Economic Growth and Women's Empowerment

A Repeated Cross-sectional Study from India

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This study examines the relationship between women's empowerment and economic growth, utilising data from the National Family Health Surveys spanning from 2006 to 2021. Our findings reveal: (i) a positive influence on economic empowerment but a more subdued, if not negative, effect on women's agency; (ii) significant but minor associations of state gross domestic product with all women's empowerment indicators; (iii) economic empowerment factors such as bank account ownership and employment demonstrate the highest responsiveness to gross domestic product. Visual inspections show that the predictive capacity and association of economic growth on women's empowerment decreases with rising SGDP at individual and ecological levels, respectively.

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India's economic growth and progress on different development indicators prompt the examination of the effectiveness of economic growth in promoting women's empowerment. The effect of economic growth, though essential, is debated for its effectiveness as a singular intervention for improving women empowerment. Some scholars argue that economic growth reduces women's vulnerabilities by diminishing household constraints, empowering them with more time, and enhancing legal rights (Duflo 2011). Others caution against simplistic narratives (Kabeer 2020) and argue that empowerment involves more than traditional metrics of progress, and advocate for interventions that address power dynamics and ensure meaningful participation in decision-making processes.

This debate becomes crucial for policy priorities while allocating resources between gender-specific initiatives and broader economic growth in resource-constrained settings of developing economies such as India. Initially, economic growth empowers women, but its impact may lessen over time, requiring targeted interventions to sustain progress (Eastin and Prakash 2013). Proponents of the Women-in-Development (WID) approach (Boserup et al 2013), like the Gender Kuznets Curve (GKC), propose a U-shaped relationship between economic growth and women's status. Recent studies like Eastin and Prakash (2013) using the S-shaped curve show initial status improvements followed by stagnation, and then resurgence. However, the variability of this relationship across nations emphasises the need for context-specific analyses (Kilinc et al 2015).

In the Indian context, understanding the association between economic growth and women empowerment becomes essential for two reasons. First, India is home to the world's largest population, with women accounting for nearly 48% of the populace in 2024 (National Commission on Population 2020), invariably making empowerment of Indian women crucial for the achievement of most Sustainable Development Goals of India as well as the world. Second, despite India's fast economic growth, and existing legal and policy interventions safeguarding female rights and improving their education and employment (Press Bureau India 2024), the realisation of effective female empowerment is low as India stands 127th out of 146 countries in the gender gap index (World Economic Forum 2023), with female labour force participation at only 30.5% in rural areas (National Sample Survey Office 2023), and only 41% of women aged 15 to 49 years having 10 or more years of education (IIPS and ICF 2021).

Existing literature predominantly focuses on assessing the impact of women's empowerment on economic growth (Sehrawat and Giri 2017), or investigating the effects of economic growth solely on female employment (Lahoti and Swaminathan 2016; Ghosh 2022). Limited attention has been given to exploring the impact of economic growth on women's agency, except in a few instances, that too using reported wealth quintiles in place of economic growth measures (Rao et al 2014).

Therefore, leveraging data from the National Family Health Survey (NFHS) conducted in 2005–06, 2015–16, and 2019–21, we aim to address three key inquiries: (i) Is economic growth associated with women's empowerment? (ii) If so, which aspects are related? and (iii) How has this association evolved? We consider aspects of women's economic empowerment as well as their autonomy.

Methods

Data source: The study uses individual as well as state-level data from NFHS-3 (2004), 4 (2014), and 5 (2020), and information about state domestic product per capita at constant prices (at 2011 base prices) from the Reserve Bank of India.

In the NFHS, information specific to women is collected at the district level (only in NFHS-4 and 5) for some indicators, such as education and financial inclusion, while at the state level for intimate partner violence (IPV). The sampling frame for each NFHS is the previous national census, providing state-level (NFHS-3) and district-level (NFHS-4 and 5) estimates. The survey follows a two-stage stratified sampling design. Further details can be found in the report (International Institute for Population Sciences 2007, 2016, 2021).

Outcome variables: Our study has seven main outcomes of women empowerment: bank account use, employment, education, financial independence, IPV, autonomy, and attitude towards wife beating. The first four outcomes relate to the economic empowerment of females, while the remaining three represent gender power dynamics. All seven variables are dichotomous in nature that take values 1 and 0.

Bank account use takes the value 1 if the woman possesses and utilises a bank or savings account, and 0 otherwise. Education takes the value 1 if the woman has completed a minimum of 10 years of schooling, and 0 otherwise. Concerning employment, a value of 1 is assigned if the woman has engaged in any form of work in the past year and received payment for it, either in cash or in kind, and 0 otherwise. Financial independence takes the value 1 if the woman has access to money she can use on her own, and 0 if not.

Further, a woman is identified as having faced IPV (score 1) if she has experienced either emotional, physical, or sexual abuse (detailed questions in Supplementary Text 1, p 80). Autonomy of the woman is measured based on their ability to visit specific places alone, including markets, health facilities, and areas outside their village or community. A score of 1 is awarded if women can access all three locations unaccompanied; otherwise they receive a score of 0. Lastly, attitude towards wife beating is captured through responses to questions asking whether a husband is justified in hitting or beating his wife in certain situations, detailed in Supplementary Text 1. A score of 1 is assigned if women answer negatively to all questions, while any affirmative response results in a score of 0.

