J Popul Econ (2018) 31:783–818
DOI 10.1007/s00148-017-0671-y

ORIGINAL PAPER

Why are fewer married women joining the work force in rural India? A decomposition analysis over two decades

Farzana Afridi[1] · Taryn Dinkelman[2] · Kanika Mahajan[3]

Received: 15 December 2015 / Accepted: 11 September 2017 / Published online: 30 September 2017

Abstract In contrast with global trends, India has witnessed a secular decline in women's employment rates over the past few decades. We investigate this decline in rural areas, where the majority of Indian women reside. Using parametric and semi-parametric decomposition techniques, we show that changes in individual and household attributes fully account for the fall in women's labor force participation in 1987–1999 and account for more than half of the decline in 1999–2011. Our findings underscore increasing education levels among rural married women and the men in their households as the most prominent attributes contributing to this decline. We provide suggestive evidence that changes in more educated women's relative returns to home production compared with market production may have adversely affected female labor force participation in rural India.

Keywords Female labor force participation · Decomposition analysis · Education · India

JEL classification J21 · J22

Responsible editor: Junsen Zhang

✉ Farzana Afridi
fafridi@isid.ac.in

Taryn Dinkelman
taryn.l.dinkelman@dartmouth.edu

Kanika Mahajan
kanika.mahajan@ashoka.edu.in

1 IZA and Economics and Planning Unit, Indian Statistical Institute (ISI), Delhi, India

2 NBER, IZA and Department of Economics, Dartmouth College, Hanover, NH, USA

3 Department of Economics, Ashoka University, Sonepat, Haryana, India

1 Introduction

Women's participation in the labor market is often associated with better access to economic opportunities as well as greater decision-making power within the household. Globally, women are joining the labor force in increasing numbers—the gender gap in labor force participation declined by 6% age points between 1980 and 2009 (World Bank 2012). In contrast to almost half of the world's female population that is working, only 32.6% of India's half a billion adult females report being part of the labor force (United Nations 2013 and India's National Sample Survey (NSS), respectively). This low rate of Indian women's labor market participation is puzzling for a country that has experienced rapid fertility transition (World Bank, various years) and broad increases in women's educational attainment (Census of India 2001 and 2011) along with substantial economic growth over the past two decades.[1] Rather than facilitating entry of women into the labor force, these changes have been accompanied by a consistently low share of women working in urban areas (Klasen and Pieters 2015) and a real reduction in the share of women working in rural areas, between 1987 and 2011 (NSS, own calculations).[2]

Using nationally representative, cross-sectional data from three rounds of India's NSS, we conduct decomposition analyses to examine how much the changes in observed demographic and socio-economic characteristics of females can account for the fall in their labor force participation rate (LFPR) in and between the decades of 1987–1999 and 1999–2011. We show that the phenomenon of declining female LFPR over these two decades is concentrated among 25–65-year-old, married women in rural India. Focusing in on this demographic group, we decompose changes in their employment rates into two components. The first component is attributable to shifts in demographic and socio-economic characteristics of women over time, for example, improvements in education levels and in measures of household income. Changes in the probability of being employed for women with a given set of demographic and socio-economic attributes drive the second component, for example, variation over time in the probability of working for a fixed level of education. Throughout the paper, we refer to the first element as the "explained" proportion of the variation in LFPR over time and the second element as the "unexplained" proportion, since we do not directly observe the factors responsible for this component of change in women's LFPR.

What factors could explain a decline in female LFPR over time? A view from economic history suggests that the stage of India's economic development might matter. At very low levels of GDP per capita, women must work in order for families to subsist. With a rise in per capita GDP, as has occurred in India in the past few decades, an income effect tends to lower women's work force participation. Continued economic growth along with higher incomes and higher wages for women in jobs with lower social stigma induces a substitution effect that outweighs this income effect and increases participation rates of women. Together, these forces tend to lead to a U-shaped curve for female labor force participation (Goldin 1995). Despite this intuitive

[1] India's fertility rate declined from 4.12 in 1987 to 2.60 in 2011. (http://databank.worldbank.org/data/reports.aspx?source=2&country=IND). GDP grew at an average rate of 5.94% during 1987–1999 and 7.19% in 1999–2011. (http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=IN).

[2] 70% of India's population continues to reside in rural areas (Census 2011).

theory, empirical evidence for the U-shaped relationship is mixed (Lahoti and Swaminathan 2013 for India). Using panel data methods, Tam (2011) finds evidence in support of the hypothesis using data from 1950 to 1980 for 130 countries. In contrast, Gaddis and Klasen (2014) are not able to establish the U-shaped relationship between economic growth and women's work force participation using data for additional years. Moreover, the evidence on the relationship between higher educational attainment of women and their LFPR is ambiguous. While the greater supply of female high school graduates, coupled with an increased demand for clerical jobs, led to a more than 15 percentage point increase in the labor force participation rates of women in the USA between 1930 and 1950 (Goldin 1995), the picture is heterogeneous in developing countries (Das and Desai 2003; Aromolaran 2004; Lincove 2008). Analyzing five Asian countries (Indonesia, Korea, Philippines, Sri Lanka, and Thailand), Cameron et al. (2001) find that female labor force participation rates respond differently to education across countries due to two potentially opposing effects: a wage effect and a bargaining power effect. Higher wages encourage women to join the workforce because the opportunity cost of time at home rises. However, if more education increases the relative bargaining power of women, and women prefer leisure or home production to working in the market, increasing levels of female education could lead to a fall in women's labor force participation. Moreover, even if female returns to education in the labor market rise, they still may not rise fast enough to counteract the rise in the returns to education in the marriage market (Behrman et al. 1999) and in home production. For example, Lam and Duryea (1999) show that as Brazilian women get more schooling, total fertility falls and wages rise, but the share of women working does not increase. They hypothesize that in Brazil, home productivity effects are large enough to offset increases in market wages up to the first 8 years of education.

Several studies have offered specific explanations for the decline in female LFPR in rural India: increases in female enrollment in higher education, increases in real household incomes reducing the need for females to engage in wage work, and limited growth in employment opportunities for females (e.g., Sorsa et al. 2015; Neff et al. 2012; Kannan and Raveendran 2012; Chowdhury 2011; Himanshu 2011).[3] However, these studies do not quantify the relative importance of multiple factors that can explain the decline. Kapsos et al. (2014) combine several years of NSS data to estimate pooled regressions of female employment. They state the explained component using coefficients from these regressions but do not analyze the contribution of each characteristic to the explained component, as we do. Chatterjee et al. (2014) focus on the demand side and estimate employment regressions controlling for district-level employment in agriculture, non-farm employment, and casual work as a proportion of total population. However, these variables likely reflect a combination of demand and supply side factors since all that we observe in the data is equilibrium employment.

In a recent paper, Klasen and Pieters (2015) address the puzzle of working women in India by focusing on the stagnant labor force participation among urban Indian women, which they attribute to both demand and supply side factors. Using parametric

[3] Das et al. (2015) analyze the relationship between labor market rigidities and female labor force participation, distinguishing between formal and informal sector employment, using NSS data for 1993–1994 to 2011–2012.

decomposition analysis (Blinder-Oaxaca) similar to ours, they find that on the supply side, rising household incomes and household heads' education reduced female LFPR in urban India, while increases in female education raised participation. They conclude that these two opposing effects have contributed to the stagnation of female LFPR in urban India.

Our paper adds to the literature on women's labor force participation broadly and in India, particularly, in several ways. First, we extend the existing literature by quantifying how much of the fall in female LFPR in rural India is accounted for by changes in the demographic and socio-economic characteristics of working age females between 1987 and 2011. We estimate the contribution of each characteristic to the fall, using parametric and semi-parametric decomposition methods. Second, unlike the recent debates in India that focus only on the decade of 1999–2011, we underline the fact that the decline in women's LFPR is not a recent phenomenon but rather a long-term trend in rural India. In contrast to Klasen and Pieters (2015) who examine LFPR trends between 1987 and 2011, we break up the period under study into 1987–1999 and 1999–2011 to compare our results between the decade of slower decline to that of faster decline in women's LFPR. This allows us to see whether factors that contribute to the decline in female LFPR differ between the two decades. Third, we highlight the role of and a potential mechanism through which women's education affects their decision to participate in the labor market. While Klasen and Pieters (2015) find evidence of women's own education contributing to a moderate *increase* in urban women's LFPR, our analysis underlines the significant role of women's education in the *reduction* of their LFPR in rural areas as their schooling rises from low levels. Different initial levels of education among urban and rural women are potential reasons for why increases in women's education play a disparate role in affecting LFP across the two studies.

