37
Less Educated	0.27	0.23	0.30	0.24	0.19	0.15	0.29
Highly Educated	0.37	0.41	0.62	0.47	0.43	0.45	0.49
Male (2020-21)							
Illiterate	0.17	0.25	0.40	0.30	0.24	0.21	0.35
Less Educated	0.45	0.15	0.15	0.12	0.10	0.07	0.20
Highly Educated	0.39	0.27	0.24	0.23	0.22	0.23	0.37

Source: Computed from PLFS data, 2017-18 and 2020-21

Figure 6A: Male 2017

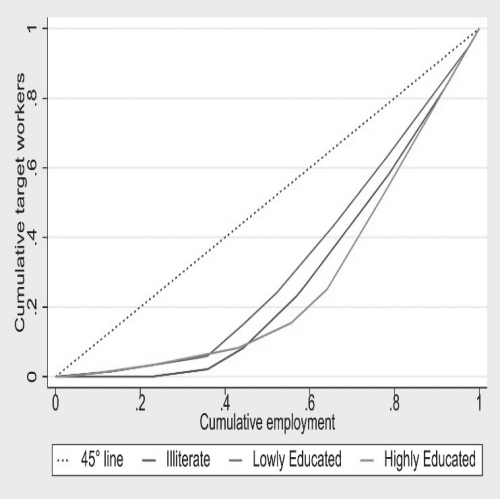


Figure 6B: Female 2017

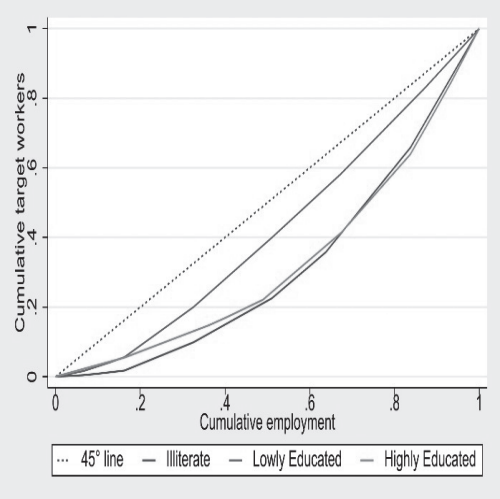


Figure 7A: Male 2020

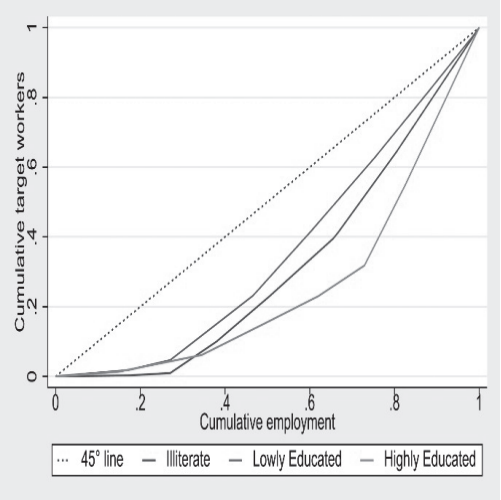
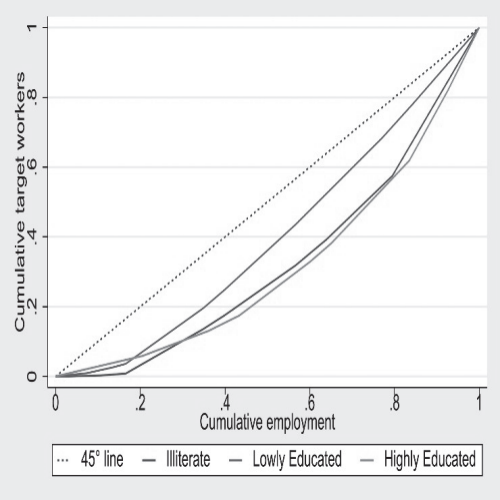


Figure 7B: Female 2020



5. Occupational Gender Segregation by Activity Status

Marked monthly income (MPCE) differences between male and female workers have been observed in Table 7. During the recent period (2020-21), a large proportion (46.3% males and 42% female) registered their MPCE between Rs. 5001 and Rs. 10000 monthly. Nearly 40% of female and 41% of male workers earned Rs. 25000 during 2020-2021, in which the share of professional and associate professional workers was high. It has been observed that the male-female difference in income is different in different occupations.

Figure 8A: Male 2020

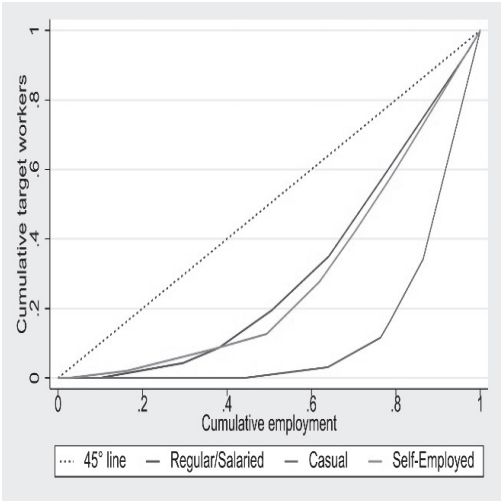


Figure 8B: Female 2020

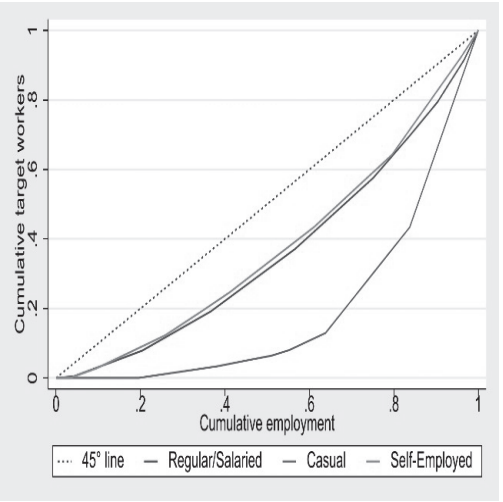


Figure 9A: Male 2020

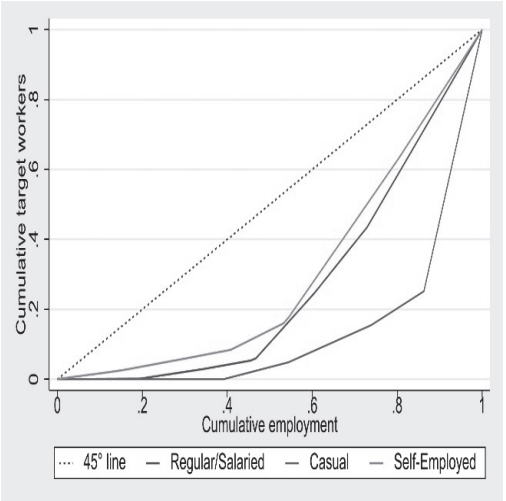
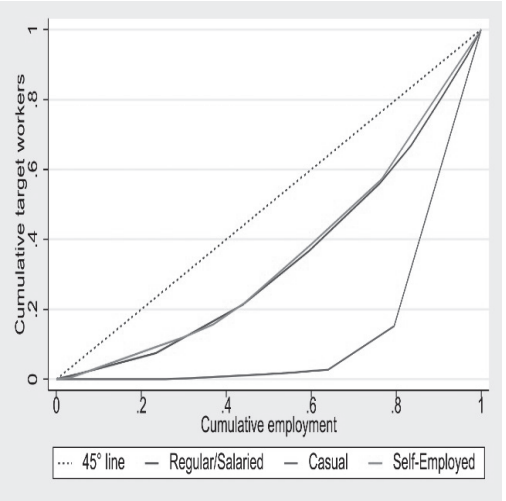


Figure 9B: Female 2020



Occupational segregation differs depending on the type of occupational activity of the workers. As a result, the current section explores gender occupation segregation across occupational activities to provide relevant insights. Three categories of activities (status) for those working: self-employed, regular, and casual. These three statuses separate the quality of employment (job). Regular workers are paid a regular pay or salary, which includes employment and social security benefits guaranteed by labour regulations. Casual workers are the most susceptible because they typically work low-wage employment with no benefits or labour regulatory coverage.

Table 11 displays the results of total gender segregation by activity category. Female self-employed workers had greater occupational segregation than regular-employed female workers and casual workers (with the least segregation). Females accounted for 24-39% of total segregation across

these employment categories in 2017-18 and 16-45% in 2020-21. Workers who are self-employed or in regular employment are the most segregated in urban regions, both males and females, in 2017-18 and 2020-21.

Additionally, in 2020-21, the female share of regular employment increased (from 41% in 2017-18 to 43% in 2020-21), while the male share decreased (from 43% in 2017-18 to 32% in 2020-21).

Table 11: Occupation Gender Segregation by Activity Groups

Occupation Gender Segregation by Activity Status	Ip	M	Gini
Contribution to Overall Segregation: Activity Groups			
Female (2017-18)	0.36	0.38	0.43
Regular	0.41	0.38	0.43
Casual	0.14	0.24	0.14
Self-Employed	0.45	0.39	0.43
Male (2017-18)	0.39	0.19	0.31
Regular	0.43	0.26	0.35
Casual	0.29	0.46	0.26
Self-Employed	0.37	0.27	0.39
Contribution to Overall Segregation: Activity Groups			
Female (2020-21)	0.40	0.43	0.45
Regular	0.43	0.45	0.44
Casual	0.10	0.16	0.10
Self-Employed	0.48	0.39	0.46
Male (2020-21)	0.28	0.28	0.36
Regular	0.32	0.23	0.35
Casual	0.29	0.51	0.26
Self-Employed	0.38	0.26	0.39

Source: Computed from PLFS data, 2017-18 and 2020-21

Table 12 shows local segregation in different employment categories by gender. Female workers are more segregated than males in all employment categories in 2017-18 and 2020-21(Figures 8A, 8B, 9A and 9B). Notably, females comprise 48% of the regular workforce, while males are only 39% during 2017-18. In 2020-21, many workers—be they male or female—are engaged as self-employed workers in urban areas. Local segregation is much higher for causally employed females. However, only some female workers have been employed as casual workers in urban areas.

Table 12: Occupation Segregation by Activity Groups

Local Segregation: Activity Groups	Population Share	D^g	GE^g (0.10)	GE^g (0.50)	$GE^g(1)$	$GE^g(2)$	G^g
Female (2017-18)							
Regular	0.48	0.31	1.24	0.41	0.30	0.24	0.39
Casual	0.08	0.65	4.99	1.48	1.13	1.38	0.75
Self-Employed	0.44	0.37	0.65	0.39	0.33	0.30	0.42

Contd...

Table 12 contd...

Local Segregation: Activity Groups	Population Share	D^g	GE^g (0.10)	GE^g (0.50)	$GE^g(1)$	$GE^g(2)$	G^g
Male (2017-18)							
Regular	0.39	0.19	0.15	0.14	0.13	0.13	0.27
Casual	0.13	0.51	2.45	0.87	0.69	0.74	0.61
Self-Employed	0.48	0.18	0.15	0.13	0.11	0.10	0.25
Female (2020-21)							
Regular	0.42	0.41	0.96	0.62	0.46	0.37	0.47
Casual	0.06	0.61	4.42	1.36	1.12	1.61	0.73
Self-Employed	0.51	0.37	0.42	0.37	0.32	0.29	0.40
Male (2020-21)							
Regular	0.40	0.23	0.18	0.17	0.16	0.16	0.32
Casual	0.13	0.64	3.05	1.35	1.10	1.31	0.73
Self-Employed	0.48	0.22	0.17	0.16	0.15	0.15	0.30

Source: Computed from PLFS data, 2017-18 and 2020-21

6. Conclusions

The above analysis examines gendered occupational segregation across caste, age, education, and activity groups in the urban labour market of Uttar Pradesh. It utilises both overall and local segregation measures. The results indicate that women experience higher levels of segregation compared to men across all measures. Specifically, the segregation of women accounts for a significant part of the overall gender segregation. Segregation is lower for younger and middle-aged male workers compared to elderly males. However, occupational segregation increased in 2020-21 among the younger female workforce. The analysis indicates less segregation among OBCs, who dominate the working population. SCs contribute most to overall segregation across occupations. Additionally, higher education does not reduce segregation, as highly educated female and male workers experience higher occupational segregation. The research conducted by Khan et al. (2023) has observed a comparable result, indicating that attributes of human capital, such as advanced education, fail to diminish the division of occupations in the workforce. Examining segregation by activity group shows females face greater segregation than males in all employment categories in 2017-18 and 2020-21. Self-employed females are particularly segregated, while regularly employed workers are less segregated. In conclusion, women experience greater discrimination in every category, with a significant number of female employees being confined to roles that are often underappreciated, irrespective of their educational background or age. Consequently, this situation forces women to opt for positions that offer a more agreeable work setting and shorter hours. Therefore, it is vital to place a stronger emphasis on policies related to gender norms. The role of governmental institutions and the media is critical in transforming gender norms both in the workplace and domestically.