Study population: To ensure consistency and comparability across survey rounds, we applied three criteria for data exclusion, depending on the dependent variable. First, individuals under 18 were excluded for analysing outcome variables such as bank account, education, employment, and financial independence. Second, those not currently married were omitted for assessing intimate partner violence, autonomy, and attitudes towards wife beating. Third, all observations with a missing value for either the outcome or the predictor variable were dropped.

Economic growth: The economic growth within individual states is assessed utilising state gross domestic product (SGDP) per capita, measured at constant prices. It delineates the aggregate monetary worth of all commodities and services generated within a given Indian state in a given time frame. The computation of gross domestic product (GDP) at constant prices involves the normalisation of values for a chosen base period, enabling temporal analysis as these estimates are adjusted for inflationary fluctuations. Further, GDP per capita is normalised for population thereby facilitating comparisons across geographical regions. Two series of SGDP estimates with different base years were used, which were all adjusted to 2011 prices.

Predictor variables: We considered various predictors such as age (five-year intervals from 15 to 49 years), marital status (never married, currently married, widowed, divorced, and separated), household wealth quintiles (poorest, poor, middle, rich, and richest), social caste (Scheduled Caste, Scheduled Tribe, Other Backward Classes, and general caste), place of residence (rural and urban), state of residence (36 states and union territories), and religion (Hindu, Muslim, Christian, or other). Additionally, we incorporated survey year indicators to account for temporal variations.

Statistical analysis: We conducted a series of regression analyses to investigate the relationship between economic growth and women's empowerment at ecological and individual levels. Linear regression was employed and associations were examined between SGDP and state-level women's empowerment indicators considering SGDP and its change in actual, logarithmic and percentage form. Additionally, generalised linear regression with a log link function was employed to get outcomes in the same form instead of log values. Year-fixed effects were used, and standard errors were clustered at the state level.

At the individual level, binary logistic regression models were utilised due to the dichotomous nature of outcome variables. Odds ratios with 95% confidence intervals were reported. Associations were examined between SGDP and women's empowerment indicators, considering both actual and log transformed

values of SGDP and its change. We also considered association with lagged values of SGDP with a lag of five years. Control variables included age, wealth quintile, state, religion, and place of residence (rural or urban). Predicted probabilities were plotted over a range of SGDP values.

To examine precise functional forms characterising the relationship at ecological levels, three forms (cubic, exponential, and geometric) were considered. The explained variance of each form was scrutinised to ascertain the most suitable model. Visualisation of the selected model was facilitated through scatterplots generated using the *curvefit* command in STATA 16.

Results

The analysis was conducted on different samples for each outcome variable that ranged from 1,06,035 for employment to 12,65,908 for education (Table 1). We observe that between 2006 and 2016, most states witnessed significant improvements in various indicators of women's empowerment (Table 2). However, in Jammu and Kashmir, education decreased, while Bihar, Karnataka, Telangana, and Uttarakhand reported a decline in access to money. Instances of IPV increased in Chandigarh, Karnataka, Meghalaya, Puducherry, Sikkim, and Uttar Pradesh, while autonomy declined in Assam, Goa, Jammu and Kashmir, Manipur, Mizoram, Tamil Nadu, and Uttar Pradesh.

Conversely, attitudes towards wife beating worsened in Andhra Pradesh, Kerala, Tamil Nadu, Telangana, and West Bengal. SGDP was the highest in Uttarakhand (559%) and lowest in Tamil Nadu (25.0%), with Uttar Pradesh witnessing a decline of 9.9% during this period. Mostly, states that observed an above-average increase in SGDP witnessed an above-average increase in aspects of women's empowerment such as bank accounts, education, employment, and access to money. However, five out of 14 states that had an above-average increase in SGDP observed an above-average increase on two out of the remaining three women's empowerment aspects of IPV, autonomy, and attitude towards wife beating.

At ecological levels, while associations are statistically significant, the effect size was very small for actual values of SGDP (Table 3, p 76). With logarithmic values of SGDP (Model 2), we observe a significant and strong association for bank accounts ($r=94.6$, p value<0.01), education ($r=110.2$, p value<0.01), IPV ($r=-103.4$, p value<0.01), and autonomy ($r=114.3$, p value<0.01). When we consider the logarithm of both women's empowerment and SGDP (Model 3), we observe a significant association for all but financial independence and attitude towards wife beating. The explained variance is nearly 80% for bank account and employment, while other explained variances are below 30% (Model 1). We observe similar associations for actual and logarithmic values of SGDP change (Models 5–8). These were strongest for employment ($r=13.5$, p value<0.01) (Model 6) and education ($r=11.9$, p value<0.01). Using generalised linear regression (Model 4), we found small and significant associations for all except bank accounts, employment, and financial independence.