Our findings nuance the existing evidence by suggesting that the reasons behind the decline in rural women's work force participation vary across decades. Changes in observable demographic and socio-economic characteristics of married women completely explain the fall in their LFPR for the period 1987–1999 and explain up to 56% of the change in their LFPR between 1999 and 2011. The explanatory power of women's individual and household characteristics in the secular decline of their LFPR is large, although their importance appears to be falling over time. We do not find strong evidence that observable variables correlated with social stigma against women working outside the home (e.g., caste, religion) can account for a substantial proportion of the fall in women's LFPR over time.

More importantly, we find that increases in both women's and men's education plays a substantial role in explaining the decline in both decades. Between 1987 and 1999, we estimate that women's own education and that of the men in their household accounted for 87–95% of the overall decline in women's LFPR. In the 1999–2011 decade, they explain 23–35% of the total decline in women's LFPR. Of course, the role of men's education could reflect, at least in part, the effect of rising incomes. However, we show that increases in household income proxied by consumption expenditure accounts for no more than 16% of the decline in 1987–1999, while the effects of higher incomes in 1999–2011 are inconsistent. This finding differs from the urban setting, where increases in income measured by imputed male earnings consistently reduced LFPR of women over the same period (Klasen and Pieters 2015). All of our results are robust to both parametric and semi-parametric decomposition methods.

The stylized facts we document—that the fall in employment has occurred only among married women in rural India, at the same time that their participation in domestic work and their average level of education is increasing—suggests a possible reason for their declining LFPR: initial improvements in education raise the relative productivity of women's work at home versus the market. If primary education provides basic skills to mothers in India, this may have a positive impact on their home productivity and little impact on their market productivity (e.g., Lam and Duryea 1999). Women may choose to invest in their homes, including their children's education and health, as they get more educated and their reservation wage rises. In addition, if they are unable to find jobs that provide them this higher reservation wage, they may be more inclined to stay at home. Consequently, women's employment may fall with more education even though education also raises the opportunity cost of not working. Although we cannot test this channel directly, we show that the same observable factors that account for the decline in female LFPR over the two decades also account for the increase in female participation in domestic work.

In the next section, we discuss the data we use in our analysis. In Section 3, we describe the decomposition methodology which quantifies the contribution of changing socio-economic characteristics to women's LFPR decline in India. We discuss results in Section 4 and conclude in Section 5.

2 Data

We use the Employment and Unemployment rounds of India's National Sample Surveys (NSS) in 1987–1988, 1999–2000, and 2011–2012 (referred to as 1987, 1999, and 2011 in this paper). The surveys include repeated cross sections of households, selected through stratified random sampling, that are representative of the country's population.[4] The NSS provides data on individual and household characteristics—household composition, religion, social group, landholding, monthly consumption expenditure as well as age, education, marital status, and participation and earnings in the labor market. Throughout our analysis, we measure an individual's labor force participation using the "Usual Principal and Subsidiary Status (UPSS)" in the NSS which classifies a respondent as working or not working (inactive) during the reference period of 365 days preceding the date of survey (see Appendix A for details).[5] A person participates in the labor force if they are currently working or seeking work.

Figure 1 shows the LFPR of 15–65-year-old men and women in rural and urban India. LFPRs are significantly higher for men and higher in rural areas. While labor force participation has been declining for 15–65-year-old females and males in both rural and

[4] The NSS follows a two-stage sampling design: In rural areas, the first stratum is a district. Villages are the primary sampling units (PSUs), picked randomly in a district with equal number of households surveyed in each quarter (over an entire agricultural year of July to June) to ensure equal spacing of observations across the year. The households are randomly chosen in the selected PSUs.

[5] We define the labor force participation rate (LFPR) as the proportion of people currently working or seeking work. Besides UPSS, the NSS provides another measure of labor force participation status—"daily status"—the number of days worked in the preceding *week* before the survey date. We do not use this measure in our analysis because the daily status employment rates in 1987 are not comparable to 1999 and 2011 due to a change in survey methodology. While these changes are unlikely to affect the employment rate using UPSS, they can artificially increase the employment figures by daily status. However, none of our conclusions change if we use daily status as our measure of employment.

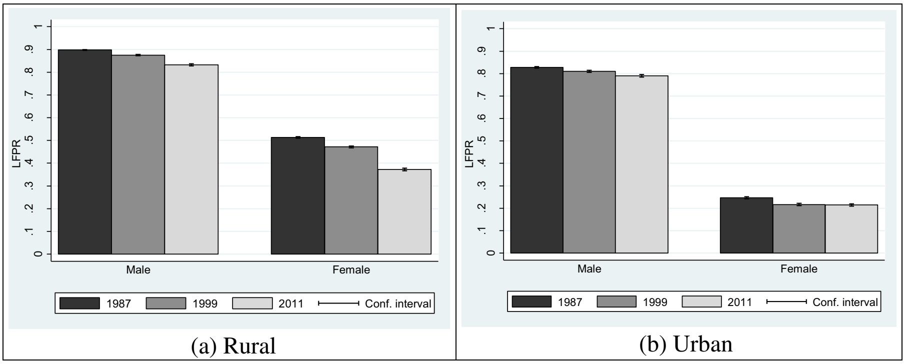

Fig. 1 Labor force participation rates (LFPRs) over time by gender sample of 15–65 year olds. *Source:* NSS (1987, 1999, 2011) Employment and Unemployment Schedule (Authors' calculations)

urban areas, the decline is most dramatic for rural women: 14 percentage points between 1987 and 2011.[6] When we restrict our sample to ages 25–65 in Fig. 2, there is almost no fall in the male LFPR over time. The differences between these two figures suggests that increasing school enrollment among men in the 15–24-year-old group accounts for the reduction in male LFPR during 1987–2011 (National Sample Survey Office, 2015). In contrast, women in the older age group of 25–65 still exhibit a declining trend over time, and substantially so in rural areas. The fall in women's LFPR has been steeper between 1999 and 2011 (9 percentage points) than in the previous decade (3 percentage points). In Fig. 3, we show that currently, married women are the ones driving this decline in work force participation. Married women are 85% of rural women in the 25–65 age group.[7] In Fig. 4, we see that the decline in rural married women's LFPR has been accompanied by an almost equivalent increase in the proportion of women who report domestic work as their primary activity in the previous 6 months during 1987–2011 (from 55% in 1987 to 69% in 2011).[8]

For the decomposition analyses, we restrict our sample to 25–65-year-old married women in rural India and use weights to make our results nationally representative. Table 1 shows summary statistics of the explanatory variables used in the decomposition analysis for each of the three rounds of the NSS. The individual variables include the female age distribution (seven indicator variables for age groups with age group 25–29 as the omitted category) and education distribution (six indicator variables with illiterate as the omitted category). Household-level variables include land owned by a household (five categories with the landholding size of less than 0.1 ha as the omitted category) and household consumption expenditure (per capita) deciles (10 indicator variables with the

[6] The decline in LFPR is 6 and 3 percentage points for rural and urban males, respectively, during this period. Urban women's LFPR declined by 3 percentage points between 1987 and 2011. The proportion of rural women looking for work has not changed during this period (NSS, various years). This suggests that it is not unemployment which is the cause of decline in women's LFPR.

[7] LFPR never married females have increased between 1987 and 2011. The share of married women in 1987, 1999, and 2011 was 82.5, 85.4, and 87.5%, respectively (NSS survey rounds). The small but significant increase in this proportion is attributable to a lower proportion of widowed women due to falling mortality rates in India.

[8] Domestic work in the NSS includes domestic chores and not-for-wages collection of goods (vegetables, roots, firewood, cattle feed, etc.), sewing, tailoring, weaving, etc. for household use. The difference between women's LFPR and the share of women in domestic work is the share of women unemployed in the previous year.

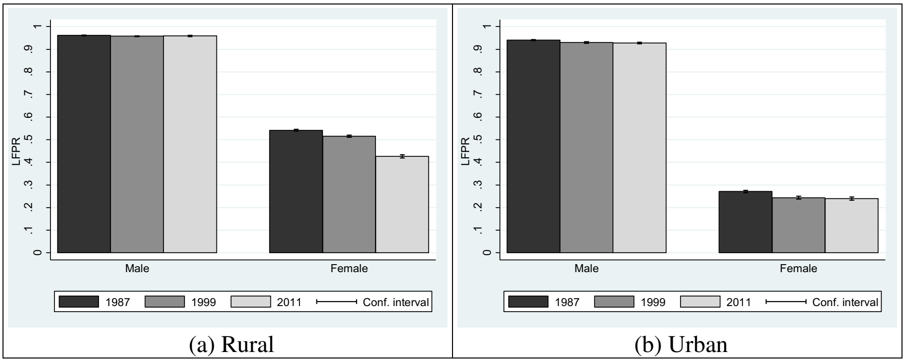

Fig. 2 Labor force participation rates (LFPRs) over time by gender. Sample of 25–65 year olds. *Source:* NSS (1987, 1999, 2011) Employment and Unemployment Schedule (Authors' calculations)

first decile omitted). Since the NSS does not contain information on the income of households, we proxy for income using monthly household consumption expenditure (e.g., as in Mammen and Paxson 2000).[9] We create deciles of household monthly per capita consumption expenditure using the data for 1987. To apply these deciles to later years, we adjust the 1987 cutoffs using the consumer price index for agricultural laborers and convert these cutoffs to nominal values in 1999 and 2011.[10] This ensures that consumption expenditure deciles are comparable across years while also taking into account the absolute expenditure levels within each year. The final set of household-level variables includes the highest level of education of male members in a household (six indicator variables with illiterate as the omitted category).[11] Since the NSS does not provide relationship codes, we cannot match women to their husbands within households. Instead, we define male education as the highest education level among all 18–65-year-old, married male members of the household. This variable is a proxy for male earnings in the absence of self-employment income in the NSS. It also captures positive assortative matching on education, a feature of the Indian marriage market that has become more prevalent during the period of our study.[12]

[9] The consumption variable as a proxy to capture the income effect includes women's income. Consequently, the contribution of income in explaining the decline in female LFPR in our analyses is likely to be a lower bound on the true negative income effect.