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SOCIOECONOMIC PROGRESS THROUGH CONVERGENCE: ANALYZING PMAY-G, SWACHH BHARAT ABHIYAN, AND PMUY IMPACTS IN TAMIL NADU

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Abstract: The study explores the role of scheme convergence in advancing socioeconomic progress through the Pradhan Mantri Awas Yojana-Gramin (PMAY-G), Swachh Bharat Abhiyan (SBA), and Pradhan Mantri Ujjwala Yojana (PMUY) in rural Tamil Nadu. These welfare schemes, targeting improvements in housing, sanitation, and access to clean cooking, respectively, present distinct opportunities and challenges when implemented together, influencing beneficiary experiences and fostering comprehensive rural development. Primary data was collected from 600 beneficiaries across four major zones in Tamil Nadu, focusing on three key outcomes: PMAY-G Assistance Sufficiency, Perceived Community Sanitation Improvement, and Satisfaction with LPG Cooking. Using binary logistic regression analysis, the study identifies significant predictors—such as age, income, employment status, community type, and access to financial support—that shape perceptions of scheme adequacy and impact. Findings highlight the importance of targeted financial support, community participation, and coordinated inter-departmental efforts to strengthen the convergence model. Policy recommendations emphasize tailored financial mechanisms and robust infrastructure to address the diverse needs of beneficiaries, thereby enhancing the overall effectiveness of these schemes in rural Tamil Nadu.

Keywords: PMAY-G, SBA, PMUY, Rural welfare, Convergence, Health outcomes

Introduction

The transformation of India's rural housing policy, particularly the reformation of the Indira Awaas Yojana (IAY) into the Pradhan Mantri Awas Yojana-Gramin (PMAY-G) in 2016, marked a strategic shift aimed at improving rural households across the nation. PMAY-G extends beyond housing by integrating essential services such as toilets, electricity, LPG gas connections, drinking water, and banking facilities, reflecting a holistic approach to rural development.[1] Through convergence with other schemes, PMAY-G seeks to address the interconnected needs of rural communities

[1] Press Information Bureau news from: Ministry of Rural Development, Government of India, 7 April, 2017.

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comprehensively, promoting both individual well-being and community welfare.

In Tamil Nadu, the impact of PMAY-G is notably amplified through alignment with flagship programmes like the Swachh Bharat Mission (SBM) and Pradhan Mantri Ujjwala Yojana (PMUY). These partnerships address fundamental rural issues, ensuring not only housing provision but also improvements in sanitation, health, and living conditions. The Swachh Bharat Mission, for instance, targets open defecation and sanitation infrastructure improvements. In Tamil Nadu, SBM's integration with PMAY-G reinforces the commitment to hygienic and health-conscious living in rural communities, reflecting Mahatma Gandhi's vision that "Sanitation is more important than independence" (Joshi, 2019).

Similarly, the Pradhan Mantri Ujjwala Yojana (PMUY) addresses the pressing need for clean cooking fuel by providing LPG connections to economically disadvantaged households. This initiative significantly benefits women's health by reducing exposure to indoor air pollution, which is prevalent with traditional cooking methods. Studies have documented the positive impact of LPG adoption on rural women, emphasizing its role in improving health and reducing time poverty (Gupta et al., 2020). In Tamil Nadu, the convergence of PMUY and PMAY-G exemplifies the government's commitment to enhancing rural quality of life by addressing multiple socioeconomic and health challenges simultaneously.

The significance of convergence models in public policy extends beyond India. For instance, in Brazil, the Bolsa Família programme—a conditional cash transfer scheme—integrates education, health and nutrition services to combat poverty holistically (Lindert et al., 2007). Similarly, Mexico's Progresa/Oportunidades programme demonstrates the effectiveness of linking education and health services to address multidimensional poverty (Skoufias et al., 2001). These examples underline the importance of cohesive policy frameworks in achieving multidimensional development, lessons that are critical for the PMAY-G convergence model in Tamil Nadu.

By exploring the implementation dynamics, identifying challenges, and assessing outcomes, this study aims to provide insights to inform policy refinements and enhance the effectiveness of rural development initiatives in the state.

Literature Review

Rural Housing and Socioeconomic Transformation

Public housing schemes in India, such as PMAY-G, play a pivotal role in the government's poverty alleviation strategy. Initially targeting marginalized groups like Scheduled Castes (SC), Scheduled Tribes (ST), and families of bonded laborers, these programs have evolved to address rural homelessness on a larger scale (Ananth, 2017; Divya, 2019). Studies by Mohapatra & Prusty (2021) and Swathi & Vezhaventhan (2018) show that housing programs have spurred economic growth in Tamil Nadu's rural regions, with PMAY-G facilitating substantial improvements in human settlements.

Despite these efforts, rural housing deficits persist, with about 90% of the shortfall attributed to households below the poverty line, affected by issues like temporary housing and overcrowded conditions (Ammannaya, 2008). Kumar (2014) suggests that a comprehensive approach addressing shelter deprivation is essential to improving rural well-being. PMAY-G, through its convergence mechanism, aims to support this approach by integrating various rural welfare programs to enhance the lives of the rural poor and facilitate socio-economic upliftment.

The Convergence of PMAY-G, SBM and PMUY

The Pradhan Mantri Awas Yojana-Gramin (PMAY-G) is designed as a demand-driven program, providing homes through a credit-linked subsidy model. This convergence model aims to bring about qualitative changes in rural communities by combining essential services under one program. Studies reveal that beneficiaries of PMAY-G report improved psychological well-being and enhanced quality of life (Reddy et al., 2018), which reflects the positive impact of secure housing on overall welfare.

Challenges in PMUY's Implementation

The Pradhan Mantri Ujjwala Yojana (PMUY) primarily addresses health risks associated with traditional cooking fuels. However, studies by Aggarwal et al. (2018) and Hanna et al. (2016) highlight limitations in the program, such as the high cost of LPG refills and challenges in accessibility. Kar et al. (2020) and Ram & Mobarak (2018) argue that households often revert to biomass, underscoring the need for both financial incentives and behavioral change for sustained use of clean fuel.

Sanitation and Public Health: The Role of SBM

The Swachh Bharat Mission (SBM) has been a major step toward improving sanitation, yet it faces obstacles in equitable access and sustainable usage. Kedia (2022) provides a critical analysis of SBM's design, arguing that the program's emphasis on individual household toilets overlooks the broader public value of community sanitation. Kedia critiques SBM's reliance on financial incentives and information tools while disregarding regulatory and organizational approaches, framing it as an overly simplistic cash transfer scheme. This perspective reveals a gap between the intended and actual outcomes of SBM, underscoring the need for a balanced policy that incorporates regulatory frameworks and public sanitation investments, which could alleviate resource constraints and benefit communities as a whole. Further, Kedia (2022) argues that SBM's approach often fails to consider context-specific challenges such as land scarcity, lack of access to water, and gender inequality, which limits the program's effectiveness in rural settings. The UNICEF (2020) report further highlights that gaps in sanitation access persist, suggesting that community involvement and behavioral change are essential for SBM's long-term success.

The Need for Coordinated Policy Design

The convergence of PMAY-G, SBM and PMUY aims to reduce poverty by tackling multiple aspects simultaneously. Studies by Dabadge (2018) and Nayak et al. (2021) suggest that effective coordination among these programmes can substantially enhance rural living standards. However, sustainable convergence requires addressing both public and private benefits, as well as fostering community involvement and inter-departmental collaboration. This requires reducing clientelism and ensuring beneficiaries to be actively involved in the process (Hueso and Bell, 2013; Nayak et al., 2021).

Gaps in Research on Convergence Impacts in Tamil Nadu

Although individual programmes like SBM and PMUY have demonstrated potential, there is limited research on the combined impact of these schemes with PMAY-G in Tamil Nadu. Reddy et al. (2018) note that while beneficiaries experience improved satisfaction and socioeconomic outcomes, challenges such as delays in housing construction and irregular access to essential services persist. This study aims to address this gap by analyzing the convergence effects of PMAY-G, SBM, and PMUY on rural welfare, focusing on health outcomes and socioeconomic upliftment in Tamil Nadu.

By examining beneficiaries' experiences, challenges, and outcomes of these integrated

programmes, this research provides insights for optimizing policy approaches and enhancing the effectiveness of rural welfare initiatives in Tamil Nadu. The findings aim to support government efforts in creating a more resilient and health-conscious rural populace, contributing to the broader goals of sustainable rural development.

Data and Methodology

This study draws on primary data collected from beneficiaries listed on the PMAY-G website of the Ministry of Rural Development (MoRD) for fiscal years 2019-20 to 2022-23 (accessed in December 2023). The research was conducted across four major zones in Tamil Nadu—North, Central, West and Coastal—using a multistage sampling approach to ensure representative data collection. Initially, one zone was selected from each of these four regions, after which two districts within each zone were chosen. Specifically, the selected districts included Tiruvannamalai and Villupuram from the North Zone, Ariyalur and Perambalur from the Central Zone, Salem and Dharmapuri from the West Zone, and Cuddalore and Nagapattinam from the Coastal Zone.

Within each district, three blocks were randomly selected, followed by five panchayat villages within each block. If a block or village did not meet the required sample size, replacements were drawn from neighboring areas to maintain sample consistency. From each selected village, five PMAY-G beneficiaries who had availed of the PMAY-G, SBA and PMUY schemes were randomly chosen. This sampling process resulted in a total of 600 beneficiaries across 120 panchayat villages, spanning 24 blocks in eight districts. Among the final 600 participants, 298 were female beneficiaries, providing a gender-balanced sample.

The study focused on beneficiaries who had completed PMAY-G housing construction as of December 2023, as recorded on the MoRD website. Only those who received financial assistance during the fiscal years 2019-20 to 2022-23 and completed construction by December 2023 were included in the final sample. To gain insights into the impacts of the PMAY-G, SBA, and PMUY convergence, a semi-structured interview schedule was developed following a pilot study conducted with a subset of beneficiaries. The questions, aligned with the study's objectives, addressed areas such as sufficiency of financial assistance, community sanitation improvement, and satisfaction with LPG cooking.

Dependent Variables

Three key dependent variables were assessed in this study. The first, PMAY-G Assistance Sufficiency, was evaluated through three questions examining financial sufficiency, house size, and the adequacy of facilities, with responses coded as '1' for sufficient and '0' for not sufficient. A response of "sufficient" to at least two of the three questions indicated an overall adequacy of assistance. The second variable, Perceived Community Sanitation Improvement, was measured through five questions addressing aspects such as SBA's utility to the community, participation levels, prevalence of open defecation, sanitation improvements, and cleanliness. Improvement was noted if respondents answered positively to at least three of these five questions. The third variable, Level of Satisfaction with LPG Cooking, was assessed through three questions regarding cooking quality, convenience compared to traditional methods, and satisfaction with LPG refills, with satisfaction marked by positive responses to at least two questions.

Analytical Approach

To analyze the predictors of these outcomes, a binary logistic regression model was applied, focusing on PMAY-G Assistance Sufficiency, Perceived Community Sanitation Improvement, and Level of

Satisfaction with LPG Cooking. The model estimated regression coefficients (β), Exp(β) values, 95% confidence intervals, and p-values, with statistical significance set at 0.05. All statistical analyses were conducted using IBM SPSS 22.0 software, ensuring a rigorous evaluation of the convergence impacts across the chosen variables.

Table 1: Estimated Binary Logistic Model Results Regarding Socio-economic Factors Affecting PMAY-G Assistance Sufficiency

Parameter		β	SE	Wald	P	Exp(β)
Constant		-0.832	1.743	0.228	0.633	0.435
Age (reference category: Less than 35)						
	36 – 45	-1.565	0.278	16.164	0.001*	0.327
	46 – 55	-1.475	0.225	13.422	0.001*	0.438
	56 – 65	-1.188	0.218	2.764	0.096	0.695
	Above 65	-1.264	0.223	4.150	0.042	0.635
Religion (reference category: Hindu)						
	Muslim	-2.959	0.884	11.217	0.001*	0.052
	Christian	-3.546	1.468	5.834	0.016	0.029
Community (reference category: SC)						
	ST	0.257	0.472	0.297	0.586	1.293
	MBC	-0.299	0.907	0.109	0.741	0.741
	BC	0.762	0.475	2.565	0.109	2.141
	OC	0.328	0.499	0.433	0.510	1.389
Educational level (reference category: Illiterate)						
	Up to Primary	0.088	0.786	0.013	0.911	1.092
	Up to secondary	-0.875	0.798	1.203	0.273	0.417
	Up to HSS	-0.526	0.800	0.432	0.511	0.591
	Graduate	-0.675	0.826	0.667	0.414	0.509
Employment (reference category: Aged- not in labour force)						
	Domestic servant	-1.403	0.835	2.824	0.093	0.246
	Self-employment	-0.430	0.553	0.605	0.437	0.650
	Construction workers	-0.043	0.555	0.006	0.939	0.958
	Agricultural labourers	-0.746	0.539	1.918	0.166	0.474
	Salaried employment	0.020	0.421	0.002	0.962	1.020
Annual Household Income (reference category: Less than ₹10000)						
	₹100000 to 150000	20.547	28420.7	0.000	0.999	8.388
	₹150001 to 200000	1.008	0.330	9.351	0.002**	2.739
	Above ₹200000	0.083	0.414	0.040	0.841	1.087
Type of house lived before (reference category: Kutcha)						
	Semi-pucca	0.465	0.289	2.593	0.107	1.592
	Dilapidated house	0.410	0.407	1.015	0.314	1.507
Additional expenditure incurred (reference category: Up to 3 lakhs)						
	Between 3 and 5 lakhs	1.125	0.332	11.502	0.001*	3.082
	Between 5 and 7 lakhs	1.088	0.368	8.746	0.003**	2.970
	Above 7 lakhs	0.889	0.414	4.611	0.032	2.432
Sources of Additional funds (reference category: savings used up / assets sold / assets pledged)						
	Borrow from private money lenders	2.715	1.188	5.227	0.022	15.108

Contd...

Table 1 contd...