At the individual level, the odds of any women's empowerment indicator are close to 1.0 (p value<0.01) when we

Table 1: Analytical Sample for Each Outcome Variable by Year

	Bank Account	Employment	Education	Financial Independence	Intimate Partner Violence	Autonomy	Attitude towards Wife Beating
2006	1,04,390	43,801	104,379	1,04,363	62,447	83,642	83,642
2016	95,891	30,743	5,56,634	95,891	55,299	76,634	76,634
2021	91,049	31,491	6,04,895	91,049	56,126	71,521	71,521
Total	2,91,330	1,06,035	12,65,908	2,91,303	1,73,872	2,31,797	2,31,797

Table 2: Change (Percentage Points) in Women Empowerment Indicators, and Percentage Change in State Domestic Product Per Capita (at Constant Prices) between 20006 and 2021 for States and Union Territories of India

State/Union Territory	Bank Account	Employment	Education	Financial Independence	Intimate Partner Violence	Autonomy	Attitude towards Wife Beating	State Domestic Product Per Capita at 2011 Constant Prices
Andhra Pradesh	64.0	80.6	12.7	-19.3	-2.2	2.5	-8.2	140.0
Arunachal Pradesh	59.4	23.8	16.1	14.3	-17.6	9.9	37.2	106.2
Assam	69.1	75.5	7.0	2.1	-8.9	-2.1	9.4	89.7
Bihar	69.2	14.3	13.2	-10.8	-20.1	20.0	20.8	113.4
Chandigarh	87.8	100	47.7	59.5	11.6	76.9	88.8	NA
Chhattisgarh	73.3	65.0	18.5	24.9	-11.9	29.5	4.5	101.3
Dadra and Nagar Haveli	84.6	97.5	25.5	77.4	16.4	80.2	90.5	NA
Goa	47.8	88.3	21.5	10.3	-8.6	-43.7	8.4	149.8
Gujarat	49.0	70.2	8.5	0.3	-18.0	6.5	26.0	224.0
Haryana	61.9	50.2	21.3	22.1	-8.9	8.1	17.1	162.7
Himachal Pradesh	60.1	63.8	23.4	33.9	3.8	18.6	12.0	137.1
Jammu and Kashmir	62.9	37.2	-39.9	10.0	-1.8	-7.0	15.6	63.9
Jharkhand	64.4	39.3	13.4	-8.2	-8.8	15.9	23.9	75.4
Karnataka	65.6	85.3	14.9	-2.0	27.9	-0.3	-10.4	33.6
Kerala	50.6	94.4	24.0	35.7	-5.7	-24	11.0	146.7
Ladakh	66.2	42.6	-40.4	17.5	13.4	-17.1	6.2	63.9
Lakshadweep	67.8	100.0	47.7	45.2	1.9	0.9	60.6	NA
Madhya Pradesh	66.0	53.2	10.9	13.1	-18.7	12.6	17.6	135.1
Maharashtra	51.7	76.2	16.1	13.0	-4.8	6.6	7.2	143.5
Manipur	69.3	67.0	9.6	8.7	-5.3	-29.9	23.3	48.1
Meghalaya	56.9	77.7	7.9	16.2	7.8	9.5	23.3	52.9
Mizoram	73.2	65.8	17.7	13.1	-11.4	-1.0	47.6	264.7
Nagaland	58.1	42.0	18.4	4.8	-9.7	10.7	49.5	112.2
NCT of Delhi	40.9	95.2	6.8	13.9	7.5	12.6	18.1	134.3
Odisha	76.4	59.5	10.5	9.3	-8.3	10.6	13.7	32.3
Puducherry	93.6	97.1	54.7	53.0	31.9	40.1	23.8	NA
Punjab	66.7	70.6	18.2	31.3	-14.3	21.9	30.8	105.0
Rajasthan	73.2	20.2	16.2	21.3	-24.0	4.3	23.9	111.7
Sikkim	54.7	69.4	22.3	30.2	3.2	14.6	44.5	335.0
Tamil Nadu	76.6	81.5	21.8	19.1	-3.2	-15.5	-10.2	25.0
Telangana	67.6	85.5	18.7	-16.7	4.4	4.1	-8.0	232.7
Tripura	57.8	54.2	3.7	30.0	-22.1	21.5	25.8	185.0
Uttar Pradesh	56.8	68.7	6.4	19.7	7.9	-11.2	6.6	-9.9
Uttarakhand	67.4	31.6	29.3	-11.3	-28.3	38.2	25.1	559.6
West Bengal	61.0	79.5	11.4	23.7	-11.9	26.2	-0.7	87.9

NA- Value not available for 2006; values highlighted in grey are above average within each category.

consider actual values of SGDP (Table 4, p 77) (Model 1). However, with logarithm of SGDP, we observe that the odds of bank account (OR=19.4, p value<0.01), education (OR=4.8, p value<0.01) (Model 2) and IPV are significantly high; whereas autonomy (OR=0.006, p value<0.001) and attitude towards wife beating (OR=0.00003, p value<0.001) are significantly low. With a unit increase in the log of change in SGDP, females are five times more likely to find employment (OR= 5.6, p value<0.01) (Model 4), three times more likely to face IPV (OR=3.1, p value <0.01), and are highly unlikely to have financial independence (OR=0.4, p value<0.01) and autonomy (OR=0.6, p value<0.01). The association of log of lagged SGDP is significant for employment (OR=348, p value <0.01) (Model 7), financial independence (OR=0.06, p value<0.01), and autonomy (OR=0.04, p value<0.01).