[10] To illustrate, the first decile in 1987 contains households having a monthly per capita expenditure of less than Rs. 76. In nominal terms. Rs 76 in 1987 is equivalent to Rs 213 and Rs 429 in 1999 and 2011, respectively. Rs 213 is then defined to be the cutoff for the first decile in 1999. Similarly, Rs 429 is defined to be the cutoff for the first decile in 2011. Our results are unchanged when we include household consumption expenditure as a continuous, non-linear variable.

[11] The NSS provides data on the highest level of completed education and not years of schooling of household members. Therefore, to avoid measurement error in calculating the average years of schooling of men in the household, we use the maximum level of male education. However, our results do not change if we use average education years. Other household characteristics which could possibly explain changes in women's employment, such as household size, share of children under age 5, share of male members, caste, and religion, have not been included in the main regressions since they do not alter our main conclusions. Also, some of these characteristics (e.g., fertility) can be endogenous to the labor force participation decision. The decomposition results including these variables are shown in robustness checks in Appendix B.

[12] The correlation between education of 18–35-year-old daughters-in-law in the household with the highest education of married males who are sons of the household head has increased from 0.54 in 1987 to 0.63 in 2011. We reach the same conclusion of a rise in positive assortative mating on education if we use the average level of education of males in the household.

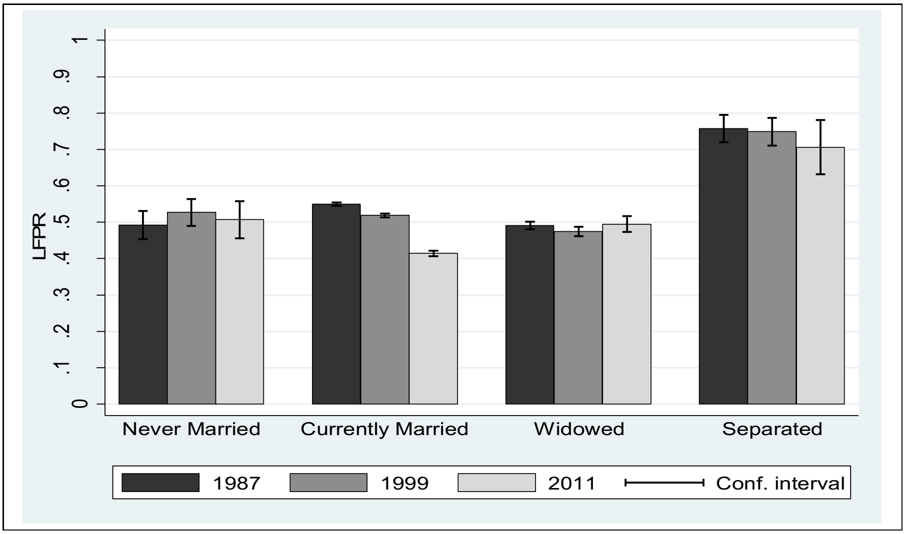

Fig. 3 Female labor force participation rates (LFPRs) over time by marital status. Rural sample. *Source:* NSS (1987, 1999, 2011) Employment and Unemployment Schedule (Authors' calculations). The sample includes women aged 25–65 in rural India

Table 1 shows that while there have been no significant changes in the age distribution of women, women's illiteracy rates have fallen dramatically from 80 to 54% between 1987 and 2011. The land ownership structure between 1987 and 2011 shows an increase in households with smaller landholdings. Real household consumption expenditures have increased with a larger percentage of women in the upper deciles of real household income in 2011 relative to

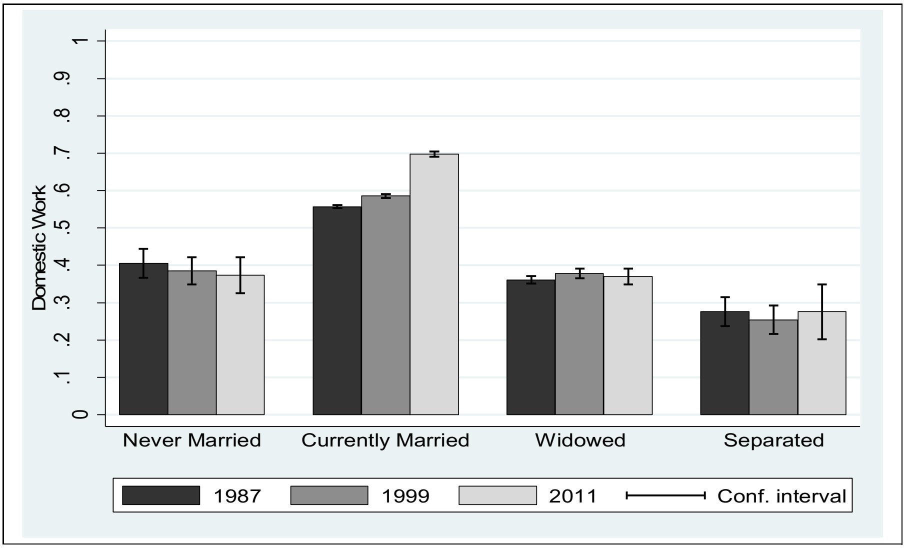

Fig. 4 Female participation in domestic work over time by marital status. Rural sample. *Source:* NSS (1987, 1999, 2011) Employment and Unemployment Schedule (Authors' calculations). The sample includes women aged 25–65 in rural India. The above graph reports proportion of women whose primary activity is domestic work

Table 1 Summary statistics

Variable	Description	Mean (standard error)					
		1987 (N = 73,833)		1999 (N = 67,108)		2011 (N = 59,029)	
Age (years)	25–29	0.23	(0.0015)	0.21	(0.0016)	0.18	(0.0016)
	30–34	0.19	(0.0014)	0.19	(0.0015)	0.18	(0.0016)
	35–39	0.16	(0.0014)	0.17	(0.0014)	0.18	(0.0016)
	40–44	0.13	(0.0012)	0.13	(0.0013)	0.13	(0.0014)
	45–49	0.11	(0.0012)	0.1	(0.0012)	0.11	(0.0013)
	50–54	0.08	(0.001)	0.08	(0.001)	0.08	(0.0011)
	55–65	0.1	(0.0011)	0.12	(0.0012)	0.13	(0.0014)
Own education	Illiterate	0.8	(0.0015)	0.71	(0.0018)	0.54	(0.0021)
	Less than primary	0.07	(0.001)	0.09	(0.0011)	0.11	(0.0013)
	Primary	0.07	(0.0009)	0.08	(0.0011)	0.12	(0.0013)
	Middle	0.03	(0.0007)	0.07	(0.001)	0.11	(0.0013)
	Higher secondary	0.02	(0.0005)	0.04	(0.0008)	0.09	(0.0012)
	Graduate and above	0	(0.0002)	0.01	(0.0003)	0.02	(0.0006)
Household's land ownership	Less than 0.1 ha	0.51	(0.0018)	0.6	(0.0019)	0.62	(0.002)
	0.1–0.2 ha	0.16	(0.0014)	0.15	(0.0014)	0.13	(0.0014)
	0.2–0.4 ha	0.16	(0.0013)	0.13	(0.0013)	0.13	(0.0014)
	0.4–0.6 ha	0.07	(0.0009)	0.05	(0.0009)	0.06	(0.001)
	More than 0.6 ha	0.1	(0.0011)	0.06	(0.0009)	0.06	(0.001)
Household's consumption expenditure decile (monthly consumption expenditure per household member)	First (< Rs 76)	0.09	(0.0011)	0.06	(0.0009)	0.02	(0.0006)
	Second (Rs 76–93)	0.11	(0.0012)	0.08	(0.001)	0.03	(0.0007)
	Third (Rs 93–107)	0.11	(0.0012)	0.09	(0.0011)	0.05	(0.0009)
	Fourth (Rs 107–121)	0.1	(0.0011)	0.11	(0.0012)	0.06	(0.001)
	Fifth (Rs 121–135)	0.1	(0.0011)	0.11	(0.0012)	0.08	(0.0011)
	Sixth (Rs 135–153)	0.1	(0.0011)	0.12	(0.0012)	0.1	(0.0012)
	Seventh (Rs 153–177)	0.1	(0.0011)	0.13	(0.0013)	0.13	(0.0014)
	Eighth (Rs 177–212)	0.1	(0.0011)	0.12	(0.0012)	0.15	(0.0015)
	Ninth (Rs 212–281)	0.1	(0.0011)	0.11	(0.0012)	0.18	(0.0016)
	Tenth (> Rs 281)	0.09	(0.0011)	0.08	(0.001)	0.21	(0.0017)
Household's highest male education	Illiterate	0.45	(0.0019)	0.37	(0.0019)	0.26	(0.0019)
	Less than primary	0.16	(0.0014)	0.14	(0.0014)	0.12	(0.0014)
	Primary	0.15	(0.0014)	0.13	(0.0013)	0.14	(0.0015)
	Middle	0.12	(0.0012)	0.16	(0.0014)	0.19	(0.0016)
	Higher secondary	0.1	(0.0011)	0.16	(0.0014)	0.21	(0.0017)
	Graduate and above	0.03	(0.0006)	0.05	(0.0009)	0.08	(0.0011)
Household size	Log household size	1.72	(0.0017)	1.69	(0.0018)	1.57	(0.0018)