Parameter		β	SE	Wald	P	Exp(β)
	personal help from friends/relatives	2.051	1.181	3.015	0.083	7.776
	credit from material suppliers	3.187	1.199	7.065	0.008	24.211
	SHG/MFT loan	3.090	1.211	6.505	0.011	21.967
	loan from banks	3.229	1.191	7.356	0.007	25.256
Classification success						69.3
Cox & Snell R-Squared						24.2
Nagelkerke R-Squared						32.2
Log likelihood						664.483
N						600

Note: **indicates significance at the 5% level and *indicates significance at the 1% level.

Results and Discussion

Table 1 presents the estimated results from a binary logistic regression model analyzing the socio-economic factors that influence the perceived sufficiency of assistance provided by the Pradhan Mantri Awas Yojana – Gramin (PMAY-G). The model's variance explanation (Cox & Snell R-Squared = 24.2%, Nagelkerke R-Squared = 32.2%) and its classification accuracy (69.3%) indicate a moderate predictive strength. The findings collectively underscore the critical role of supplementary financial support and income levels in enhancing sufficiency perceptions, while age, religion, and household investment in housing improvements further influence beneficiary satisfaction. This suggests that convergence efforts, in line with Kedia's (2022) recommendations for integrative policies, could benefit from incorporating financial support mechanisms and targeted assistance for specific age and religious groups to improve overall perceptions of adequacy.

The results show that respondents aged 36-45 and 46-55 are significantly less likely to find the assistance sufficient compared to those under 35 ($p = 0.001$ for both groups), with odds ratios of 0.327 and 0.438, respectively. This result is consistent with Dabadge (2018), who found that middle-aged individuals may have heightened expectations of service delivery. Additionally, the reduced likelihood of sufficiency perceptions among respondents over 65 may indicate unmet needs in this demographic due to age-related vulnerabilities in housing adequacy (Satish, 2007). These findings support Rao (2019) and Divya (2019), who emphasize that housing schemes should address age-specific needs to improve perceptions of sufficiency.

Religion shows a strong influence on perceptions of assistance sufficiency: Muslims ($p = 0.001$, odds ratio = 0.052) and Christians ($p = 0.016$, odds ratio = 0.029) are significantly less likely than Hindus to perceive PMAY-G assistance as sufficient. This may point to socio-cultural or community-specific factors affecting perceptions of adequacy in assistance. This result aligns with Kedia's (2022) observation of community-specific challenges and suggests that factors beyond financial support, such as community support structures, influence perceptions of adequacy. This finding also reflects the conclusions of Kumar and Ravindra (2013). That is, convergence across ministries must consider socio-cultural factors to address rural housing needs effectively.

Interestingly, community categories (e.g., Scheduled Tribes (ST), Most Backward Classes (MBC), Backward Classes (BC), Other category (OC)) did not significantly affect perceived sufficiency compared to Scheduled Castes (SC), contrasting with Nayak et al. (2021), which emphasized the

impact of social background on accessing public benefits. This suggests that PMAY-G may have effectively mitigated certain demographic barriers, though broader evidence, including Swathi and Vezhaventhan (2018), indicates that community-specific factors often influence the perception of aid adequacy.

The absence of a statistically significant effect for educational attainment aligns with Ram and Mobarak (2018), who noted that structural and financial barriers often outweigh educational advantages in accessing clean energy schemes like PMUY. Similarly, within PMAY-G, practical or financial constraints may overshadow educational differences in determining sufficiency perceptions. This finding corresponds with Reddy et al. (2018), who observed that educational attainment alone does not necessarily increase satisfaction with housing schemes.

Employment, barring domestic work, generally lacks statistical significance in influencing perceptions of sufficiency. However, domestic servants are less likely to find the assistance sufficient ($p = 0.093$), paralleling Kar et al. (2020), who argue that income levels rather than employment type have a more direct impact on scheme efficacy. This further supports Khan's (2019) findings that employment type alone is insufficient for determining perceived adequacy in housing schemes.

Households with annual incomes between ₹150,001 and ₹200,000 are significantly more likely to find PMAY-G assistance sufficient ($p = 0.002$, odds ratio = 2.739). Higher household income appears to enhance the ability to utilize government aid effectively, supporting Mohapatra and Prusty (2021), who found that socio-economic stability is central to rural development program satisfaction.

The type of previous housing (semi-*pucca* or dilapidated) was not significantly associated with perceived assistance sufficiency. However, higher additional expenses for housing improvements correlate with higher satisfaction with PMAY-G assistance, as expenses between ₹3 and ₹7 lakh significantly improved perceptions of adequacy.[2] This finding agrees with Nayak et al. (2021), who emphasize that self-funded investments complement PMAY-G assistance, reinforcing that additional financial investments contribute to perceived adequacy of government aid. These results further reflect Reddy et al. (2018), where 80% of beneficiaries in three states invested additional resources to complete their PMAY-G houses.

Moreover, beneficiaries who access additional credit sources—such as private money lenders, material suppliers, SHGs, and banks—are more likely to find PMAY-G assistance sufficient, with high odds ratios for these sources. This observation supports Kedia (2022) and Hueso and Bell (2013), who argue that accessible credit is essential for the success of social programs. Such access to credit echoes the findings of Puttkamer (2015) on the importance of credit-linked subsidies in PMAY-G, further confirming that external financial support can bridge government aid gaps.

Table 2: Estimated Binary Logistic Model Results Regarding Socio-Economic Factors Affecting Community Sanitation Improvement

Parameter	β	SE	Wald	P	Exp(β)
Constant	-0.284	1.673	0.029	0.865	0.752
Age (reference category: Less than 35)					
36 – 45	-0.213	0.753	0.080	0.777	0.808
46 – 55	-0.062	0.608	0.011	0.918	0.939
56 – 65	0.861	0.624	1.902	0.168	2.365
Above 65	0.058	0.598	0.010	0.922	1.060

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[2] 1 lakh = 0.1 million

Table 2 contd...

Parameter		β	SE	Wald	P	Exp(β)
Religion (reference category: Hindu)						
	Muslim	0.321	1.009	0.101		
	Christian					
Community (reference category: SC)						
	ST	0.009	0.646	0.000	0.989	1.009
	MBC	20.29	1184	0.000	0.999	6.513
	BC	-0.883	640	1.903	0.168	0.414
	OC	0.026	0.704	0.001	0.970	1.026
Educational level (reference category: Illiterate)						
	Up to Primary	1.941	0.921	4.442	0.035	6.965
	Up to secondary	1.450	0.932	2.418	0.120	4.262
	Up to HSS	1.934	0.960	4.061	0.044	6.919
	Graduate	1.712	0.973	3.094	0.079	5.539
Employment (reference category: Aged- not in labour force)						
	Domestic servant	1.452	1.215	1.430	0.232	4.273
	Self-employment	-0.022	0.688	0.001	0.974	0.978
	Construction workers	0.164	0.677	0.059	0.808	1.179
	Agricultural labourers	0.150	0.673	0.050	0.823	1.162
	Salaried employment	1.270	0.556	5.211	0.022	3.559
Annual Household Income (reference category: Less than ₹10000)						
	₹100000 to 150000	18.918	2842	0.000	0.999	1.644
	₹150001 to 200000	-0.602	0.537	1.254	0.263	0.548
	Above ₹200000	-1.478	0.599	6.092	0.014	0.228
Type of toilet (reference category: Indian toilet)						
	Western toilet	-1.045	0.607	2.965	0.085	0.352
Reasons for not constructing toilet before SBA (reference category: Not hygienic)						
	No place in the house	0.478	0.544	0.772	0.379	1.613
	Open defecation is convenient	-0.784	0.415	3.576	0.059	0.457
	Unable to bear expenses	0.685	0.547	1.571	0.210	1.984
Water available inside the toilet (reference category: Yes)						
	No	0.681	0.336	4.098	0.043	1.976
Where do you prefer going for toilet before SBA (reference category: ODC)						
	Community toilets	-0.613	0.732	0.701	0.402	0.542
Motivation to avoid open defecation (reference category: Self-motivation)						
	Awareness created by government	0.953	0.487	3.826	0.050	2.594
	Pressure from community	1.973	0.459	18.469	0.000*	7.193
All of your family members using toilet only (reference category: Yes)						
	No	-1.765	0.356	24.552	0.000	0.171
Classification success						90.2
Cox & Snell R-Squared						20.6
Nagelkerke R-Squared						36.7
Log likelihood						354.940
N						600

Note: **indicates significance at the 5% level and *indicates significance at the 1% level.

Table 2 presents the estimated results from a binary logistic regression model analyzing socio-economic factors that influence community sanitation improvement under the Swachh Bharat Abhiyan (SBA). The findings from the binary logistic regression model on socio-economic factors affecting community sanitation improvement under the Swachh Bharat Abhiyan (SBA) align with several studies while providing new insights, especially within the context of Tamil Nadu. The model explains 20.6% to 36.7% of variance in sanitation perceptions (Cox & Snell R-Squared = 20.6, Nagelkerke R-Squared = 36.7), with a high 90.2% classification accuracy, demonstrating robustness in identifying key socioeconomic predictors. These findings affirm the critical role of education, employment, and community influence in driving positive sanitation perceptions under SBA while highlighting the need for a holistic approach in convergence frameworks (Nayak et al., 2021) that addresses both private benefits and community-wide infrastructure improvements as suggested by Kedia (2022).

Firstly, the data show that age does not significantly affect perceptions of community sanitation improvement across various age groups (36-45, 46-55, 56-65, and above 65), as p-values are consistently above 0.1. This lack of age significance may suggest that sanitation perception is more universally relevant, unaffected by generational differences. This neutrality in perception contrasts slightly with some studies suggesting that younger generations are more influenced by modernization efforts in sanitation infrastructure (Hueso and Bell, 2013).

The incomplete results on the effect of religion reflect gaps in our understanding of how socio-cultural dimensions, like religion, influence sanitation perception. This gap is echoed in the work of Hueso and Bell (2013), who stress the need for nuanced approaches that consider cultural factors when implementing community sanitation programs. The absence of significant findings here indicates that further research may be needed to clarify religion's role in sanitation perception under SBA. The impact of community type (ST, MBC, BC, OC) also shows no statistically significant difference compared to Scheduled Castes (SC) in influencing perceptions of sanitation improvement. This supports Kedia's (2022) finding that sanitation policies often fail to consider the socio-cultural diversity in rural areas and may imply that SBA interventions have not sufficiently addressed the unique needs of different community groups.

Education emerges as a significant factor in perceptions of sanitation improvement, with those educated up to primary level ($p = 0.035$, odds ratio = 6.965) and higher secondary school (HSS) ($p = 0.044$, odds ratio = 6.919) reporting higher sanitation satisfaction levels. This aligns with Nayak et al. (2021), who argue that education enhances the awareness and adoption of public sanitation programs. However, Kedia (2022) critiques that current schemes focus excessively on incentives rather than educational programs, and this model's findings may reflect a need for targeted education-based approaches at even higher levels of schooling for sustainable impact.

In terms of employment, salaried employment significantly increases positive perceptions of sanitation improvement ($p = 0.022$, odds ratio = 3.559). This finding supports Dabadge (2018), who noted that stable employment tends to boost program uptake by enhancing household financial security. However, high-income households (income above ₹200,000) report a lower perception of sanitation improvement ($p = 0.014$, odds ratio = 0.228), possibly indicating that wealthier households may have alternative sanitation facilities, aligning with Ram and Mobarak's (2018) observations on LPG adoption challenges among high-income groups.

Higher-income households being less likely to perceive sanitation improvement reflects a divergence in dependency on SBA interventions. This finding also resonates with Kedia's (2022) critique that SBA may primarily benefit lower-income households, leaving higher-income groups less

reliant on or satisfied by SBA's community-driven initiatives.

The findings on toilet types and pre-existing sanitation preferences reveal complex motivations. Households using Western-style toilets show a marginally significant lower perception of community sanitation improvement ($p = 0.085$, odds ratio = 0.352), which may suggest alignment with Kedia's (2022) assertion that SBM's focus on household toilets misses broader community infrastructure. For households citing open defecation convenience, perceptions of SBA improvements are lower ($p = 0.059$, odds ratio = 0.457), possibly echoing the need for more robust behavior change interventions as suggested by UNICEF (2020).

A significant finding is that water availability inside toilets positively correlates with perceived sanitation improvement ($p = 0.043$, odds ratio = 1.976), supporting UNICEF's (2020) report on the importance of adequate water resources in sustaining toilet use. Furthermore, community pressure and government awareness play highly influential roles ($p < 0.001$ and $p = 0.050$, respectively), aligning with Nayak et al. (2021), who emphasize that community-driven enforcement and public awareness are pivotal in enhancing scheme acceptance.

Finally, family toilet usage consistency significantly correlates with sanitation improvement perceptions, with households where not all members use the toilet reporting lower satisfaction ($p < 0.001$, odds ratio = 0.171). This supports Kar et al. (2020), who argue that internal household practices must align with program objectives for lasting impact.

The strong association of community pressure with sanitation improvement perception supports the idea that social factors significantly influence public health outcomes, as noted by Aggarwal et al. (2018). Community-driven motivations, as this study suggests, may complement government-led awareness efforts for more effective program outcomes.

The positive impact of government awareness campaigns, though less significant than community pressure, highlights the importance of continuous government engagement. This supports Hanna et al. (2016), who emphasized that awareness campaigns alone are not a panacea but play a crucial role in raising initial adoption rates.

The association between full family toilet usage and improved sanitation perceptions under SBA underscores the importance of complete adoption within households. This finding agrees with Kedia's (2022) argument that SBM's goals are not fully achieved until household-level behavioral shifts are realized, indicating the need for persistent behavior change interventions to ensure sustainable usage.