Table 5 (p 78) provides the odds of women's empowerment given a unit change in the log of SGDP for three different years, that is 2006, 2016, and 2021. We observe that the association is highly significant for all indicators in 2006, none in 2016, and five of seven in 2021. While the odds of education and IPV were more than 1.0 in 2006 and rest all were less than 1.0, we observe much higher odds for employment (OR-21.4, p value<0.01), and IPV (OR=7.2, p value<0.01) in 2021. Similarly, the odds of autonomy and attitude towards wife beating, although below 1.0, have notably declined in its effect size between 2006 and 2021. The odds of financial independence remain comparable in both 2006 and 2021.

At the individual level, we plot the predicted probabilities (sigmoid curves given use of logistic regression) at various levels of logarithmic value of SGDP (Figure 1, p 77). We observe that while the confidence intervals for bank accounts, education, and IPV are small, that of employment are larger at lower levels of SGDP, showing that the predictive capacity of SGDP for employment increases with SGDP. We observe a declining (inverted s-shaped) curve for autonomy and attitude towards wife beating with small confidence intervals. For access to money, we observe a relatively linear decline in probability with SGDP.

At ecological levels, we find that linear models explain 80% of variation for bank account and employment with SGDP (Table 2), while for the rest, exponential or geometric models

Table 3: Association between Each of the Seven Women's Empowerment Indicators and Per Capita State Domestic Product at Constant Prices under Different Model Specifications at Ecological Level

	Bank Account	Employment	Education	Financial Independence	Intimate Partner Violence	Autonomy	Attitude towards Wife Beating
Model 1	6.47e-05***	5.82e-05***	9.37e-05***	6.89e-05***	-6.57e-05**	8.40e-05**	7.72e-05**
95% CI	(2.67e-05 - 0.000103)	(1.73e-05 - 9.91e-05)	(5.34e-05 - 0.000134)	(3.13e-05 - 0.000107)	(-0.000116 - -1.50e-05)	(7.68e-06 - 0.000160)	(2.93e-06 - 0.000151)
R-squared	0.89	0.855	0.27	0.27	0.13	0.10	0.17
Model 2	94.6***	31.9	110.2***	51.3	-103.4***	114.3***	66.2
95% CI	(51.54 - 137.8)	(-18.82 - 82.71)	(64.62 - 155.8)	(-10.94 - 113.5)	(-166.6 - -40.17)	(47.14 - 181.5)	(-29.64 - 162.2)
R-squared	0.90	0.84	0.27	0.22	0.20	0.13	0.15
Model 3	2.8***	-1.7**	4.4***	0.9	-3.9***	2.3***	0.8
95% CI	(1.747 - 3.943)	(-3.256 - -0.303)	(2.722 - 6.200)	(-0.399 - 2.351)	(-6.623 - -1.373)	(0.964 - 3.795)	(-1.410 - 3.147)
R-squared	0.88	0.77	0.43	0.20	0.15	0.11	0.08
Model 4	1.68e-06***	-6.86E-08	3.01e-06***	1.31e-06***	-2.42e-06***	1.85e-06***	1.34e-06**
95% CI	(8.45e-07 - 2.51e-06)	(-7.65e-07 - 6.27e-07)	(1.53e-06 - 4.49e-06)	(5.99e-07 - 2.02e-06)	(-4.23e-06 - -6.10e-07)	(4.46e-07 - 3.25e-06)	(1.43e-07 - 2.54e-06)
AIC	9.7	10.01	8.7	9.7	8.7	9.7	9.9
BIC	-434.9	-425	-424	-436	-420	-430	-425
Model 5	-1.68E-05	0.000122**	0.000121**	4.94E-05	2.98E-05	7.87E-05	7.93E-05
95% CI	(-0.000121 - 8.79e-05)	(1.84e-06 - 0.000243)	(2.21e-05 - 0.000220)	(-0.000102 - 0.000201)	(-5.22e-05 - 0.000112)	(-0.000154 - 0.000311)	(-0.000120 - 0.000279)
R-squared	0.008	0.09	0.16	0.02	0.017	0.03	0.04
Model 6	-2.1	13.5***	11.9***	7.9*	3.2	7.6	8.3
95% CI	(-9.005 - 4.700)	(3.807 - 23.28)	(3.954 - 19.86)	(-0.837 - 16.74)	(-3.039 - 9.615)	(-6.838 - 22.10)	(-2.854 - 19.65)
R-squared	0.02	0.20	0.27	0.11	0.03	0.07	0.10
Model 7	-0.04	0.2**	0.3***	0.2	-0.1	0.1	0.2
95% CI	(-0.154 - 0.0547)	(0.0311 - 0.467)	(0.125 - 0.592)	(-0.257 - 0.792)	(-0.833 - 0.450)	(-0.285 - 0.641)	(-0.123 - 0.550)
R-squared	0.05	0.16	0.2	0.03	0.04	0.02	0.06
Model 8	-0.009	-0.02	0.05***	-0.02	-0.04**	0.06***	0.05*
95% CI	(-0.0407 - 0.0212)	(-0.0877 - 0.0401)	(0.0169 - 0.0841)	(-0.0742 - 0.0246)	(-0.0789 - -0.0101)	(0.0281 - 0.0957)	(-0.00213 - 0.105)
R-squared	0.01	0.01	0.13	0.03	0.15	0.14	0.12

Level of significance: ***<0.01; **<0.05, *<0.1

Model 1: The association is considered between actual values of women's empowerment indicators (state-level percentages) and state domestic product per capita at constant prices (2011) using linear regression. Year-fixed effects are considered.