Table 1 (continued)

Variable	Description	Mean (standard error)					
		1987 (N = 73,833)		1999 (N = 67,108)		2011 (N = 59,029)	
Male members	Percentage male (age 15–65)	0.48	(0.0006)	0.48	(0.0006)	0.48	(0.0006)
Children in household	Share of children under 5	0.15	(0.0006)	0.13	(0.0006)	0.1	(0.0006)
Household's social group	Scheduled caste (SC)	0.18	(0.0014)	0.21	(0.0016)	0.2	(0.0016)
	Scheduled tribe (ST)	0.1	(0.0011)	0.1	(0.0012)	0.1	(0.0013)
	Others	0.71	(0.0017)	0.69	(0.0018)	0.7	(0.0019)
Religion	Hindu	0.85	(0.0013)	0.85	(0.0014)	0.84	(0.0015)
	Muslim	0.1	(0.0011)	0.1	(0.0011)	0.11	(0.0013)
	Christian	0.02	(0.0005)	0.02	(0.0006)	0.02	(0.0006)
	Others	0.03	(0.0007)	0.03	(0.0007)	0.03	(0.0007)

The sample includes 25–65-year-old, rural married women. The descriptive statistics have been estimated using sampling weights provided in the NSS. The cutoffs for consumption expenditure deciles for the year 1987 are used and adjusted for cost of living for 1999 and 2011. *Source:* NSS (1987, 1999, 2011) Employment and Unemployment Schedule (Authors' calculations)

1987. The educational attainment of men in the household has also increased, with a significant reduction in illiterate men (26 from 45%) and a larger proportion of married men completing at least middle school and above during this period. There has been virtually no change in the caste and religious composition of the women in this age group during 1987–2011.

3 Methodology

We use parametric and semi-parametric decomposition methods to estimate the proportion of the decline in women's LFPR accounted for by the changing demographic and socio-economic characteristics of women and the households they live in. We divide the data into two periods—1987–1999 and 1999–2011—to allow for structural changes post liberalization of the economy in 1991 (e.g., Topalova 2010). In the next section, we describe each decomposition technique. We refer to employment rates interchangeably with LFPRs, because there is no change in the unemployment rate of rural women over time.

3.1 Parametric decomposition: Blinder-Oaxaca

We first use the non-linear Blinder (1973) and Oaxaca (1973) technique to decompose the change in employment rates of women over time. We estimate the following reduced form logit model for each of the 3 years in our cross-sectional datasets:

$$\hat{Y}_i^j = F\left(\boldsymbol{X}_i^j \hat{\beta}^j\right) \tag{1}$$

where Y is the binary outcome variable—woman i's participation status in the labor force (= 1 if the woman is currently in the labor force and 0 otherwise) in year j. $\mathbf{X}$ includes all individual and household characteristics as discussed in Table 1, and $\hat{\beta}^j$ are the parameter estimates. We examine the pattern of $\hat{\beta}^j s$ estimated using the participation logits for each decade to gain some insight into the "returns" that changed, contributing to the decline in female LFPR.

We use the estimated $\hat{\beta}^j$ to decompose the predicted differentials in participation rate between 1987 and 1999 using the coefficient estimates from (1) as follows:

$$\overline{Y}^{1987} - \overline{Y}^{1999} = \left[\sum_{i=1}^{N^{1987}} \frac{F\left(\boldsymbol{X}_i^{1987}\hat{\beta}^{1987}\right)}{N^{1987}} - \sum_{i=1}^{N^{1999}} \frac{F\left(\boldsymbol{X}_i^{1999}\hat{\beta}^{1987}\right)}{N^{1999}}\right] + \left[\sum_{i=1}^{N^{1999}} \frac{F\left(\boldsymbol{X}_i^{1999}\hat{\beta}^{1987}\right)}{N^{1999}} - \sum_{i=1}^{N^{1999}} \frac{F\left(\boldsymbol{X}_i^{1999}\hat{\beta}^{1999}\right)}{N^{1999}}\right] \quad (2)$$

Here, $\overline{Y}$ is the mean employment rate, and N is the population size. The superscripts reflect the year of measurement.

The first term in square brackets, on the right hand side of Equation (2), represents the change in women's LFPR that can be attributed to their changing demographic and socio-economic characteristics ($\mathbf{X_i}$) over time holding the coefficients $\left(\hat{\beta}^{1987}\right)$ constant. We refer to this as the explained component of the variation in LFPR over time. The second term represents the change in women's LFPR holding $\mathbf{X_i}$ constant while varying the coefficients over time. It shows the change in women's LFPR explained by women with the same characteristics having different participation rates over time. We call this the unexplained component of the variation in LFPR over time. Dividing the explained (unexplained) component by the total change in female employment (i.e., the left hand side of (2)) gives us the explained (unexplained) proportion of the change in women's LFPR over time. Equation (2) shows one version of the decomposition, when the coefficients for 1987 $\left(\hat{\beta}^{1987}\right)$ define the reference relationship between female employment and individual characteristics. However, shifts in the structure of the economy, such as a change in the supply or demand for women's labor, could change the relationship between women's employment and their characteristics over time. For instance, if $\hat{\beta}^{1999} < \hat{\beta}^{1987}$ for women in low-income households, this could be because either female labor supply in these households or labor demand for these women fell (or a combination of the two). We will not be able to distinguish between these two explanations. Instead, we estimate the explained proportion at the regression coefficients for two benchmark years 1987 ($\hat{\beta}^{1987}$) and 1999 ($\hat{\beta}^{1999}$) and discuss whether our findings differ depending on the specific year used to construct the decomposition.

In addition, any interaction effects between changing attributes and changing coefficients might contribute to the variation in female LFPR over time (e.g., Biewen 2012). For example, if households own less land over time and if probability of working in the market falls with time for women belonging to a land-owning household, then the combination of these two changes would account for a lower proportion of any decline in female LFPR. We outline the role of these interaction terms more formally in Appendix B and show how the total decomposition that we implement in (2) incorporates any potential interaction effects.

3.2 Semi-parametric decomposition

In a second approach, we use a generalization of the Blinder-Oaxaca approach—a semi-parametric decomposition method first proposed by DiNardo et al. (1996) (henceforth, DFL), which does not impose a linear relationship between the dependent variable and the explanatory variables.[13] We outline the DFL decomposition method below using the same notations as in Black et al. (2011).