Table 3: Estimated Binary Logistic Model Results Regarding Socio-Economic Factors Affecting Level of Satisfaction with LPG Cooking

Parameter	β	SE	Wald	P	Exp(β)
Constant	2.361	1.638	2.079	0.149	10.602
Age (reference category: Less than 35)					
36 – 45	-0.426	0.499	0.729	0.393	0.653
46 – 55	0.209	0.361	0.336	0.562	1.233
56 – 65	-0.019	0.349	0.003	0.958	0.982
Above 65	0.191	0.357	0.286	0.593	1.210
Religion (reference category: Hindu)					
Muslim	1.306	0.640	4.159	0.041	3.691
Christian	1.506	1.152	1.709	0.191	4.510

Contd...

Table 3 contd...

Parameter	β	SE	Wald	P	Exp(β)
Community (reference category: SC)					
ST	-0.489	0.449	1.189	0.276	0.613
MBC	-0.581	0.853	0.465	0.495	0.559
BC	-0.829	0.457	3.287	0.070	0.436
OC	-0.892	0.460	3.755	0.053	0.410
Educational level (reference category: Illiterate)					
Up to Primary	-0.653	0.780	0.713	0.399	0.518
Up to secondary	-0.634	0.783	0.656	0.418	0.530
Up to HSS	-0.587	0.789	0.553	0.457	0.556
Graduate	-0.824	0.823	1.003	0.317	0.439
Employment (reference category: Aged- not in labour force)					
Domestic servant	-1.723	0.874	3.891	0.049	0.178
Self-employment	-0.653	0.528	1.529	0.216	0.521
Construction workers	-1.004	0.541	3.445	0.063	0.366
Agricultural labourers	-0.317	0.553	0.329	0.566	0.728
Salaried employment	-0.413	0.427	0.935	0.334	0.662
Annual Household Income (reference category: Less than ₹10000)					
₹100000 to 150000	-0.883	1.504	0.345	0.557	0.413
₹150001 to 200000	0.075	0.300	0.063	0.802	1.078
Above ₹200000	-0.933	0.370	6.356	0.012	0.393
Years of using LPG (reference category: Less than 3 years)					
3 to 5 years	-0.457	1.056	0.188	0.665	0.633
5 to 7 years	0.709	1.045	0.460	0.498	2.032
More than 7 years	0.004	1.068	0.000	0.997	1.004
Number of cylinders purchase on an average per year (reference category: Less than 4)					
4 to 6	-1.094	1.229	0.793	0.373	0.335
7 to 9	-1.851	1.230	2.266	0.132	0.157
10 to 12	-2.054	1.236	2.762	0.097	0.128
Considering the impact on health, compared to a traditional cook stove, LPG based cooking is (reference category: Better)					
Worse	-0.071	0.225	0.100	0.751	0.931
Classification success					67.2
Cox & Snell R-Squared					13.1
Nagelkerke R-Squared					17.7
Log likelihood					719.417
N					600

Note: **indicates significance at the 5% level and *indicates significance at the 1% level.

Table 3 presents estimated results from a binary logistic regression model analyzing socio-economic factors that influence the level of satisfaction with LPG cooking among beneficiaries in Tamil Nadu. The variables in the table represent various socio-demographic and economic attributes, with β values (coefficients) indicating the effect of each factor on the likelihood of satisfaction with LPG cooking. The model achieves a 67.2% accuracy in predicting satisfaction levels, with Cox & Snell R-Squared (13.1%) and Nagelkerke R-Squared (17.7%) suggesting moderate explanatory power. The model's lower log likelihood (719.417) underscores a need for additional or refined variables to enhance prediction accuracy. This result is consistent with Nayak et al. (2021), who argue

that effective policy implementation requires a comprehensive understanding of both individual and community-level factors affecting scheme utilization and satisfaction.

The positive baseline constant ($\beta = 2.361$) implies a generally high level of satisfaction with LPG cooking among participants, even without controlling for socio-economic factors. This result aligns with Hanna et al. (2016), who noted improved health outcomes from clean energy access through PMUY. However, the constant's lack of statistical significance ($p = 0.149$) suggests that additional factors influence satisfaction, underscoring Ram and Mobarak's (2018) finding that satisfaction with LPG adoption requires more than access; affordability and behavioral changes are critical.

The data reveal that age has no statistically significant impact on LPG cooking satisfaction, indicating that age alone may not be a deciding factor in fuel preference. In contrast, religion, specifically among Muslim households ($\beta = 1.306$, $Exp(\beta) = 3.691$, $p = 0.041$), significantly influences satisfaction, with Muslims 3.7 times more likely than Hindus to express satisfaction. This finding echoes Aggarwal et al. (2018), who observed that community-specific dynamics can influence LPG adoption and satisfaction. However, the slightly lower satisfaction observed among Backward Class (BC) and Other Category (OC) members is only marginally significant ($p = 0.07$ for BC, $p = 0.053$ for OC).

Education appears to have no statistically significant influence on satisfaction, indicating that even educated beneficiaries may struggle with LPG usage or refill costs. This aligns with Kar et al. (2020) and Kedia's (2022) findings that education alone may not drive behavioral change in fuel usage, and financial constraints often limit sustained adoption. Employment type, however, shows notable effects, with domestic servants significantly less satisfied ($\beta = -1.723$, $Exp(\beta) = 0.178$, $p = 0.049$). Manual laborers, including construction workers ($p = 0.063$), may face economic barriers, highlighting potential disparities in satisfaction that suggest a need for targeted subsidies or support for lower-income workers.

The data show that higher-income households (> ₹200,000 annually) are significantly less satisfied with LPG ($\beta = -0.933$, $Exp(\beta) = 0.393$, $p = 0.012$). This finding may reflect increased expectations among higher-income groups, who may view LPG as less convenient or cost-effective compared to other fuel sources. It aligns with Kedia's (2022) critique of PMUY, suggesting that mere access may not ensure satisfaction, as higher-income users could be influenced by preferences for other cooking methods.

Duration of LPG use shows no significant impact on satisfaction, supporting UNICEF (2020), which noted that sustained use of clean fuels like LPG requires not only access but also affordable refill options and a shift from biomass fuel reliance. Households purchasing 10-12 cylinders annually report slightly lower satisfaction ($\beta = -2.054$, $Exp(\beta) = 0.128$, $p = 0.097$), hinting at economic strain or dissatisfaction due to the cost burden associated with frequent refills, a limitation also highlighted by Ram and Mobarak (2018) in their analysis of refill affordability challenges.

Despite the assumed health benefits of LPG cooking, perception of health impacts does not significantly affect satisfaction in this study ($p = 0.751$). This finding challenges some previous research, such as that by Hanna et al. (2016), which cited health improvements as a primary motivator for LPG use. The lack of significance here may point to a gap in awareness or perceived immediate benefits among beneficiaries, possibly due to an insufficient focus on health education within the PMUY rollout.

In summary, the analysis supports that age, religion, financial flexibility, and credit access

significantly influence satisfaction with PMAY-G, SBA, and PMUY assistance, underscoring the importance of customized approaches to address diverse beneficiary needs across Tamil Nadu.

Conclusions

This study underscores the vital role of programme convergence, specifically the PMAY-G, SBM, and PMUY schemes, in enhancing socioeconomic conditions in rural Tamil Nadu. Results from the logistic model reveal that income stability, access to credit, and supplementary investments significantly impact beneficiary satisfaction with PMAY-G, affirming that higher household income and credit access lead to improved perceptions of adequacy (Mohapatra and Prusty, 2021). Findings further highlight that middle-aged respondents (36-55 years) and certain religious groups report lower adequacy perceptions, pointing to unmet age- and community-specific needs (Kumar and Ravindra, 2013; Kedia, 2022). For SBM, educational attainment and employment status emerge as significant predictors of satisfaction, indicating the influence of social and economic factors on community sanitation perceptions. Similarly, PMUY satisfaction levels vary by income and socio-cultural backgrounds, reflecting potential mismatches between program offerings and community-specific preferences (Kar et al., 2020).

This study's limitations include the use of cross-sectional data and binary logistic models, which may constrain the depth of understanding of dynamic and evolving factors affecting program satisfaction. Future studies would benefit from employing mixed methods and longitudinal analyses to capture long-term program impacts and integrating qualitative insights from beneficiaries to provide a richer understanding of programme nuances.

To optimize the effectiveness of convergent programs, policies should target socio-economic and cultural factors influencing satisfaction. Tailored approaches, such as income-sensitive subsidies, educational campaigns, and increased credit accessibility for PMUY and PMAY-G, could enhance program efficacy and beneficiary satisfaction. Furthermore, fostering community engagement and implementing behavior change strategies, as recommended by Hueso and Bell (2013), may improve acceptance and utilization. A convergence framework that integrates financial support, community participation, and behavioral interventions can serve as a sustainable model for rural socioeconomic upliftment in India.

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EARLY MARRIAGE AND INTRA-WOMEN DISPARITY IN LITERACY IN INDIA: A COMPREHENSIVE ANALYSIS OF TRENDS, PATTERNS AND INEQUALITY

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Abstract: The present study delves into a comprehensive analysis of early marriage and intra-women disparity in literacy across major states in India. The use of the Achievement Model by Atkinson and the General Entropy Index enhances the understanding of literacy disparities among women married at an early age compared to those married as adults. This paper uses the National Family Health Survey (NFHS) data—one to five rounds. The sample includes currently married women aged 15-49 years in India. The findings reveal that the literacy of women in adult marriage is disproportionately higher than that of women who married early. Poor households, rural areas, scheduled caste category, etc. are also important factors. The mean year of schooling of women in adult marriage is found to be higher than that of women in early marriage, and the gap in schooling has declined from NFHS-1 to NFHS-5. The states like Kerala, Tamil Nadu, and Maharashtra could retain their positions within rank 1 to rank 5 during NFHS-1 to NFHS-5 with respect to the intra-women disparity in literacy. Contrary to this, states like Rajasthan, Bihar, and Uttar Pradesh have retained the bottom three positions over the last three decades. The policy-level intervention to increase literacy for early married women and reduce inequality aligns with broader efforts towards improving educational achievement and addressing gender disparities.

Keywords: Early Marriage, Literacy, General Entropy Index, NFHS, India

Introduction

Gender disparity in literacy is quite high in India. The gender gap in literacy is considered to be a critical element in achieving social sector development in India (Swargiary, 2024). Moreover, literacy is considered to be a good qualitative indicator of development and plays a very important role in the socio-economic development of a country (Patowary, 2020). Sen (1990) argues that women with high rates of literacy have led to greater awareness and contributed to the socio-economic development of a country. In addition, persons aged seven-and-above who can read, write, and understand their own language are considered to be literate (Saurabh et al., 2013). Kumar et al. (2017)

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argue that the literacy rate of married women is very low in India.[1] Women with lower age at marriage are associated with lower education attainment, which leads to lower human capital formation in their lives (Singh et al., 2023; Parsons et al., 2015). Moreover, the probability of marriageable ages for girls increased by one year, and the acquisition of skills increased by 2 percent (Arthur et al., 2017). Previous literature suggests that women in early marriage have a greater risk of increasing the gender inequality in society (Jennifer et al., 2015). Moreover, girls who are illiterate are three times more likely to marry below the age of 18 as compared to girls with secondary and higher education (Marcus, 2018; UNFPA, 2012). Therefore, women in early marriage have been considered the main barrier to achieving universal primary education and promoting gender inequality in society, which affects the Sustainable Development Goal and Millennium Development Goal in India (Parsons et al., 2015; Khattak et al., 2017). Intra-women disparity in literacy occurred among those women who were married at an early age as compared to adults in India (Brahmapurkar, 2017). Therefore, intra-women disparities in literacy among married women have been found to be alarming in India.

The National Policy of Education 1986 (Government of India, 1986) has set down some guidelines for bridging the discrimination among married women, but the disparity has become quite high (Maiti et al., 2023). According to the Prohibition of Indian Child Marriage Act 2006 (Government of India, 2007), child marriage is defined as marriage or a union taking place before the age of 18 years. Researchers have used the term 'early marriage' for marriages occurring between 15 and 17 years of age (Chakravarty, 2021). Modak (2019) argues that the largest drop in the prevalence of early marriage has been in under-15 marriages, while marriages in the age group of 15-17 years continue to occur quite commonly in India. According to the NFHS-5 report (2019-2021), about 23.3 percent of women married below the age of 18 in 20-24 age cohorts of India. Moreover, the highest percentage of early marriage has been found in the states of Bihar, Rajasthan, Jharkhand, Uttar Pradesh, West Bengal, and Madhya Pradesh. Therefore, intra-women disparity in literacy is an important challenge before the country. In this paper, we are explaining the five sections. The review of literature and the objectives of the study are presented in the following section. The next section provides the data source. The methodology section of the paper discusses the achievement model and general entropy index. The estimates and findings of the study are presented in the results and the discussion sections. Finally, the conclusion section discusses the policy implications of the findings and the scope for future research on the issue.

Review of Literature and Research Gap

Early marriage continues to be a prevalent issue in India, particularly among women from rural and economically disadvantaged backgrounds (Dhamija and Roychowdhury, 2020). This practice has significant implications for women's access to education and their literacy levels. Literature on early marriage suggests that it disproportionately affects the literacy rates of women who marry at an early age compared to those who marry as adults. However, there is a lack of comprehensive analysis regarding the intra-women disparity in literacy stemming from early marriage within diverse socio-cultural contexts across major states within India. The literature review begins by examining the impact of early marriage on female literacy. Numerous studies have highlighted that young brides are more likely to drop out of school, leading to limited educational opportunities and lower literacy rates (Raj et al., 2019**).** For example, research conducted by Beattie et al. (2019) argue that Indian women who married before 18 years old were less likely to complete primary and secondary education compared to those marrying as adults. Additionally, social norms and cultural factors play

[1] Married women represent those who are married but currently not divorced, widowed or separated.

a significant role in perpetuating this gap. Societies with a higher prevalence of early marriages often prioritise traditional gender roles, which result in limited educational opportunities for young brides (Pourtaheri et al., 2024).