Model 2: The association is considered between actual values of women's empowerment indicators (state-level percentages) and the logarithmic values of state domestic product per capita at constant prices (2011) using linear regression. Year-fixed effects are considered.

Model 3: The association is considered between logarithmic values of women's empowerment indicators (state-level percentages) and the logarithmic values of state domestic product per capita at constant prices (2011) using linear regression. Year-fixed effects are considered.

Model 4: The association is considered between actual values of women's empowerment indicators (state-level percentages) and the actual values of state domestic product per capita at constant prices (2011) using generalised linear regression with a log-link function. Year-fixed effects are considered.

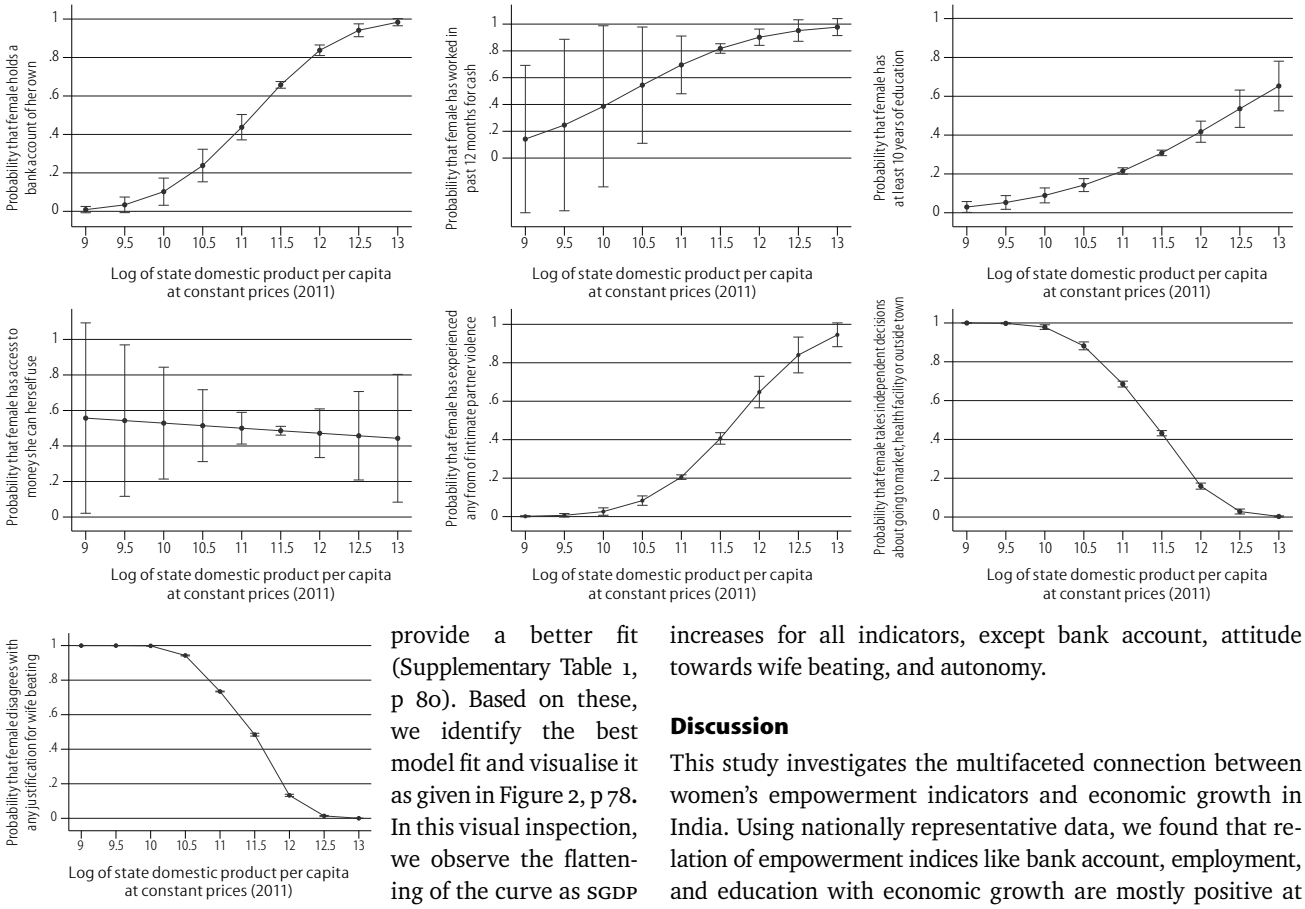
Model 5: The association is considered between change both in actual values of women's empowerment indicators (state-level percentages) and state domestic product per capita at constant prices (2011) between 2006 and 2021 using linear regression.

Model 6: The association is considered between change in actual values of women's empowerment indicators (state-level percentages) and log of change in values of state domestic product per capita at constant prices (2011) between 2006 and 2021 using linear regression.

Model 7: The association is considered between logarithmic values of change in both women's empowerment indicators (state-level percentages) and state domestic product per capita at constant prices (2011) between 2006 and 2021 using linear regression.

Model 8: The association is considered between actual values of change in women's empowerment indicators (state-level percentages) and percentage change in state domestic product per capita at constant prices (2011) between 2006 and 2021 using linear regression.