Let E(e| x, t) denote the expected (mean) employment rate for people with a set of characteristics x at time t and let $f(x| t)$ denote the distribution of characteristics at time t. The aggregate employment rate at time t can then be expressed as

$$E(e|t) = \int E(e|\ x, t)\ f(x|t)\ dx \tag{3}$$

The notation highlights the fact that both the employment-characteristic relationship ($E(e|\ x, t)$) and the distribution of characteristics ($f(x| t)$) can vary over time. To quantify the share of the fall in women's employment accounted for by the change in demographic and socio-economic characteristics of women (i.e., by changes in $f(x| t)$), we construct counterfactual employment rates as follows. We denote the time for which the set of employment rates for each characteristic is drawn by t_e, and the time from which the distribution of characteristics is drawn by t_x. The average employment rate at time t can then be alternatively expressed as

$$E(e|\ t_e = t, t_x = t) = \int E(e|\ x, t_e = t)\ f(x|t_x = t)\ dx \tag{4}$$

where $E(e|\ t_e = 1987, t_x = 1987)$ denotes the observed employment rate in year 1987 given 1987 characteristics, while $E(e|\ t_e = 1987, t_x = 1999)$ denotes the counterfactual employment rate in 1987, i.e., the employment rate that would have been observed in 1987 had the distribution of individual characteristics been given by the distribution in 1999. Holding the base year (1987)

[13] DiNardo (2002) shows that the DFL method is identical to Blinder-Oaxaca decomposition when the variable of interest is the mean of the outcome variable and there is a single categorical explanatory variable. While this technique has been used to decompose wage and earning differentials (Leibbrandt et al. 2010; Biewen 2001; Butcher and DiNardo 2002; Hyslop and Mare 2005; Daly and Valletta 2006), only a handful of papers have used it to decompose differences in other outcomes, such as employment (Black et al. 2011) and health (Geruso 2012).

employment-characteristic relationship constant over time (analogous to the $\hat{\beta}^j$ in the parametric approach), we can decompose the change in aggregate employment between 1987 and 1999 into two components. The first is an explained component or a change in employment due to change in socio-economic characteristics of working age women. The second is an unexplained component or a change in employment due to change in employment rates of women with same characteristics. We can write this as

$$Total\ change = Explained\ change + Unexplained\ change$$

$$\begin{aligned} &E(e|\ t_e = 1987, t_x = 1987) - E(e|\ t_e = 1999, t_x = 1999) \\ &\quad = [E(e|\ t_e = 1987, t_x = 1987) - E(e|\ t_e = 1987, t_x = 1999)] \\ &\qquad + [E(e|\ t_e = 1987, t_x = 1999) - E(e|\ t_e = 1999, t_x = 1999)] \end{aligned} \tag{5}$$

where the counterfactual employment rate in 1987 is given by

$$E(e|t_e = 1987, t_x = 1999) \quad \begin{aligned} &= \int E(e|x, t_e = 1987)\ f(x|t_x = 1999)dx \\ &= \int E(e|x, t_e = 1987)\varphi(x) f(x|t_x = 1987)dx \end{aligned} \tag{6}$$

$\varphi(x)$ is a re-weighting function which we use to adjust the distribution of characteristics in a given year to look like the distribution of characteristics in a different year. We apply Baye's rule to get this re-weighting function:

$$\varphi(x) = \frac{Pr(t_x = 1987)}{Pr(t_x = 1999)} \frac{Pr(t_x = 1999|x)}{Pr(t_x = 1987|x)} \tag{7}$$

where $\Pr(t_x = t)$ is the percentage of observations that belong to year t. The estimate for $\Pr(t_x = t|x)$ is obtained by estimating a discrete choice model where the dependent variable is a dichotomous variable for the observations belonging to year t and x are the explanatory characteristics. Then, $\varphi(x)$ is constructed using the predictions for each individual in year 1987.

The counterfactual employment rate that is part of (6) can then be empirically constructed as

$$\hat{E}(e|\ t_e = 1987, t_x = 1999) = \sum_{i=1}^{N_{1987}} \frac{\hat{\varphi}_i(x)\ e_i}{N_{1987}} \tag{8}$$

where $(\hat{\varphi}_i(x))$ is the estimated re-weighting function and e_i is whether or not a woman is in labor force in year 1987. The estimated re-weights $(\hat{\varphi}_i(x))$ are such that the distribution of observed characteristics across years is the same.[14]

We use both the Blinder-Oaxaca decomposition and the DFL decomposition to estimate the explained component of variation in LFPR over time using counterfactuals in 1987 and in 1999. We then repeat these exercises for the 1999–2011 decade and compare our results across methodologies and over time.

[14] For example, in the above case, we re-weight observations in year 1987 so that the distribution of observed characteristics in 1987 is identical to that in 1999. If real income is higher in 1999, individuals belonging to households with higher incomes in 1987 are weighted up so that the percentage of individuals in each income decile after re-weighting is identical across years.

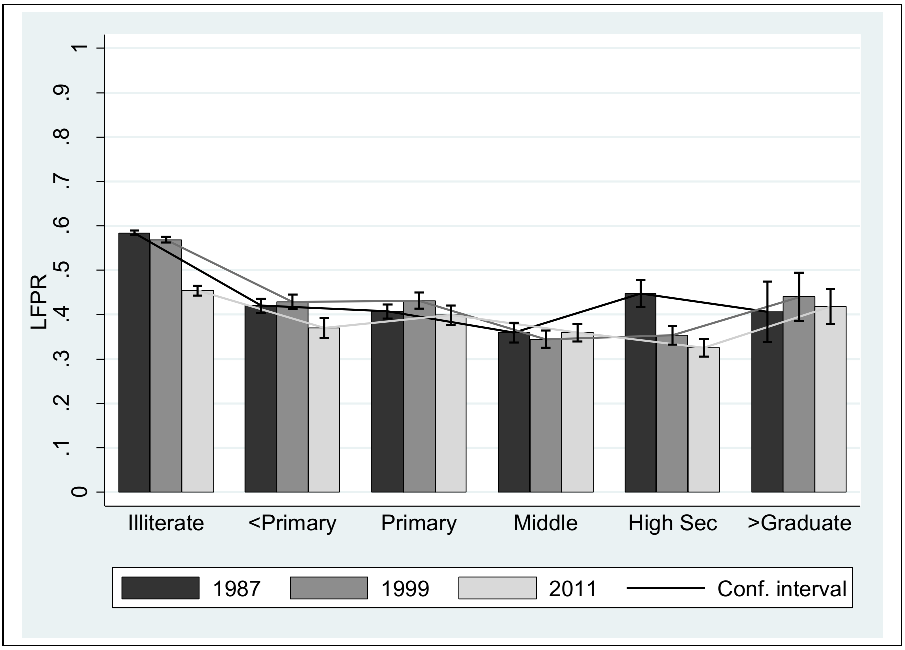

Fig. 5 Female labor force participation rates (LFPR) over time by education level. Rural sample of married women. *Source:* NSS (1987, 1999, 2011) Employment and Unemployment Schedule (Authors' calculations). The sample includes women aged 25–65 in rural India. "High Sec" refers to secondary and higher secondary level of education. *Bars* show means of LFPR by level of education for each NSS survey year by education category. The *lines* connect the means across education categories

4 Results

4.1 Estimates from LFPR logits for each decade

Before turning to the results of our decomposition analysis, we discuss the reduced form relationships between female education and female LFPR (Fig. 5), as well as the logit regressions of a woman's labor force participation status on her socio-economic characteristics for 1987, 1999, and 2011 (Table 2). A few findings stand out.

First, the role of women's education in predicting their LFPR is salient across all education categories between 1987 and 2011. Figure 5 shows a "U"-shaped relationship between rural women's education and LFPR. The results in Table 2 reflect this pattern. Education raises women's LFPR, but only at the highest level of schooling ("more than graduate") after 1999, in comparison with 1987 when the coefficient turns positive at "higher secondary" level. This provides a clue as to why patterns of LFPR among rural and urban women may differ. Table 1 shows us that the majority of women in rural areas are on the declining portion of this Ucurve, given their low level of average schooling.[15] In contrast, women in urban areas have higher average levels of

[15] In urban India, the proportion of 25–65-year-old married women with higher secondary and graduate education has risen dramatically—from 13 to 25% and 6 to 18%, respectively—between 1987 and 2011. In contrast, Table 2 shows the percent of rural women with higher secondary schooling or above rose from only 2 to 11% over the same period.

education and appear to be on the upward portion of the U curve (Klasen and Pieters 2015).

A second point to note in Table 2 is that keeping other factors constant, the effect of income (using consumption expenditure deciles as a proxy) on women's labor market participation has become weaker over time and is mostly insignificant in 2011. This is again in contrast to findings in urban areas of India, where proxies for income are significantly negatively associated with women's LFP. Third, male education has a robust and negative impact on women's LFPR throughout, albeit less significantly at lower levels of education. If we think that male education is only proxying for household income, this correlation suggests a strong negative income effect on female LFP. However, because of strong positive assortative matching in the Indian marriage market, male education also very likely captures some of the effects of rising female education (and thus education in general) on women's choices about working. Overall then, education levels of men and women are going to be important in accounting for changes in female LFP over time. These broad patterns in each decade are robust to including caste, religion, and other demographic variables, as well as district fixed effects (results available upon request).[16]

4.2 Proportion of decline in women's LFPR explained by socio-economic characteristics

Our main results from the decomposition analyses appear in Tables 3 and 4. We first estimate changes in female LFPR between 1987 and 1999 (i.e., 1987 less 1999) and then between 1999 and 2011 (similarly, 1999 less 2011). The changes are therefore positive, capturing the declining female LFPRs over time.