These cultural barriers exacerbate the intra-women disparity in literacy between those who marry at an early age versus adulthood. Furthermore, economic consequences stemming from early marriage also impact educational opportunities for young brides, contributing to disparities in literacy outcomes (Yoosefi et al., 2023). Studies have observed that household wealth can help mitigate the problems associated with female illiteracy; however, disparities persist within wealth quintiles (Azubuike et al., 2024). While existing literature provides valuable insights into the relationship between early marriage and female literacy levels in India, there are several notable research gaps. Most studies have not adequately explored potential differences within states across India. Besides, the existing literature has predominantly focused on establishing the association between early marriage and female literacy without thoroughly examining potential mediating factors such as individual, children, household, and partner characteristics, which may influence this relationship. Many existing studies are based on older datasets such as NFHS-3 or NFHS-4. Therefore, there is a need to work on more recent data sources like NFHS-5 and to compare over time.

The objectives of this study are:

1. To investigate the relationship between early marriage and female literacy among currently married women aged 15-49 years in India;
2. To compare education outcomes among women who were married at an early age compared to those who were married at an adult age across 15 major states in India and to see whether it converges or not.

These objectives aim to contribute to a comprehensive understanding of how marital timing intersects with the literacy of married women in India, thereby providing valuable insights for relevant policy and intervention strategies.

Data and Methodology

Data Source

This analysis uses National Family Health Survey (NFHS) data for the five rounds, which were conducted under the Ministry of Health and Family Welfare (MOHFW), Government of India.[2] MOHFW was designated by the International Institute for Population Sciences (IIPS), Mumbai, as the nodal agency for the survey. NFHS-5 data is chosen as the main source for this analysis because it provides the latest information on literacy among married women at a national level. NFHS data is basically cross-sectional data, i.e., all observations are at a given point in time. This paper has taken five time points from NFHS-1 to NFHS-5 to check the intra-women adjusted literacy among women who were married at an early age as compared to adults in India. This paper uses individual-level data on the behaviour of individual women and their literacy. The selection of 15 major states based on Indian Census 2011 adds depth to the analysis by considering diverse socio-cultural contexts within India. It was used to identify the inequality in literacy among women in early marriage as compared to adults in India.

[2] A detailed description of each round of NFHS with respect to its sampling design, data collection and procedure of survey is provided in the national report released by International Institute for Population Sciences (IIPS) for each round. These reports are available on their website (http://rchiips.org/nfhs/). The datasets are publicly available at https://www.dhsprogram.com/data/available-datasets.cfm.

Econometric Model

The logistic regression method has been applied in the regression analysis. The odds ratio (OR) is a statistical measure used in logistic regression to quantify the strength and direction of the association between a predictor variable and an outcome variable. The model can be written below.

$$P(\mathrm{Yij}=1)=\frac{1}{1+e^{-(\Theta_0+\Theta_1 \mathrm{i}1\, \mathrm{X}_1 \mathrm{i}1+\Theta_2 \mathrm{i}1\, \mathrm{X}_2 \mathrm{i}1+\Theta_3 \mathrm{i}1\, \mathrm{X}_3 \mathrm{i}1+\cdots+\Theta_{12} 1\, \mathrm{X}_{12} \mathrm{i}1 .+\epsilon_1)}}$$

In this model, Yij denotes the women's literacy, where i stands for individual and j stands for literacy (aged 15-49 years), which are binary variables. Here, θ_0 is the intercept term and θ_1, θ_2, … … . . θ_{12} are the coefficients of explanatory variables, respectively. In case of regressor variables, women in early marriage are classified into two categories: married less than 14 years (θ_1) and 15–17 years (θ_2), which are binary variables, and married above 18 years is the reference category. Here, control variables are age of women (θ_3), underweight (θ_4), currently working (θ_5), current age of child (θ_6), living children more than 3 (θ_7), child health problems (θ_8), nuclear family (θ_9), household wealth (θ_{10}), watching television (θ_{11}), spousal age gap (θ_{12}). Here, θ_1 is the error term. Regression model explained in the Appendix A. The odds ratio can be interpreted as follows: Odds ratio greater than 1—the predictor variable (early marriage) increases the chances of the event occurring (literacy); odds ratio less than 1—the predictor variable (early marriage) decreases the chances of the event occurring (literacy); odds ratio equal to 1—the predictor variable (early marriage) does not affect the risk of the event occurring (literacy).

Outcome Variables

Education outcome is measured by the literacy of married women**.** Literacy can be measured by a woman being able to read and write a sentence, which is binary in nature (Handebo et al., 2023; Lam et al., 2011).

Regressor Variables

The variable of age at cohabitation is used as a proxy for age at marriage. According to the NFHS-4 report, 'cohabitation' is defined as a couple living together as if married and raising the same human rights concerns as applicable for marriage (Meggiolaro and Ongaro, 2019). Modak (2019) argue that the largest drop in the prevalence of early marriage has been in under-15 marriages, while marriages in the age group of 15-17 years continue to occur quite commonly in India. For those reasons, women in early marriage can be classified into two categories. Here, the regressor variables of women in early marriage can be classified into two categories: marriage less than 14 years and 15-17 years.

Control Variables

The inclusion of control variables in the analysis to capture the effect of early marriage on literacy in India is a critical component of rigorous research. Control variables help to isolate the impact of early marriage on literacy levels while accounting for other factors that may also influence educational outcomes. The suggested categories for control variables align with existing literature and provide a comprehensive framework for understanding the complex interplay between early marriage, women's literacy, and various socio-economic and demographic factors. The child-specific variables, such as current age and health status, are particularly important as they can directly impact a woman's ability to pursue education after an early marriage (Datta et al., 2022). Additionally, considering individual-specific variables like women's age, underweight status, and employment status provides valuable insights into how these factors can influence educational attainment among married women

(Murakami et al., 2017). These are crucial considerations as they encompass both personal attributes and societal dynamics that shape educational opportunities (Howlader et al., 2023). Moreover, a higher spousal age gap indicates lower autonomy and decision-making power for married women, which is negatively associated with the literacy of married women (Mare et al., 2022).

Household-specific variables related to family structure and wealth further illuminate the broader context in which early marriage occurs (Mughal and Awan, 2020). Understanding how household characteristics impact female literacy highlights the interconnectedness between individual agency and socio-economic conditions within a family unit (Marphatia et al., 2021). Finally, community-specific variables like access to media (for example, TV) offer insights into external influences that may shape educational opportunities for married women within their communities (Brahmapurkar, 2017). It is evident from existing literature cited in this discussion that these control variables have been studied extensively in relation to female education outcomes globally. Incorporating this knowledge into the analysis not only strengthens its empirical grounding but also ensures that potential confounding factors are appropriately addressed. By systematically integrating these control variables into the analysis framework, researchers can more accurately assess the specific impact of early marriage on women's literacy levels while accounting for other influential determinants.

Achievement Model

To measure the gap in literacy among women in early marriage as compared to adults in India, this paper uses the approach of the Atkinson (1970) model for measuring relative literacy gaps. Let X measures the achievement of women. Here, X_f and X_m denote the achievement of early and adult marriage women. This paper assumes $X_f < X_m$ Moreover, N_f and X_m indicate the numbers of early and adult marriage women in the population. The mean achievement is denoted by $\overline{X}$, which is given below:

$$\overline{X} = \frac{N_f X_f + N_m X_m}{N_f + N_m} \qquad \ldots\ldots \text{(a)}$$

It can be written as $\overline{X} = P_f X_f + P_m X_m$. Here, P_f and P_m denote the proportion of early and adult marriage women in the population, respectively. Here, social planner objectives are to create an optimum trade-off between a high level of mean achievement and a minimum intra-women gap in literacy rate. Moreover, social planners want to increase the mean level of achievement ($\overline{X}$) on one hand and reduce the gap between early and adult marriage women ($X_m - X_f$) on the other. To solve this problem, then consider a social value function for achievement, which is additively, separable, symmetric, and with constant elasticity of marginal value. The equation is presented as:

$$V(X) = \begin{cases} \dfrac{X^{(1-\varepsilon)}}{(1-\varepsilon)}, & \varepsilon \geq 0, \varepsilon \neq 1 \\ Log\ X, & \varepsilon = 1 \end{cases}$$

Here, ε denotes the preference for equality in the social valuation function, which is positive. Therefore, we can construct 'Equally Distributed Equivalent Achievement' (X_{EDEA}). According to social value function, for a given value of ε, X_{EDEA} is defined as:

$$\mathrm{X_{EDEA}} = [\mathrm{P_f X_f^{(1-\varepsilon)}} + \mathrm{P_m X_m^{(1-\varepsilon)}}]^{\frac{1}{(1-\varepsilon)}} \qquad \ldots\ldots \text{(b)}$$

where $P_f = \frac{N_f}{(N_f+N_m)}$ and $P_m = \frac{N_m}{(N_f+N_m)}$

Here, X_{EDEA} is defined by "(1- ε) average"of X_f and X_m and rather than a simple arithmetic average of the two groups. The important results can be demonstrated for "(1- ε) average" from equation (b):

1. The optimum trade-off is done by high level of women achievement and the Intra-women equality through X_{EDEA} for ε > 0. When ε = 0, X_{EDEA} reduces to $\bar{X}$. There is no concern for equality. But when ε > 0, there is a social preference for equality.
2. When ε = ∞, $X_{ede} \rightarrow$ Min,$\{X_f, X_m\}$. This means that sensitivity is so high; and we end up at a lower pair of the two numbers. The larger the value of ε, the smaller the value of X_{ede} (given X_f ,$X_m > 0$). If early marriage occurrence (X_f) is lower than the adult marriage occurrence (X_m), the following results will be obtained: $X_f \leq X_{ede} \leq Xm$.
3. From equation (b), we have the following results assuming $P_f = P_m = \frac{1}{2}$. If ε = 0, X_{EDEA} = $\bar{X}$, and if ε = 1, $X_{EDEA} = \sqrt{X_f X_m}$ = GM of X_f & X_m. Similarly, for ε = 2, $X_{EDEA} = \frac{2}{\frac{1}{x_f}+\frac{1}{x_m}}$

   HM of X_f and X_m . Therefore, we can write: $X_{EDEA} \leq \bar{X}$ for ε ≥ 0. This follows that:

$$\frac{X_{EDEA}}{\bar{X}} \leq 1 \text{ for } \varepsilon \geq 0 \qquad \ldots\ldots \text{(c).}$$

General Entropy (GE) Index

The GE Index is used to measure inequality in literacy rates among women in early marriage as compared to adults in 15 major states of India. This paper uses a parameter α that assigns a weighted difference in literacy rate among 15 major states of India. Here, the value of α lies between zero and infinity. A lower value of α is more sensitive to changes in the lower tail of the distribution, and higher values of α represent the upper tail of the distribution. The most common values of α became 0, 1, and 2. When α = 0, the index is called "Theil's L" or "mean log deviation." When α = 1, the index is called "Theil's T" or Theil index". When α = 2, the index is called the "coefficient of variation".

Results

The data presented in Table 1 clearly demonstrates that across various demographic characteristics and regions in India, women who were married at an early age have lower literacy rates compared to those who married as adults. The prevalence of literacy among women in adult marriage is disproportionately higher than that of women in early marriage with respect to various demographic characteristics such as the poorest household (52.79 percent vs. 47.21 percent), rural areas (65.04 percent vs. 34.96 percent), the scheduled caste category (64.24 percent vs. 35.76 percent), and Hindu communities (66.92 percent vs. 33.08 percent) of India. Similarly, across all regions of India, the same result was found: the literacy of women in adult marriage is greater than that of women in early marriage. For example, the northern (76.24 percent vs. 23.76 percent), southern (72.05 percent vs. 27.95 percent), and northeastern (69.35 percent vs. 30.65 percent) regions have a higher percentage of literacy among women in adult marriage than those who witnessed early marriage in India. This information is essential for understanding the intersectionality of factors contributing to lower literacy rates among women who marry early.

Table 1: Prevalence of Literacy of Currently Married Women Aged 15-49

Demographic Characteristic	Adult Marriage		Early Marriage		Total
	N	%	N	%	
Region of residence					
Rural	108,507	65.04	58,321	34.96	100
Urban	55,841	74.36	19,259	25.64	100
Religion					
Hindu	120,815	66.92	59,716	33.08	100
Muslim	20,894	65.43	11,040	34.57	100
Social category					
Schedule Caste (SC)	24,624	64.24	13,708	35.76	100
Schedule Trib e (ST)	27,757	68.62	12,696	31.38	100
Other backward classes (OBC)	63,061	65.75	32,844	34.25	100
Others	40,752	73.85	14,429	26.15	100
Wealth quintile					
Poorest	14,528	52.79	12,990	47.21	100
Poor	27,508	58.32	19,658	41.68	100
Middle	35,176	65.44	18,580	34.56	100
Richer	41,315	72.19	15,912	27.81	100
Richest	45,821	81.44	10,440	18.56	100
Region of the country					
North	36,389	76.24	11,343	23.76	100
central	34,784	65.34	18,449	34.66	100
East	23,112	55.83	18,287	44.17	100
Northeast	26,463	69.35	11,693	30.65	100
west	15,289	69.14	6,823	30.86	100
south	28,311	72.05	10,985	27.95	100

Note: % is based on weighted sample and N is unweighted sample.
Source: Calculated by authors using NFHS-5 data.