Figure 1: Visualisation of Association (Predicted Probabilities) between Women's Empowerment Indicators and State Domestic Product Per Capita at Constant Prices (2011) at Individual Levels



provide a better fit (Supplementary Table 1, p 80). Based on these, we identify the best model fit and visualise it as given in Figure 2, p 78. In this visual inspection, we observe the flattening of the curve as SGDP increases for all indicators, except bank account, attitude towards wife beating, and autonomy.

Discussion

This study investigates the multifaceted connection between women's empowerment indicators and economic growth in India. Using nationally representative data, we found that relation of empowerment indices like bank account, employment, and education with economic growth are mostly positive at

Table 4: Association (Adjusted Odds Ratio) between Each of the Seven Women's Empowerment Indicators and Per Capita State Domestic Product at Constant Prices under Different Model Specifications at Individual Level

	Bank Account	Employment	Education	Financial Independence	Intimate Partner Violence	Autonomy	Attitude towards Wife Beating
Model 1	1.0***	1.0***	1.0	1.0***	1.0***	1.0***	1.0***
95% CI	(1.0 - 1.0)	(1.0 - 1.0)	(1.0 - 1.0)	(1.0 - 1.0)	(1.0 - 1.0)	(1.0 - 1.0)	(1.0 - 1.0)
Model 2	19.4***	1.0***	4.8***	0.8	19.8***	0.006***	0.00003***
95% CI	(6.0-62.5)	(1.0-1-0)	(2.7-8.6)	(0.3-2.3)	(5.5-71.7)	(0.002-0.02)	(9.95e-06 - .0001504)
Model 3	1.0	1.0***	1.0	1.0***	1.0***	1.0***	1.0***
95% CI	(1.0 - 1.0)	(1.0 - 1.0)	(1.0 - 1.0)	(1.0 - 1.0)	(1.0 - 1.0)	(1.0 - 1.0)	(1.0 - 1.0)
Model 4	0.9	5.6***	0.7	0.4***	3.1***	0.6***	0.2***
95% CI	(0.7 - 1.1)	(4.1 - 7.8)	(0.7 - 0.7)	(0.3 - 0.5)	(2.5 - 4.0)	(0.5 - 0.7)	(0.2 - 0.3)
Model 5	0.9	1.0***	0.9***	0.9***	1.0***	0.9***	0.9***
95% CI	(0.9 - 1.0)	(1.0 - 1.0)	(0.9 - 0.9)	(0.9 - 0.9)	(1.0 - 1.0)	(0.9 - 0.9)	(0.9 - 0.9)
Model 6	1.0***	1.0***	1.0***	1.0***	1.0	1.0***	1.0***
95% CI	(1.0 - 1.0)	(1.0 - 1.0)	(1.0 - 1.0)	(1.0 - 1.0)	(1.0 - 1.0)	(1.0 - 1.0)	(1.0 - 1.0)
Model 7	0.1***	348.3***	1.0	0.06***	2.2*	0.04***	6.40e-05***
95% CI	(0.05 - 0.3)	(67.9 - 1,786)	(0.6 - 1.4)	(0.03 - 0.1)	(0.9 - 5.4)	(0.01 - 0.09)	(2.43e-05 - 0.000168)

Level of significance: ***<0.01; **<0.05, *<0.1; All models are controlled for marital status, wealth, place pf residence, religion, caste, state, and year.

Model 1: The association is considered between women's empowerment indicators (state-level percentages) and actual value of state domestic product per capita at constant prices (2011) using binary logistic regression controlling for outlined predictor variables.

Model 2: The association is considered between women's empowerment indicators (state-level percentages) and logarithmic value of state domestic product per capita at constant prices (2011) using binary logistic regression controlling for outlined predictor variables.

Model 3: The association is considered between women's empowerment indicators (state-level percentages) and actual value change in value of state domestic product per capita at constant prices (2011) between 2006 and 2021 using binary logistic regression controlling for outlined predictor variables. The model uses observations only for 2019–21.