Table 3 shows the parametric decomposition results. The specifications across columns differ in the individual and household characteristics included in the analysis. We include age of the woman and her education as the only explanatory characteristics in the first specification (column (1)). Columns (2) and (3) add household land ownership and household consumption expenditure controls, respectively. In column (4), we replace household consumption expenditure with the highest level of education among men in the household, which is more likely to be exogenous to women's LFPR

[16] In additional analyses (available on request), we investigated relationships between fertility choices, female education, and female work. We controlled for the proportion of household members who are in the 0–5 and 6–14 age group as well as their interactions with woman's education. As expected, the higher the share of young kids in the household, the lower the female LFPR is, in all years (insignificant in 2011). This was particularly so for women in the 25–45 age group. Moreover, this negative correlation between young children and female employment is larger for women with higher levels of education. The share of children in the older age groups has a positive effect on female LFP. This could be because of older children providing a substitute for mother's time. It is, however, difficult to interpret these results causally since fertility decisions are jointly determined with woman's LFP. There are two opposing effects here: if women, who derive greater utility from raising children, choose to have more children, then this would bias the coefficient downwards. On the contrary, if women, who derive greater utility from higher quality of children, choose to have fewer children, then this would result in a positive bias on the coefficient. Our results indicate that the latter channel of deriving greater satisfaction from quality of children may be dominant. Unfortunately, given that there exists no exogenous variation in fertility in our study, we cannot estimate the true effect of fertility on women's labor force participation. We hope to address this issue in future work.

Table 2 Predictors of women's labor force participation: logit estimates by decade

Year	1987		1999		2011	
	Marginal effect	SE	Marginal effect	SE	Marginal effect	SE
Age (years)	Base: age 25–29					
30–34	0.032***	(0.007)	0.045***	(0.008)	0.055***	(0.013)
35–39	0.042***	(0.008)	0.056***	(0.008)	0.085***	(0.013)
40–44	0.039***	(0.008)	0.053***	(0.010)	0.066***	(0.014)
45–49	0.016*	(0.008)	0.029***	(0.010)	0.059***	(0.015)
50–54	− 0.043***	(0.010)	− 0.007	(0.011)	0.012	(0.017)
55–65	− 0.159***	(0.009)	− 0.141***	(0.009)	− 0.055***	(0.015)
Education category	Base: illiterate					
Less than primary	− 0.105***	(0.009)	− 0.098***	(0.010)	− 0.071***	(0.013)
Primary	− 0.096***	(0.009)	− 0.083***	(0.011)	− 0.038***	(0.013)
Middle	− 0.106***	(0.014)	− 0.141***	(0.012)	− 0.060***	(0.013)
Higher secondary	0.011	(0.017)	− 0.093***	(0.014)	− 0.069***	(0.015)
Graduate and above	0.031	(0.036)	0.064**	(0.029)	0.076***	(0.026)
Per capita household land ownership	Base: landless					
0.1–0.2 ha	0.025***	(0.007)	0.073***	(0.007)	0.106***	(0.012)
0.2–0.4 ha	0.069***	(0.006)	0.135***	(0.007)	0.114***	(0.012)
0.4–0.6 ha	0.100***	(0.008)	0.151***	(0.010)	0.144***	(0.017)
More than 0.6 ha	0.131***	(0.007)	0.174***	(0.009)	0.099***	(0.016)
Consumption expenditure decile	Base: decile 1					
Decile 2	− 0.021**	(0.010)	− 0.007	(0.015)	− 0.009	(0.035)
Decile 3	− 0.051***	(0.010)	− 0.056***	(0.014)	− 0.026	(0.033)

Table 2 (continued)

Year	1987		1999		2011	
	Marginal effect	SE	Marginal effect	SE	Marginal effect	SE
Decile 4	− 0.066***	(0.010)	− 0.061***	(0.014)	− 0.010	(0.032)
Decile 5	− 0.084***	(0.011)	− 0.069***	(0.014)	− 0.075**	(0.031)
Decile 6	− 0.094***	(0.010)	− 0.105***	(0.014)	− 0.027	(0.031)
Decile 7	− 0.096***	(0.011)	− 0.086***	(0.014)	− 0.043	(0.030)
Decile 8	− 0.095***	(0.011)	− 0.097***	(0.014)	− 0.005	(0.029)
Decile 9	− 0.101***	(0.011)	− 0.118***	(0.015)	0.008	(0.029)
Decile 10	− 0.092***	(0.011)	− 0.157***	(0.017)	0.010	(0.029)
Male education in household	Base: illiterate					
Less than primary	− 0.060***	(0.007)	− 0.062***	(0.009)	− 0.036**	(0.015)
Primary	− 0.066***	(0.007)	− 0.049***	(0.009)	− 0.026*	(0.014)
Middle	− 0.161***	(0.008)	− 0.128***	(0.008)	− 0.058***	(0.013)
Higher secondary	− 0.221***	(0.009)	− 0.164***	(0.009)	− 0.131***	(0.013)
Graduate and above	− 0.328***	(0.014)	− 0.251***	(0.014)	− 0.208***	(0.016)
Observations	67,257		62,720		55,694	
Pseudo *R*-squared	0.05		0.06		0.03	

Table shows coefficients (marginal effects) from the logit regressions of female LFP on covariates. Regressions include sampling weights provided in the NSS. The cutoffs for consumption expenditure deciles for the year 1987 are used and adjusted for cost of living for 1999 and 2011. The sample includes 25–65-year-old, rural married women. Standard errors in parenthesis. ***, **, * significant at 1, 5, and 10%, respectively. *Source:* NSS (1987, 1999, 2011) Employment and Unemployment Schedule (Authors' calculations)

Table 3 Blinder-Oaxaca decomposition of change in women's LFPR

	(1)	(2)	(3)	(4)	(5)
Panel A: 1987–1999					
Change in predicted LFPR	0.0310	0.0310	0.0331	0.0309	0.0331
Explained component at:					
1987 coefficients	0.0210	0.0267	0.0322	0.0410	0.0449
1999 coefficients	0.0216	0.0322	0.0370	0.0433	0.0468
Explained proportion at:					
1987 coefficients	0.68	0.86	0.97	1.33	1.36
1999 coefficients	0.7	1.04	1.12	1.4	1.41
Observations	140,842	140,842	139,020	131,682	129,977
Panel B: 1999–2011					
Change in predicted LFPR	0.1041	0.1041	0.1041	0.1057	0.1057
Explained component at:					
1999 coefficients	0.0347	0.0377	0.0567	0.0430	0.0588
2011 coefficients	0.0155	0.0192	0.0163	0.0222	0.0174
Explained proportion at:					
1999 coefficients	0.33	0.36	0.54	0.41	0.56
2011 coefficients	0.15	0.18	0.16	0.21	0.16
Observations	126,089	126,089	126,085	118,418	118,414
Covariates included?					
Own age group	Yes	Yes	Yes	Yes	Yes
Own education	Yes	Yes	Yes	Yes	Yes
Land ownership of HH		Yes	Yes	Yes	Yes
Consumption of HH			Yes		Yes
Male education in HH				Yes	Yes

A woman is defined to be in labor force if she is working or seeking work as her primary or subsidiary activity. LFPR is the share of women in the labor force. The sample includes rural married women aged 25–65. The analysis incorporates the sampling weights in NSS. Explained proportion is calculated by dividing the explained component by the change in predicted LFPR (e.g., in the first column: 0.0210/0.0310 = 0.68). The change in predicted LFPR varies marginally across columns in panels A and B because the number of observations varies due to missing data for certain variables. Because our decomposition subtracts 1999 from 1987 (or 2011 from 1999), and female LFPR are falling over time, the changes in LFPR are positive

than household expenditure. Column (5) includes all of these demographic and socio-economic characteristics.[17]

[17] Socio-economic factors which show minor or no change in distribution (for example, social group, religion, number of male members in household) or that exhibit a change in a direction that cannot explain the fall in women's LFPR (e.g., number of children, household size) have not been included in our specifications in Tables 3 and 4. We show that our main results are robust to including these additional variables in Appendix B, Table 8.