Table 2 presents the mean years of schooling of currently married women aged 15-49 who were married early as compared to adults in India. The t-test shows a comparison of the mean years of schooling between currently married women who were married early and those who married as adults in India. The significant difference in the mean year of schooling between these two groups indicated that early marriage has an impact on educational attainment. Here, the mean year of schooling of women in adult marriage is higher than that of women in early marriage in all NFHS data of India. Additionally, the gap in mean year of schooling has declined from NFHS-1 (4.36 percent) to NFHS-5 (3.85 percent), providing valuable insight into the trend over time. This information is important for understanding changes in educational opportunities for women in India. All gaps are significant at the 1% level.

Table 2: Mean Years of Schooling of Currently Married Women Aged 15-49

Variable: Years of Schooling	NFHS-1		NFHS-2		NFHS-3	
	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
Gr.1: Adult Marriage	7.58	0.001	7.61	0.002	7.66	0.002
Gr.2: Child Marriage	3.22	0.002	3.27	0.002	3.30	0.002
Combined	5.39	0.002	5.41	0.002	5.45	0.002
Mean difference (Gr. 1 - Gr. 2)	4.36***	0.003	4.34***	0.003	4.36***	0.003
Observation Gr.1	33014		40026		41131	
Observation Gr.2	57749		55987		53220	
Combined	90763		96013		94351	

Variable: Years of Schooling	NFHS-4		NFHS-5	
	Mean	Std. Err.	Mean	Std. Err.
Gr.1: Adult Marriage	7.77	0.001	8.01	0.013
Gr.2: Child Marriage	3.39	0.002	4.16	0.014
Combined	5.12	0.001	6.08	0.010
Mean difference (Gr. 1- Gr. 2)	4.38***	0.003	3.85***	0.019
Observation Gr. 1	83401		148,441	
Observation Gr. 2	55689		93,939	
Combined	139090		242,380	

Note: *, **, and *** refer to 10%, 5%, and 1% levels of significance, respectively.
*Source:*Calculated by authors using NFHS 1-5 data.

Table 3 presents the percentage of the intra-women gap in literacy rate of currently married women aged 15-49 who were married at an early age as compared to adults across 15 major states (NFHS-2 to NFHS-5). Here, AM denotes the literacy of women in adult marriage; CM denotes the literacy of women in early marriage; IWG represents the intra-women gap in literacy; and RG represents the relative gap in literacy. The analysis reveals that the literacy rate of women in adult marriage is consistently higher than that of women in early marriage across all major states. The relative gap in literacy has shown variability over time, with certain states exhibiting notable changes. In NFHS-2, Madhya Pradesh had the highest relative gap in literacy (61.87 percent), followed by Uttar Pradesh (60.32 percent) and Karnataka (58.62 percent). Conversely, Kerala (12.43 percent) had the lowest relative gap, followed by Assam (37.16 percent) at that time. However, over the years, there have been shifts in these rankings. In NFHS-5 data, Madhya Pradesh (37.1 percent) and Punjab (36.5 percent) showed the highest relative gaps, while Kerala (6.09 percent) maintained its position with the lowest relative gap, followed by Assam (12.8 percent). The analysis also highlights volatility and changes in married women's literacy across major Indian states over the decades studied. It is worth noting that while there has been a decline in intra-women gaps in literacy for Andhra Pradesh, Assam, and Tamil Nadu from NFHS-2 to NFHS-5, it does not always correspond to an increase in overall adjusted literacy for women married at an early age compared to adults.

Table 3: Percentage of Intra-women Gap in Literacy Rate of Currently Married Women Aged 15-49 who were Married an Early Age as Compared to Adults across 15 Major States in India

State	NFHS-2 (1997-98)				NFHS-3 (2005-06)				RG of NFHS-2 to 3
	AM	CM	IWG	RG	AM	CM	IWG	RG	
Andhra Pradesh	68.51	29.72	38.79	56.62	75.17	43.3	31.89	42.42	25.07
Assam	64.93	40.8	24.13	37.16	71.75	47.5	24.24	33.78	9.09
Bihar	38	17.79	20.21	53.18	59.5	28.9	30.56	51.36	3.43
Gujarat	69.56	31.83	37.73	54.24	71.27	42.4	28.91	40.56	25.22
Haryana	61.77	30.33	31.44	50.9	64.83	42.8	22.01	33.95	33.3
Karnataka	73.03	30.22	42.81	58.62	71.83	37	34.87	48.55	17.19
Kerala	92.34	80.86	11.48	12.43	94.87	85.2	9.69	10.21	17.84
Madhya Pradesh	61.13	23.31	37.82	61.87	69.63	37	32.64	46.88	24.23
Maharashtra	85.12	45.2	39.92	46.9	85.87	55.8	30.07	35.02	25.33
Odisha	62.61	30.06	32.55	51.99	66.46	34.4	32.05	48.22	7.24
Punjab	70.25	38	32.25	45.91	72.43	42	30.46	42.05	8.39
Rajasthan	40.79	18.06	22.73	55.72	46.61	25.5	21.08	45.23	18.84
Tamil Nadu	67.99	40.48	27.51	40.46	75.29	52.2	23.07	30.64	24.27
Uttar Pradesh	54.87	21.77	33.1	60.32	59.53	30.1	29.47	49.5	17.94
West Bengal	75.68	45.05	30.63	40.47	75.88	49.8	26.11	34.41	14.98
State	**NFHS-4 (2015-16)**				**NFHS-5 (2019-21)**				**RG of NFHS-4 to 5**
	AM	**CM**	**IWG**	**RG**	**AM**	**CM**	**IWG**	**RG**	
Andhra Pradesh	70.1	49	21.05	30.1	70.63	49.7	20.89	29.6	1.74
Assam	71.8	60.4	11.36	15.8	72.73	63.4	9.29	12.8	19.16
Bihar	46.4	36.9	9.46	20.4	51.74	36.9	14.85	28.7	-40.69
Gujarat	73.5	52.6	20.98	28.5	70.43	51.7	18.72	26.6	6.74
Haryana	77.1	58.4	18.7	24.3	79.86	59.5	20.4	25.5	-5.12
Karnataka	72.5	52.1	20.31	28	74.58	50.6	24.01	32.2	-14.98
Kerala	98.1	94.9	3.18	3.24	95.45	89.6	5.81	6.09	-87.87
Madhya Pradesh	62.1	37.4	24.76	39.9	64.52	40.6	23.92	37.1	7.08
Maharashtra	82.5	64.4	18.1	21.9	82.73	62.6	20.09	24.3	-10.88
Odisha	66.5	50.2	16.36	24.6	67.3	47.9	19.39	28.8	-17.12
Punjab	79.6	57.5	22.01	27.7	77.86	49.5	28.38	36.5	-31.59
Rajasthan	57.1	38.3	18.78	32.9	58.86	42.1	16.79	28.5	13.3
Tamil Nadu	81.8	61.6	20.19	24.7	84.9	64.8	20.14	23.7	3.96
Uttar Pradesh	60.4	39.1	21.31	35.3	61.92	42.8	19.14	30.9	12.43
West Bengal	72	59.1	12.83	17.8	76.5	58	18.55	24.2	-36.23

Note: RG: Relative gap in literacy. Relative gap is calculated as: (Literacy gap of AM – Literacy gap of CM) / (Literacy gap of AM) *100.

Source: Calculated by authors using NFHS 2-5 data.

The logistic regression model presented in Table 4 demonstrates the association between literacy and women in early marriage among currently married women aged 15-49 years in India. Here, women in early marriage can be classified into two categories: marriage <14 years and 15-17 years. The analysis indicates that women married at a young age, specifically those married at less than 14 years, have lower odds (0.155 points in NFHS-5 and 0.177 points in NFHS-4 in UAOR and 0.857 points in NFHS-5 and 0.838 points in NFHS-4 in AOR) of being literate than those married above 18 years, as evidenced by both unadjusted and adjusted odd ratios. The entire coefficients are significant at the 1 percent level. The results can test the following null hypothesis $H_0: \theta_{1i3} = 0$ and alternative hypothesis $H_1: \theta_{1i3} \neq 0$. Here, the results accept the null hypothesis (Ho); that is, the above-mentioned hypothesis is valid, and this rejects the alternative hypothesis in all unadjusted and adjusted models. In addition, the marginal effect is lower for less than 14 years of married women as compared to above 18 years of married women in both adjusted and unadjusted models of India.

Additionally, the study highlights that girls who marry at an early age are more likely to drop out of school and have lower levels of educational attainment than those who marry later in life (Dahl, 2010; Raj et al., 2019). This is due to various factors, such as parental beliefs that schooling is not important for girls once they move to their husband's family after marriage, leading them to prioritise domestic work over education (Mughal and Awan, 2020). The results also indicate that even among those married within the age range of 15-17, there are lower odds of literacy compared to women married above 18 years. The analysis indicates that women married at a young age—specifically those married within 15-17 years' age range—have lower odds (0.296 points in NFHS-5 and 0.316 points in NFHS-4 in UAOR; and 0.888 points in NFHS-5 and 0.909 points in NFHS-4 in AOR) of being literate than those married above 18 years, as evidenced by both unadjusted and adjusted odd ratios. The entire coefficients are significant at the 1 percent level. The result can test the following null H_0; $\theta_{2i3} = 0$ hypothesis and alternative hypothesis $H_1: \theta_{2i3} \neq 0$. Here, the results accept the null hypothesis (Ho); that is, the above-mentioned hypothesis is valid, and this rejects the alternative hypothesis in all unadjusted and adjusted models.

Therefore, the results can say that women in early marriage (say, 15-17 years) have lower chances of being literate than women in adult marriage (≥ 18 years) in India. One thing is very crucial in the adjusted and unadjusted odd ratio: women married within 15-17 years have higher odds of being literate than women married at less than 14 years. In addition, among adjusted and unadjusted models, the marginal effect is lower for 15-17 years of married women than for above 18 years of married women in both data analyses of India. Similarly, the marginal effect is lower for less than 14 years of married women than for 15-17 years of married women. Furthermore, the analysis suggests that poverty often drives parents to marry off their daughters at an early age, leading them to drop out of school due to their marriage (Parsons et al., 2015; Sheetal and Sisir, 2014). Gender inequality within households and society also hinders educational opportunities for young married women (Brahmapurkar, 2017; Raj et al., 2019). This suggests a consistent trend where early marriage is associated with reduced educational opportunities for young women. Overall, the findings support the conclusion that there are significant barriers to education for girls who enter into early marriages in India.

Over the last two decades, the literacy in India has increased. This attainment, however, has not been the same in all states; while some states have achieved a high literacy level, others are far behind. In Figure 1, IWG is higher in the states of Madhya Pradesh, Karnataka, and Punjab than the state mean level in NFHS-5 data. Moreover, the gap is consistently higher than the state mean level

in all NFHS data. So, this state's position became worse in 15 major states at different time points of NFHS data in India. Similarly, states like Kerala and Assam are performing better in terms of the intra-women gap in literacy rate than the state mean level in NFHS-5 data.

Table 4: Logistic Regression Models

	NFHS-5			NFHS-4		
	Unadjusted (UAOR)			Unadjusted (UAOR)		
	ORs	[95% Conf. Interval]	Marginal effect	ORs	[95% Conf. Interval]	Marginal effect
Dependent variable: Women literacy						
Independent variable: Different categories of women in early marriage						
<14 years	0.155***	0.151-0.158	-0.434	0.177***	0.173-0.181	-0.408
	0.002			0.002		
15-17 years	0.296***	0.292-0.298	-0.268	0.316***	0.312-0.319	-0.264
	0.002			0.002		
≥18 years	(1.00 ref)			(1.00 ref)		
Cons.	3.858***	3.83-3.88		3.232***	3.21-.3.25	
	0.013			0.011		
Pseudo R^2	0.0684			0.062		
N	512,408			499,627		
	NFHS-5			NFHS-4		
	Adjusted (AOR)			Adjusted (AOR)		
	ORs	[95% Conf. Interval]	Marginal effect	ORs	[95% Conf. Interval]	Marginal effect
Dependent variable: Women literacy						
Independent variable: Different categories of women in early marriage						
<14 years	0.857***	0.753-0.974	-0.027	0.838***	0.719-0.975	-0.023
	0.056			0.065		
15-17 years	0.888***	0.827-0.952	-0.020	0.909***	0.833-0.992	-0.012
	0.032			0.040		
≥18 years	(1.00 ref)			(1.00 ref)		
Cons.	0.048***	0.036-0.064		0.023***	0.016-0.034	
	0.007			0.004		
Pseudo R^2	0.609			0.759		
N	54,599			55,578		

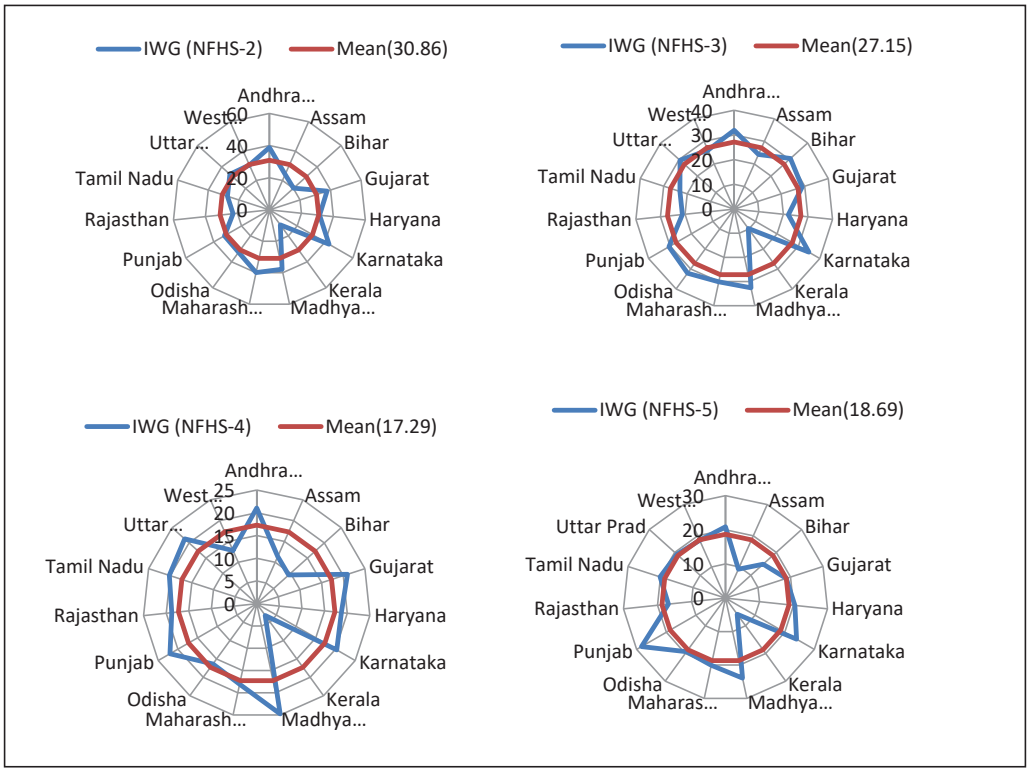
Notes: *, **, and *** refer to 10%, 5%, and 1% levels of significance, respectively. Regression control for women age, women underweight, work for last 12 months, current age of child, living child ≥ 3, child health problem, nuclear family, household wealth, spousal age gap, and watching television.