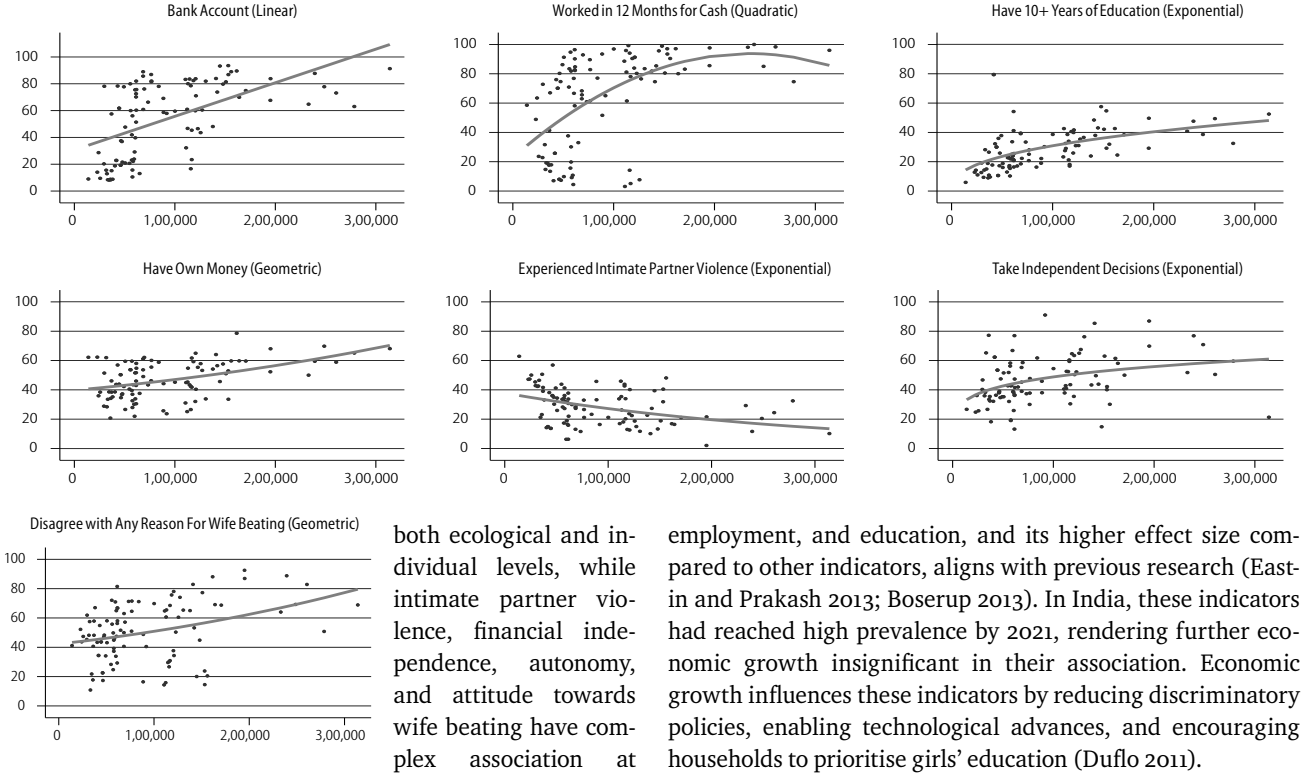
Model 4: The association is considered between women's empowerment indicators (state-level percentages) and logarithmic value of change in value of state domestic product per capita at constant prices (2011) between 2006 and 2021 using binary logistic regression controlling for outlined predictor variables. The model uses observations only for 2019–21.

Model 5: The association is considered between women's empowerment indicators (state-level percentages) and percentage change in value of state domestic product per capita at constant prices (2011) between 2006 and 2021 using binary logistic regression controlling for outlined predictor variables. The model uses observations only for 2019–21.

Model 6: The association is considered between women's empowerment indicators (state-level percentages) and actual value of state domestic product per capita at constant prices (2011) five years prior to survey using binary logistic regression controlling for outlined predictor variables. The model uses observations only for 2015–16 and 2019–21.

Model 7: The association is considered between women's empowerment indicators (state-level percentages) and logarithmic value of state domestic product per capita at constant prices (2011) five years prior to survey using binary logistic regression controlling for outlined predictor variables. The model uses observations only for 2015–16 and 2019–21.

Figure 2: Visualisation of Association between Women's Empowerment Indicators and State Domestic Product Per Capita at Constant Prices (2011) at Ecological Levels by the Model Specification under Which Explained Variance Is Highest



both ecological and individual levels, while intimate partner violence, financial independence, autonomy, and attitude towards wife beating have complex association at these two levels with economic growth. Second, based on the effect size for actual values of SGDP, the logarithm of SGDP, and its change, we observe that all women empowerment indicators have a significant but small association with SGDP. Third, within the given small associations, economic empowerment indicators like a bank account and employment are most responsive to SGDP, followed by the attitude towards wife beating and autonomy. Fourth, effect sizes of indicators have mostly increased between 2006 and 2021, with the largest difference observed for employment and the least for financial independence. While the effect on employment has changed its direction between these years, that of education and bank account has become statistically insignificant. Lastly, visual inspection of predicted probabilities and scatterplots reveals that the predictive capacity and association of economic growth on women's empowerment decreases with rising SGDP at individual and ecological levels, respectively.

The positive relationship between SGDP and economic empowerment indicators like bank account ownership, employment, and education, and its higher effect size compared to other indicators, aligns with previous research (Eastin and Prakash 2013; Boserup 2013). In India, these indicators had reached high prevalence by 2021, rendering further economic growth insignificant in their association. Economic growth influences these indicators by reducing discriminatory policies, enabling technological advances, and encouraging households to prioritise girls' education (Duflo 2011).

When examining IPV, contrasting trends appear at ecological and individual levels. Ecological data shows a decline, while individual data reveals a non-linear increase. This discrepancy might arise because individual data controls for socio-economic factors, whereas the ecological model only controls for the year. Consequently, even if IPV increases individually, the overall population might see a positive trend due to a higher number of women experiencing less IPV. Evidence shows that IPV increases with increase in some of women's economic empowerment indicators such as employment (Lenze and Klasen 2017), and access to money (Ganle et al 2015; Schuler et al 1998).