Table 4 Dinardo-Fortin-Lemieux (DLF) decomposition of change in women's LFPR

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: 1987–1999						
Change in predicted LFPR	0.0311	0.0311	0.0311	0.0311	0.0311	0.0311
Explained proportion at:						
1987 coefficients	0.67	0.83	0.97	1.33	1.41	1.31
1999 coefficients	0.69	1.05	1.16	1.39	1.46	1.45
Observations	140,941	140,941	140,941	140,941	140,941	140,941
Panel B: 1999–2011						
Change in predicted LFPR	0.1042	0.1042	0.1042	0.1042	0.1042	0.1042
Explained proportion at:						
1999 coefficients	0.34	0.37	0.55	0.43	0.60	0.57
2011 coefficients	0.15	0.19	0.15	0.19	0.13	0.16
Observations	126,137	126,137	126,137	126,137	126,137	126,137
Covariates included?						
Own age group	Yes	Yes	Yes	Yes	Yes	Yes
Own education	Yes	Yes	Yes	Yes	Yes	Yes
Land ownership of HH		Yes	Yes	Yes	Yes	Yes
Consumption of HH			Yes		Yes	Yes
Male education of HH				Yes	Yes	Yes

A woman is defined to be in the labor force if she is working or seeking work as her primary or subsidiary activity. LFPR is the share of women in the labor force. The sample includes rural married women aged 25–65. The analysis incorporates the sampling weights in NSS. The specification in column (6) includes two-way interactions between all the variables when estimating the re-weighting function. See Section 3 for an explanation of the semi-parametric Dinardo-Fortin-Lemieux (DFL) decomposition technique

Panel A of Table 3 shows the decomposition results for the change in women's LFPR between 1987 and 1999. We calculate the explained proportion of the total predicted change in female LFPR by dividing the explained component by the total change in predicted LFPR. For instance, in panel A column (1), the explained proportion at 1987 coefficients is 0.0210/0.0310 = 0.68. This means that the changing structure of female education and the distribution of women across age groups can account for 68% of the change in female LFPR between 1987 and 1999, keeping the 1987 coefficients constant. Across specifications in Table 3, panel A, the share of the change in female LFPR that can be explained by observables varies from 68 to 136 (70 to 141) % when we use the 1987 (1999) coefficients. The explained proportions using 1987 coefficients are similar to the explained proportions using 1999 coefficients. When all variables are included, the share of the change that we can account for is 136 (141) % evaluated at the regression coefficients for the year 1987 (1999). This implies that the included demographic and socio-economic attributes fully explain the fall in women's LFPR between 1987 and 1999. Explained proportions greater than one suggest that if only these attributes were responsible for the change in women's LFPR during this period, then the fall in female LFPR should have been larger than we observe. In other words, the effects of the included variables on the change in female LFPR must have changed size, and possibly their direction of influence, over time.

Panel B shows the decomposition results for 1999–2011. When all the demographic and socio-economic characteristics of women are included in our analysis (column (5)), only 56 (16) % of the decline in women's LFPR in this period can be explained at the 1999 (2011) employment regression coefficients as indicated in column (5). Thus, we can account for a higher proportion of the fall in women's LFPR during 1999–2011 using the 1999 coefficients than using the 2011 coefficients. As discussed earlier, the employment regression coefficients for 1999 are likely to reflect the relationship between employment and individual characteristics given specific labor demand conditions in 1999. Changing labor demand over time, especially in response to the economic reforms of the 1990s, could have altered the observed relationship between characteristics and employment by 2011. We discuss this issue in more detail later.

We can use our methodology to understand whether there are interaction effects between changing characteristics and changing coefficients that predict the variation in female LFPR. For example, Table 1 shows that the proportion of women with schooling has risen across all education categories in rural India. At the same time, the logit estimates in Table 2 show that as education increases from low levels, women are less likely to work, and over time, the coefficients on all categories of education have increased in absolute magnitude (when compared to illiterate women) in 2011 as compared to 1999. The effect of this increase in women's education combined with the change in the corresponding coefficients will therefore be to reduce female LFPR by even more than the effects of the changes in coefficients, or changes in characteristics, alone.

Algebraically, these interaction effects are equal to the difference in the explained proportions evaluated at each of the two sets of coefficients (e.g., see Biewen 2012). For example, in column (5) of Table 3, this interaction effect is equal to 56–16 ≈ 39%. The results in Table 3 show that there are larger gaps between the explained proportions of the change in female LFPR using the 1999 or 2011 coefficients (panel B), compared with smaller gaps between the explained proportions using the 1987 or 1999 coefficients (panel A). This suggests that the role of interactions between the changes in the socio-economic characteristics of interest and the coefficients has become more important over time. We provide a longer discussion and illustration of computing these interaction effects in Appendix B, and Table 7.

Moving on to Table 4, we show results from the semi-parametric DFL decomposition technique. For brevity, we show only the calculated explained proportions (that is, the share of the predicted variation in female LFPR accounted for by the specific set of observable characteristics). Panel A indicates that between 67 and 141% (69 and 146%) of the fall in women's LFPR between 1987 and 1999 can be explained, depending on the demographic and socio-economic characteristics we include, at the counterfactuals for 1987 (1999). Similarly, 34–60% (13–19%) of the fall in women's LFPR between 1999 and 2011 is accounted for by the included characteristics at the counterfactuals for 1999 (2011) in panel B. These explained proportions are comparable to those obtained in Table 3 using Blinder-Oaxaca decomposition. The largest difference in the explained component obtained by the two methods is for the 1999–2011 period. In this case, the

Blinder Oaxaca decomposition tells us that we can account for 56 (16) % of the predicted change between 1999 and 2011, while the DFL estimate accounts for 60 (13) % of the predicted change at 1999 (2011) coefficients (comparing column (5) in Tables 3 and 4).

To check the validity of the semi-parametric results, Black et al. (2011) suggest conducting *t* tests for individual variable means, across the re-weighted observations in the base year and the actual observations in the other year(s). The null of equality of means is more likely to be accepted when the re-weighting function is precisely estimated for which, they advocate inclusion of interaction terms among the characteristics. As a robustness check, therefore, we show the DFL decomposition results when all two-way interaction terms between observables are included as explanatory variables while estimating the re-weighting function in column (6) of Table 4.[18] These estimates are comparable to those shown in column (5), in which we do not include interaction terms among the set of characteristics, suggesting that we have not omitted any important non-linearities from our analysis.[19]

4.3 Contribution of characteristics to the predicted changes in female LFPR

While the similarities in the explained proportions estimated using both the parametric and the semi-parametric techniques give us confidence in the Blinder-Oaxaca decomposition, it only provides a general picture of how the set of included observables, along with the year-specific coefficients on these variables, account for the changes in female LFPR over time. To clearly explain the *relative* role of different characteristics, we use a method proposed by Fairlie (2005). For each specific observable characteristic, we estimate how much of the total predicted change in female LFPR is accounted for by that characteristic and its year-specific coefficient, conditional on the other variables included in the regression. We do this using the Blinder-Oaxaca analysis, in Table 5.

Panel A shows the contribution of each characteristic to the total explained component (in italic) in 1987–1999 at the regression coefficients for 1987. We obtain this by dividing the characteristics' contribution (in the row below the italic figures) by the total explained component for that specification in Table 3. For instance, in specification (1), woman's education contributes fully to the explained proportion, because 0.0213/0.0210 ≈ 1.02.[20] In specifications (2) and (3), we include land and household consumption expenditure to proxy for household wealth, and we see the contribution of education to the explained proportion of change in female LFPR falls to 81 and then 58% due to the correlations between all the included variables. However, as we look

[18] For instance, we interact age group indicators with education, land owned, income, male education, and own education separately.

[19] In specification (6), the re-weighting function is unable to match the age-group composition at statistically significant levels, for the decomposition in 1987–1999, but the absolute differences are not large. For example, in panel A, specification 6, the re-weighted observations in 1987 have an age group composition of 22, 20, 17, 13, 11, 8, and 10% for age groups 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, and 55–65, respectively. The corresponding numbers for actual population in 1999 provided in Table 1 are very close to these proportions.

[20] Rounding off errors in Table 5.

across columns (1)–(3), woman's own education continues to be the largest contributor to the explained proportion of changing female LFPR. Adding controls for the education of men in the household, in columns (4) and (5) reduces the contribution of

Table 5 Relative contributions of characteristics to Blinder-Oaxaca decomposition of change in women's LFPR