Source: Calculated by authors using NFHS-5 data.

Intra-women disparity in literacy is calculated during five time points of NFHS data across 15 major states of India, as shown in Table 5. In order to understand the relative position of the states over time with respect to the intra-women adjusted literacy, calculate X_{edea} (equality distributed

equivalent achievement), assuming the inequality aversion parameter ε = 1. It is interesting to note that states like Kerala, Tamil Nadu, and Maharashtra are capable of retaining their positions of 1 to 3 during NFHS-1 to NFHS-5 in respect of intra-women adjusted literacy (X_{ede} for literacy); however, contrary to this, states like Rajasthan, Bihar, and Uttar Pradesh have been remaining in the bottom 3 positions in respect of intra-women adjusted literacy. Moreover, the positions of some states like West Bengal and Punjab are found to be volatile in respect of intra-women adjusted literacy. Kerala did perform well over the period from NFHS-1 to NFHS-5. The positions of states like Maharashtra and Tamil Nadu were 3 and 4, respectively, among the 15 major states in the NFHS-5 data. In NFHS-5 data, Punjab has improved its position to 2nd rank, whereas Haryana ranked 5th. The relative positions of the states like West Bengal and Gujarat have deteriorated from NFHS-1 to NFHS-5. Rajasthan and Bihar have appeared to be the worst states in respect of the intra-women adjusted literacy (Xedea), and its position remained the same from NFHS-1 to NFHS-5.

Figure 1: Inter-state Variation of the Intra-women Gap in Literacy around the State Mean Level in India



Source: Calculated by authors using NFHS 2-5 data.

Table 5: Intra-women Adjusted Literacy (Xedea, ε = 1) among Currently Married Women Aged 15-49, Who were Married at an Early Age as Compared to Adults across Major States in India

State	NFHS-1	Rank	NFHS-2	Rank	NFHS-3	Rank
Kerala	83.89	1	88.93	1	92.3	1
Tamil Nadu	47.68	2	54.9	5	65.08	3
Maharashtra	46.72	3	59.1	3	69.88	2
Assam	46.58	4	50.91	6	58.66	6
Punjab	45.39	5	61.45	2	59.92	4
West Bengal	44.5	6	55.94	4	59.48	5
Gujarat	42.91	7	47.07	7	55.43	7
Haryana	36.58	8	42.59	8	51.64	9
Karnataka	34.5	9	41.62	9	49.76	10
Odisha	33.68	10	40.86	10	46.22	12
Andhra Pradesh	28.38	11	35.37	11	53.35	8
Madhya Pradesh	23.77	12	29.16	12	47.52	11
Uttar Pradesh	22.42	13	28.05	13	39.5	13
Bihar	22.03	14	21.99	15	35.36	14
Rajasthan	16.57	15	22.63	14	30.68	15

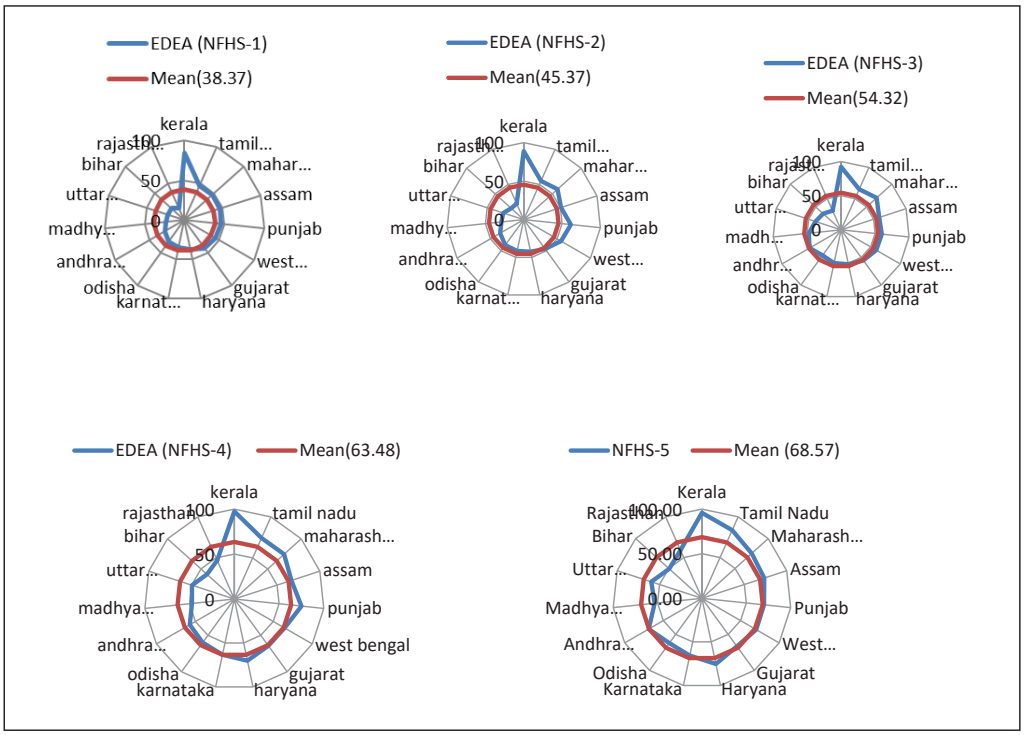
State	NFHS-4	Rank	NFHS-5	Rank
Kerala	97.48	1	93.87	1
Tamil Nadu	74.32	4	81.57	2
Maharashtra	74.47	3	73.14	4
Assam	66.77	6	71.43	5
Punjab	75.02	2	67.99	7
West Bengal	64.41	7	68.23	6
Gujarat	64.34	8	64.61	9
Haryana	70.17	5	73.32	3
Karnataka	63.36	9	63.76	10
Odisha	59.86	10	60.16	11
Andhra Pradesh	57.19	11	66.92	8
Madhya Pradesh	47.39	13	51.24	14
Uttar Pradesh	49.52	12	57.76	12
Bihar	41.01	15	47.38	15
Rajasthan	46.92	14	57.09	13

Source: Calculated by authors using NFHS 1-5 data

The state-level disparity of X_{edea} around mean X_{edea} from NFHS-1 to NFHS-5 is presented graphically in the following radar graph in Figure 2**.** In this figure, states like Rajasthan, Bihar, and Uttar Pradesh are found to be in a worse position than the state mean level in all NFHS data. Similarly, states like Kerala, Tamil Nadu, and Maharashtra are found to be in the top position, and their values remain above the state mean level. The maximum inequality is found in the states of Bihar and Rajasthan in the NFHS-4 data. When moving from NFHS-1 to NFHS-5, then result can

find that the states like West Bengal, Odisha, Karnataka, and Assam remain in the same position at the state mean level.

Figure 2: Inter-state Variation of Literacy ($X_{ede,}$ ε = 1) around State Mean Level in India



Source: Calculated by authors using NFHS 1-5 data.

In this analysis, we examine the convergence of the states with respect to the intra-women adjusted literacy ($X_{edea, \varepsilon}$ = 1). The values of GE (0), GE (1), and GE (2) have declined in all NFHS-1 to NFHS-5 data sets, which means that the states are converging in respect of the intra-women gap in literacy. This is presented in Table 6. In NFHS-1, the GE (1) index of intra-women adjusted literacy is 0.0341 log point, and the value dropped to 0.0058 log point in NFHS-5. Thus, the results can conclude that states are converging in respect of the intra-women gap in literacy rate.

Table 6: General Entropy Index (x_{ede}, ε = 1) for Different Time Points in India

	NFHS-1	NFHS-2	NFHS-3	NFHS-4	NFHS-5
GE (0) / Mean log deviation					
Combined Literacy rate	0.0219	0.0162	0.0093	0.0087	0.0064
Adult married literacy rate	0.0159	0.0106	0.0063	0.0053	0.0046
Early married literacy rate	0.0401	0.0333	0.0190	0.0135	0.0101
Xede, ε = 1	0.0342	0.0305	0.0151	0.0102	0.0058
Xede, ε = 2	0.0370	0.0331	0.0165	0.0107	0.0060

Contd...

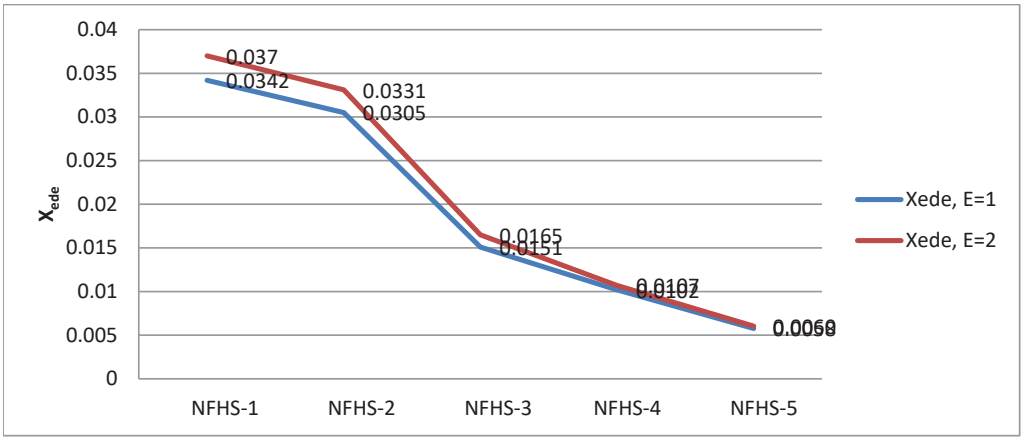
Table 6 contd...

	NFHS-1	NFHS-2	NFHS-3	NFHS-4	NFHS-5
GE(1) / Theil Index					
Combined Literacy rate	0.0214	0.0160	0.0094	0.0088	0.0065
Adult married literacy rate	0.0148	0.0099	0.0061	0.0052	0.0045
Early married literacy rate	0.0432	0.0352	0.0200	0.0140	0.0105
Xede, ε = 1	0.0341	0.0297	0.0150	0.0102	0.0058
Xede, ε = 2	0.0374	0.0325	0.0165	0.0107	0.0061
GE(2) / Coefficient of variation					
Combined Literacy rate	0.0545	0.0403	0.0240	0.0222	0.0164
Adult married literacy rate	0.0350	0.0234	0.0148	0.0127	0.0110
Early married literacy rate	0.1271	0.0992	0.0547	0.0368	0.0277
Xede, ε = 1	0.0910	0.0755	0.0382	0.0254	0.0145
Xede, ε = 2	0.1018	0.0841	0.0424	0.0268	0.0152

Note: All figures are in log point.
Source: Calculated by authors using NFHS 1-5 data.