Given the positive effect of economic growth on such indicators, one can assume that IPV reacts positively to economic growth. The marital dependency and resource theories (Goode 1971; Kalmuss and Straus 1982) can potentially explain the increasing IPV by suggesting that women with limited empowerment lack the means to seek alternatives to abusive relationships, while economically empowered women may

Table 5: Association (Adjusted Odds Ratio) between Each of the Seven Women's Empowerment Indicators and Per Capita State Domestic Product at Constant Prices under Different Model Specifications at Individual Level by Year of Survey

Year	Bank account	Employment	Education	Financial Independence	Intimate Partner Violence	Autonomy	Attitude towards Wife Beating
2006	0.776***	0.377***	1.550***	0.245***	5.215***	0.797***	0.394***
	(0.668 - 0.903)	(0.283 - 0.502)	(1.304 - 1.842)	(0.217 - 0.278)	(4.218 - 6.446)	(0.693 - 0.917)	(0.342 - 0.453)
2016	0.196	0.108	0.799	0.29	8.991	1.295	0.343
	(0.196 - 0.196)	(0.108 - 0.108)	(0.799 - 0.799)	(0.290 - 0.290)	(8.991 - 8.991)	(1.295 - 1.295)	(0.343 - 0.343)
2019	0.196	21.40***	0.567	0.240***	7.267***	0.470***	0.108***
	(0.196 - 0.196)	(12.43 - 36.86)	(0.567 - 0.567)	(0.184 - 0.312)	(4.834 - 10.93)	(0.347 - 0.635)	(0.0753 - 0.154)

Level of significance: ***<0.01; **<0.05, *<0.1; All models are controlled for marital status, wealth, place of residence, religion, caste, and state. The association is considered between women's empowerment indicators (state-level percentages) and logarithmic value of state domestic product per capita at constant prices (2011) using binary logistic regression controlling for outlined predictor variables.

challenge patriarchal norms and provoke violence. However, these evidences are context specific (Khan and Klasen 2018), and may show an inverse association in some situations (McDougal et al 2019).

Similarly, we find that the indicators reflecting a woman's agency, such as autonomy and attitude towards wife beating, exhibit a decline with increasing economic growth at the individual level but demonstrate an increase at the ecological level. The variation observed between ecological and individual associations mirrors that of intimate partner violence, suggesting the role of confounding factors. The small effect size at individual levels of economic growth on woman's agency is confirmed by Braga et al (2018) and Peters et al (2019) using other demographic and health surveys.

In summary, our research highlights the nuanced effects of economic growth on women's empowerment, showing a positive impact on economic empowerment, and a subdued effect (sometimes negative) on women's agency. While economic growth may translate to economic empowerment and trickle down to women's agency in some contexts, mostly in India, evidence suggests otherwise. This will require us to go beyond trickle-down effects and implement targeted interventions. In recent years, India has launched significant initiatives to advance women's empowerment, such as the financial inclusion programme Stand-Up India; and campaigns like Beti Bachao, Beti Padhao to promote gender equality (Press Bureau India 2024). However, to maximise benefits, these initiatives should be considered collectively rather than in isolation. Additionally, it is crucial to recognise the importance of context and decentralise efforts to make women's empowerment more granular in administration and planning.

This study has several limitations. First, there are many missing values in the indicators of female empowerment, especially employment. Second, using a binary variable for attitudes towards wife beating and intimate partner violence might miss subtle differences that a continuous variable could capture. However, we used binary outcomes for consistency across various indicators, focusing on the extreme scenario where women reject all justifications for wife beating or do not experience any form of violence. Third, we did not account for contextual factors like cultural norms or family obligations that affect the impact of economic growth on female empowerment. Fourth, most empowerment indicators, except education, are only available for women of reproductive age, limiting insights into older women. Nonetheless, the impact of economic growth is usually stronger on newer cohorts, so this limitation is less critical. Finally, our study covers only 15 years (2005–21) and does not address reverse causality, although we tested for one-way causality by examining the effect of lagged SGDP on women's empowerment five years later.

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Supplementary Table 1: Explained Variance under Various Model Specifications for Ecological Association between Female Empowerment Indicators and State Domestic Product Per Capita at Constant Prices, 2011

	Cubic	Growth	Exponential	Geometric
Education	0.24	0.85	0.85	0.85
Financial independence	0.19	0.95	0.95	0.95
Intimate partner violence	0.18	0.80	0.86	0.86
Autonomy	0.15	0.9	0.9	0.9
Attitude towards wife beating	0.1	0.88	0.88	0.88

Supplementary Text 1: Questions Used from NFHS to Estimate Intimate Partner Violence and Attitude towards Wife Beating

Intimate partner violence	(Does/did) your (last) husband ever do any of the following things to you: Slap you? Twist your arm or pull your hair? Push you, shake you, or throw something at you? Punch you with his fist or with something that could hurt you? Kick you, drag you or beat you up? Try to choke you or burn you on purpose? Threaten or attack you with a knife, gun, or any other weapon? Physically force you to have sexual intercourse with him even when you did not want to? Force you to perform any sexual acts you did not want to? (Does/did) your (last) husband ever: Say or do something to humiliate you in front of others? Threaten to hurt or harm you or someone close to you? Insult you or make you feel bad about yourself?
Attitude towards wife beating	Sometimes a husband is annoyed or angered by things that his wife does. In your opinion, is a husband justified in hitting or beating his wife in the following situations: If she goes out without telling him? If she neglects the house or the children? If she argues with him? If she refuses to have sex with him? If she does not cook food properly? If he suspects her of being unfaithful? If she shows disrespect for in-laws?