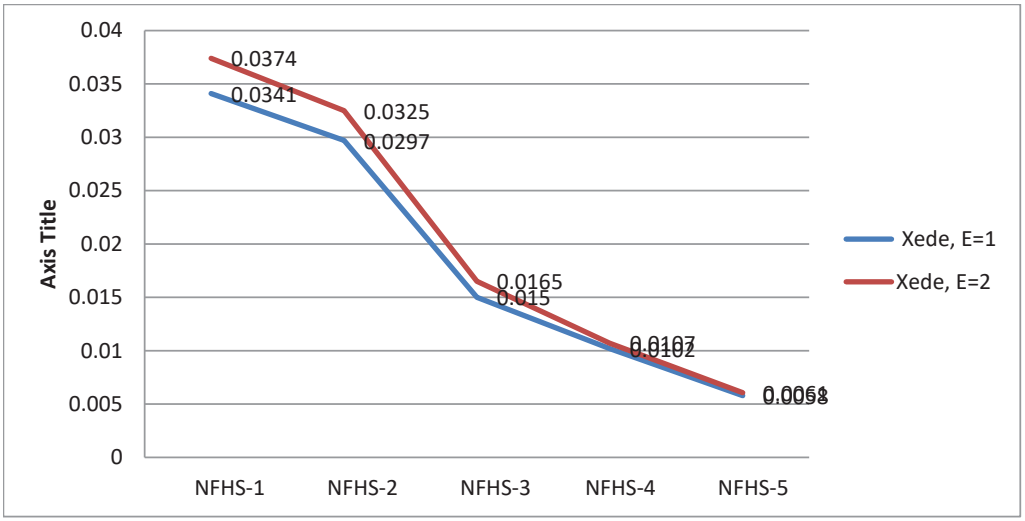
Figures 3-5 show the values of X_{ede} for the five time points considered in the study. Figure 3 shows the mean log deviation results; Figure 4 shows the Theil index results; and Figure 5 shows the coefficient of variation results. In this analysis, a fall in X_{edea} values from NFHS 1 to NFHS 5 shows a fall in the literacy gap between women in early and adult marriages. However, the fall in inequality was greater between NFHS 2 and NFHS 3. Since NFHS-3, the rate of decline in the literacy gap has fallen.

Figure 3: Mean log Deviation of Literacy for Five Time Points in India



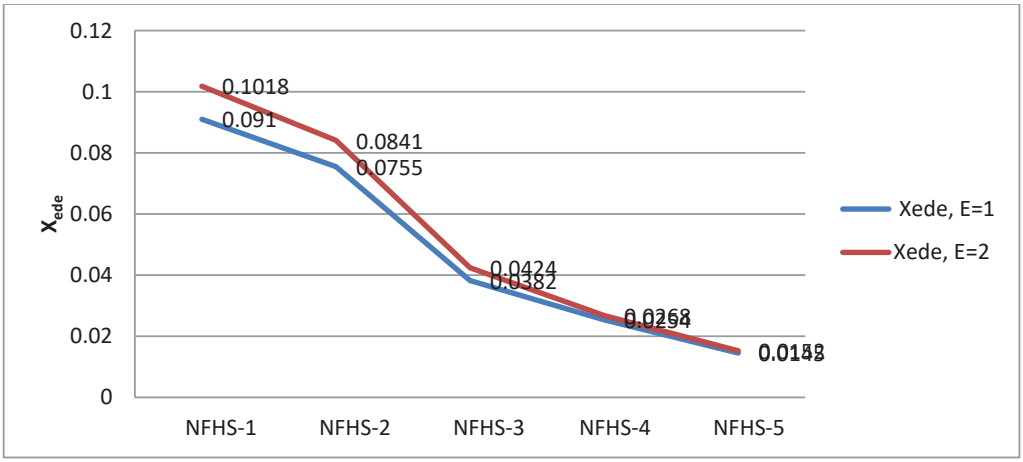
Source: Calculated by authors using NFHS 1-5 data.

Figure 4: Theil Index of Literacy for Different Time Points in India



Source: Calculated by authors using NFHS 1-5 data.

Figure 5: Coefficient of Variation of Literacy for Different Time Points in India



Source: Calculated by authors using NFHS 1-5 data.

Discussion

The analysis presented in this study provides a comprehensive understanding of the relationship between early marriage and women's literacy levels in India. The findings underscore significant disparities in literacy prevalence and mean years of schooling between women who were married at an early age and those married as adults, across various demographic characteristics and regions. The study's exploration of intra-women gap and relative gap over time offers nuanced perspectives on state-level disparities, shedding light on regional variations that allow for targeted interventions to address educational inequalities among women. The consistent decrease in the intra-women gap in literacy over time from NFHS-2 to NFHS-5 indicates some progress, although it is important

to note that some states continue to struggle with low levels of literacy among women married at an early age. The findings underline the need for targeted interventions focused on improving literacy rates among women married at an early age, especially in states where disparities are most pronounced.

Additionally, the importance of continued monitoring and evaluation of state-level disparities is highlighted to identify areas requiring urgent attention. As regards odds ratios shown in logistic regression models, the analysis highlights lower odds of literacy among women married at an early age compared to those married as adults. It underscores the need for specific policies and programmes aimed at improving education access for girls at risk of early marriage. However, it is crucial for all conclusions throughout the paper to be coherent across different sections. Any conflicting results should be carefully addressed with clear explanations or potential contextual factors that could contribute to these discrepancies. Furthermore, while this analysis provides valuable insights into trends over time, further research could delve deeper into underlying reasons for changes observed in intra-women gaps over the years. This comprehensive analysis contributes significantly by emphasizing urgency in addressing educational disparities among girls at risk of early marriage and highlighting key areas where targeted interventions can make a meaningful difference in promoting gender equality through education.

Conclusions

The analysis provides a comprehensive understanding of the disparities in literacy levels and mean years of schooling between women married at an early age and those married as adults in India. The findings reveal that the literacy of women in adult marriage is disproportionately higher than that of women in early marriage in poor households. Apart from this, rural areas, the scheduled caste category, and Hindu communities are also determining factors. From regression analysis, it appears that women in early marriage have lower chances of being literate in India. This suggests that early marriage of women acts as a barrier to their literacy. The findings underscore the urgent need to address educational barriers for girls at risk of early marriage and emphasise regional variations that necessitate targeted interventions. The study recommends specific attention be given to states with high gaps in literacy rates—such as Madhya Pradesh, Orissa, Rajasthan, and Uttar Pradesh—to improve literacy among young married women. Furthermore, it emphasises the importance of policies aimed at improving access to education for young girls as a means of contributing to gender equality and societal development.

The analysis calls for targeted educational initiatives aimed at preventing early marriage and enabling girls to stay in school longer, particularly focusing on areas with high rates of early marriage. Additionally, it recommends policy enhancements to raise the minimum age of marriage, allowing girls more opportunities for education before entering into marriage. There is also a suggestion for further research into underlying social, cultural, and economic factors driving changes in educational inequalities over time. Future studies are suggested to focus on assessing the long-term impact of educational interventions on delaying marriage and empowering women across different regions within India. Overall, this analysis underscores the critical role that education plays in empowering women while calling for concerted efforts from policymakers, researchers, and stakeholders to ensure equal opportunities for all girls regardless of their marital status.

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APPENDIX

Appendix A: Description of Variables Used in the Analysis

Outcome variables	Description	Coding of variables
Y_1	Literacy	♦ 1 if women is literate, 0 otherwise
Regressor variables	**Description**	**Coding of variables**
X_1	Married less than 14 years	♦ 1 if women married ≤14 years, 0 otherwise
X_2	Married 14-15 years	♦ 1 if women married 15-17 years, 0 otherwise
Control variables	**Description**	**Coding of variables**
X_3	Women age	♦ Continuous variables
X_4	Women underweight	♦ 1 if women underweight (BMI < 18.5); 0 otherwise
X_5	Currently working	♦ 1 if yes, 0 otherwise
X_6	Current age of child	♦ Continuous variable
X_7	Living child more than 3	♦ 1 if yes, 0 otherwise
X_8	Child health problems	♦ 1 if yes, 0 otherwise
X_9	Nuclear family	♦ 1 if household members <= 4, 0 otherwise
X_{10}	Household wealth	♦ categorical variable
X_{11}	Watching television	♦ 1 if yes, 0 otherwise
X_{12}	Spousal age gap	♦ Continuous variables

Source: Extracted from NFHS-4 and NFHS-5 data.

BOOK REVIEW

Econometrics of Money and Happiness in India **by T. Lakshmanasamy, 2023, Concept Publishing Company Ltd., pp. 404, Rs. 1750/-**

When I just started my early lessons in Economics, my teachers taught me about the neo-classical approach to welfare maximisation. I also learnt lessons related to Irving Fisher's advocacy of realising utility from the choices people make. Later Lionel Robbins introduced the term ordinal utility in the subject. Utility derived by an individual was measured. The revealed preference approach views the utility maximisation behaviour of the rational individuals, making their choices subject to income and time constraints. The idea is that while individuals can choose between two different goods/ services or situations, they cannot assign a cardinal evaluation of that using a number, and even if they do, this number is meaningless (Kapteyn, 2020). However, in recent years, having been intrigued by Behavioural Economics, economists have once again returned to the measurement of happiness and utility.

Times have changed since then. Now we live in a time of high anxiety. Despite the world's unprecedented total wealth, there is vast insecurity, unrest, and dissatisfaction. The relentless pursuit of higher income is leading to unprecedented inequality and anxiety, rather than to greater happiness and satisfaction in life. Economic progress is important and can greatly improve the quality of life, but only if it is pursued in line with other goals (Sachs, 2011).

Econometrics of Money and Happiness in India by T. Laxmanasamy is an attempt to analyze the relationship between money and happiness with an econometric approach. Based on the quantitative analysis, the book scholarly attempts to understand the relationship between money and happiness. The book has 16 chapters. The first chapter deals with theoretical aspects of economics of happiness. Chapter two deals with socio-economic and demographic distribution and differentials of happiness. Chapters six to sixteen deal with econometrics of happiness. World Values Survey data has been used for the analysis of twelve major states of India as these states have been a part of the survey since 1990. The results of the study show that there has not been much rise in the average levels of satisfaction and happiness in life over the years. Shockingly, both satisfaction in life and financial satisfaction have declined. The analysis shows a positive relationship between income and satisfaction in life but the degree varies across socioeconomic and demographic groups. Chapter three is an attempt to examine the relevance of Easterlin paradox in India. The analysis shows a considerable variation in the levels of subjective well-being indicators within the states and also across the states. The findings of the study show that there is no significant difference in well-being levels among the twelve states. The inter-state analysis shows that the rise in per-capita NSDP (net state domestic product at the state level) is not accompanied by improvement in well-being indicators in the long run. The analysis does not confirm any positive relationship between income and happiness. The author validates Easterlin paradox for India and concludes that "economic growth in the states of India seems to have not improved the human lot but seems to leave people more dissatisfied and less happy in life".

Chapter four is a study of happiness at two points in time. The chapter attempts to understand the level of happiness and its determinants among the poor in India. Based on the data from 1990 and 2014, the author found that the poor in India are not happy and there has been no change over

the years and also that the variables such as income, gender and education do not have much impact on happiness; rather the socio-psychological factors such as mutual trust and family value system are found important in the determination of happiness. Similarly, chapter five that deals with positional aspirations, status comparison and happiness suggests that the inter-personal comparisons must also be taken into consideration in happiness studies.

Chapters six to nine use logit and probit models for understanding happiness. Findings of chapter six are based on a primary survey carried out in Chennai in 2007. The author found that it is not just the absolute income of an individual but also the relative income that determines happiness and concludes that the growing income disparities will reduce happiness. One interesting aspect of the study is the impact of freedom of choice and confidence in institutions on happiness. These have positive impact on happiness. Happiness is also affected by the control that an individual has on one's life. In short, the confidence in the institutions that govern the life of an individual is sufficiently important for happiness.

Chapters ten to sixteen are based on panel econometrics of happiness. The author concludes that a hierarchical society like India thrives on relative values and status consciousness that comes through money and wealth. This implies that the subjective well-being is largely driven by aspiration for more money and relative economic status in the neighbourhood rather than the absolute income. This is in contradiction to the gross national happiness approach in India's neighbourhood, Bhutan, where this concept of happiness originated. The author also suggests that the increase in income of people could reduce the pain of low relative income.

For many decades, the standard economic theories, such as Solow growth model and Walrasian equilibrium model, were dominating economic analysis. These rational choice models assumed that economic variables are accountable for most, if not all, of variations in economic outcomes. These theories focused primarily on economic variables and hardly recognise the potential role of social and cultural factors on economic development. Essentially, socio-cultural factors were left unaccounted for in standard economic theories (Bilig, 2000). Even now, mainstream economic theories pay little attention to social values and are reluctant to rely on these values as potential determinants of economic outcomes (Barro and McCleary, 2002; Guiso et al., 2006). In the 1990s, a new school of thought on the determinants of economic development emerged which, embracing the concept of social capital (trust, social networks, and institutions), explicitly explains the effect of socio-cultural values on economic behaviour. Social capital embodies cultural traits of a society and is considered as source of wealth (Putnam, 1993; Fukuyama, 1995). Chapter 14 specifically discusses the impact of social capital on happiness. Interestingly, the author found that social capital moderates the negative effect of relative income on satisfaction in life. The author concludes that the declining degree of inter-personal trust and quality of sociability reduces the values attached to collective action of the people.

The findings of the discussion on happiness and inequality suggest that rise in income levels and reduction in income inequalities can improve the satisfaction in life. The innovations in neurophysiological techniques and development in molecular genetics have attempted to unfold the mystery of human behavior, while biological aspects of human behaviour are being analyzed with no significant outcomes. Human behaviour is not rational at times as behavioural economics also reminds us. It is not even stationary. The answers lie in heuristic, altruistic and bounded rationality behaviour of human beings.

The book manifests as a very comprehensive analysis of happiness and its correlates. Not many studies have been carried out to understand and analyse the happiness in India. This book from

the academic perspective is a significant contribution. Statistical analyses have been done carefully. However, while the title of the book highlights econometrics of money and happiness, the entire book actually discusses income and happiness. Language could have been taken care of. Right on the jacket of the book, the spelling of India appears incorrect. Other errors in the book also could have been taken care of.

The book is published in 2023, but much of the data is out-dated. For instance, on page 39, GDP data for India is for the year 2010. Since then, India has travelled fast on its path to economic growth. Similarly, on page 43, the Reserve Bank of India handbook of statistics refers to the 2016-17 Indian economy data. Overall, the book is a significant contribution to the literature on happiness with special reference to India.

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