Contribution to explained variation in LFPR	(1)		(2)		(3)		(4)		(5)	
Panel A: 1987–1999										
1987 coefficients										
Explained proportion	0.68		0.86		1.04		1.33		1.36	
Own age group	*− 0.02*		*0.00*		*0.00*		*− 0.01*		*− 0.01*	
	− 0.0003	**	0.0000		0.0000		− 0.0005	***	− 0.0005	***
	(0.0001)		(0.0001)		(0.0001)		(0.0001)		(0.0001)	
Own education	*1.02*		*0.81*		*0.58*		*0.22*		*0.16*	
	0.0213	***	0.0216	***	0.0186	***	0.0088	***	0.0072	***
	(0.0008)		(0.0008)		(0.0008)		(0.0009)		(0.0009)	
Land ownership of HH			*0.19*		*0.22*		*0.17*		*0.19*	
			0.0052	***	0.0071	***	0.0071	***	0.0085	***
			(0.0004)		(0.0004)		(0.0004)		(0.0004)	
Consumption of HH					*0.21*				*0.12*	
					0.0066	***			0.0052	***
					(0.0004)				(0.0004)	
Male education of HH							*0.62*		*0.54*	
							0.0255	***	0.0244	***
							(0.0008)		(0.0008)	
1999 coefficients										
Explained proportion	0.70		1.04		1.20		1.40		1.41	
Own age group	*− 0.02*		*0.00*		*0.01*		*0.00*		*0.00*	
	− 0.0005	***	0.0001		0.0003	***	0.0000		− 0.0001	
	(0.0002)		(0.0001)		(0.0001)		(0.0001)		(0.0001)	
Own education	*1.02*		*0.70*		*0.50*		*0.31*		*0.24*	
	0.0220	***	0.0224	***	0.0187	***	0.0132	***	0.0111	***
	(0.0007)		(0.0007)		(0.0007)		(0.0008)		(0.0008)	
Land ownership of HH			*0.30*		*0.34*		*0.25*		*0.28*	
			0.0096	***	0.0124	***	0.0109	***	0.0134	***
			(0.0005)		(0.0004)		(0.0005)		(0.0005)	
Household's consumption					*0.15*				*0.10*	
					0.0055	***			0.0046	***
					(0.0004)				(0.0005)	
Male education of HH							*0.44*		*0.38*	
							0.0191	***	0.0180	***
							(0.0008)		(0.0008)	

Table 5 (continued)

Contribution to explained variation in LFPR	(1)		(2)		(3)		(4)		(5)	
Panel B: 1999–2011										
1999 coefficients										
Explained proportion	0.33		0.36		0.54		0.41		0.56	
Own age group	*− 0.01*		*0.01*		*0.00*		*− 0.01*		*− 0.01*	
	− 0.0003		0.0004	*	− 0.0003		− 0.0004	*	− 0.0007	***
	(0.0003)		(0.0002)		(0.0002)		(0.0002)		(0.0002)	
Own education	*1.01*		*0.95*		*0.53*		*0.47*		*0.28*	
	0.0351	***	0.0360	***	0.0298	***	0.0203	***	0.0162	***
	(0.0012)		(0.0011)		(0.0012)		(0.0014)		(0.0014)	
Land ownership of HH			*0.03*		*0.03*		*0.02*		*0.03*	
			0.0013	***	0.0016	***	0.0010	***	0.0015	***
			(0.0002)		(0.0002)		(0.0002)		(0.0002)	
Consumption of HH					*0.45*				*0.36*	
					0.0255	***			0.0210	***
					(0.0019)				(0.0019)	
Male education of HH							*0.52*		*0.35*	
							0.0222	***	0.0207	***
							(0.0009)		(0.0009)	
2011 coefficients										
Explained proportion	0.15		0.18		0.16		0.21		0.16	
Own age group	*− 0.12*		*− 0.10*		*− 0.10*		*− 0.10*		*− 0.11*	
	− 0.0019	***	− 0.0019	***	− 0.0017	***	− 0.0022	***	− 0.0020	***
	(0.0004)		(0.0004)		(0.0004)		(0.0004)		(0.0004)	
Own education	*1.12*		*0.94*		*1.15*		*0.30*		*0.47*	
	0.0174	***	0.0180	***	0.0188	***	0.0067	***	0.0081	***
	(0.0015)		(0.0014)		(0.0014)		(0.0018)		(0.0018)	
Land ownership of HH			*0.16*		*0.18*		*0.08*		*0.10*	
			0.0031	***	0.0030	***	0.0017	***	0.0018	***
			(0.0004)		(0.0004)		(0.0003)		(0.0003)	
Consumption of HH					*− 0.23*				*− 0.41*	
					− 0.0038				− 0.0071	***
					(0.0025)				(0.0027)	
Male education of HH							*0.72*		*0.95*	
							0.0159	***	0.0165	***
							(0.0015)		(0.0015)	

The italic figures show the share of the total explained component of the decomposition that is accounted for by a specific characteristic. It is estimated by dividing the component explained by the characteristic (below the italic figures) by the explained component for that specification in Table 3. Rounding off errors. Standard errors in parentheses. ***, **, * significant at 1, 5, and 10%, respectively women's education to the explained component by more than half. This likely indicates strong positive assortative matching: women matching to men at the same levels of education in the Indian marriage market (Dalmia 2011). The rise in men's education, some of which may proxy for rising household incomes, constitutes 54 to 62% of the explained component of the fall in women's LFPR between 1987 and 1999. Across all columns for panel A, women's own education and the education of the men in their household together can account for 70 to 84% of the explained component of the decline in women's LFPR between 1987 and 1999.

Decreases in per capita landholdings of the household contribute 17 to 22% to the explained component during this period across specifications in panel A. This is likely because women belonging to households with more land have a larger probability of being employed, primarily due to self-employment on own land. Increases in household consumption expenditure constitute 12 to 21% of the explained component of the fall in women's LFPR during 1987–1999, depending on the specification we use. The results follow a similar pattern when the explained proportion is evaluated at the 1999 coefficients—with own and male education contributing between 62 and 75% to the explained component.

During the 1999–2011 decade (panel B of Table 5), increases in women's and men's education were again the largest contributors to the explained proportion. When all the characteristics are included (column 5), women's education constitutes 28 (47) % of the explained component at 1999 (2011) coefficients. Similarly, male education contributes 35 (95) % to the explained proportion. Change in households' landholdings contributes little to the explained component during this decade as shown in panel B. Of note is the role of household consumption expenditure in predicting the fall in female LFPR. While household consumption expenditure accounts for 36–45% of the explained component when evaluated at the regression coefficients for 1999, the negative proportion obtained for the 2011 coefficients suggests that increases in consumption expenditure should have resulted in an *increase* in women's LFPR during this period. In other words, because the overall change in female LFPR is negative, rising household expenditures should have mediated this decline (the opposite of what we usually think of as an income effect). The effect of increasing household consumption expenditure is not consistent over time (Table 2). One of the reasons for this may be that the contribution of consumption expenditure towards the decline in female LFPR that we obtain is a lower bound on the true income effect. Overall, the magnitude of the contribution of the non-education variables to explaining female LFPR between 1999 and 2011 is significantly smaller than the contribution of the education variables.[21]

[21] The proportion of explained variation falls when additional variables are included in Appendix B, Table 8. The female characteristics continue to explain the entire fall in female LFPR between 1987 and 1999, but the explained proportion between 1999 and 2011 falls to 48%. This is because household size and number of children under age 5 have fallen over time. This change in quantity of children should increase the female LFPR. Social group membership and male members do not contribute much to the explained proportion. The only additional characteristic which contributes to the decline in female LFPR between 1999 and 2011 is the change in religious composition. This is because the proportion of population that is Muslim has increased, and Muslim women tend to have lower participation rates in the labor market. Our main conclusion remains: individual and household characteristics (in particular education) play the most important role in explaining declining LFPR.

Based on the figures in Table 5, we can estimate the contribution of education to the actual decline in women's LFPR. In specification (5) of Table 5, panel A, the contribution of women's education to the explained variation in LFPR over the first decade is 16 percentage points, while the explained proportion is 136% (Table 3) at the regression coefficients for 1987. This implies that changes in women's education over time explain about 21.8% (= 0.16 × 1.36) of the total decline in female LFPR. Using this method, we estimate that women's own education and that of the men in their household (specification 5) account for between 87 and 95% of the overall decline in women's LFPR in 1987–1999 depending on whether we use 1987 or 1999 coefficients. In the 1999–2011 decade, they explain 23–35% of the total decline in women's LFPR. In both decades, education is the largest contributor to the decline in women's LFPR. This is in contrast to what we might have expected—that increasing female education is associated with an *increase* in women's work.

Before turning to a broader discussion of results, it is worth noting the importance of rising men's education in accounting for falling female LFP in each of the decomposition analyses. Increasing male education is likely to be correlated with lower female LFP through several channels, one of which may be through rising household incomes. Note, however, that we directly control for proxies of household income using consumption expenditure and land ownership, as other studies do.[22] Male education may also capture the effects of female education, simply because of positive assortative matching. As this type of marriage-market matching has increased in India over the past decades, the role of rising men's education in accounting for the decline in female LFPR cannot be separated from women's changing preferences about time allocation. While raising men's education is unlikely to directly raise female productivity in the home, the correlation of education levels within a marriage means that men's education in our decomposition analyses may be capturing some of the effects of rising levels of female schooling on LFP. However, even if we assume that male education only proxies for household income, so that all of the effect of rising male education on depressing female LFP is through an income effect, it is still the case that rising female education, conditional on men's education, lowers female LFP. This negative relationship is not consistent with education propelling women into the workforce; rather, it suggests something about the relative returns to higher education in the home versus in the market.

4.4 Discussion of results

4.4.1 Possible mechanism for the role of education in the decline of the female LFPR

One potential mechanism that can explain the negative impact of rising women's education on their labor market participation is higher returns to women's time at home as their education increases. This could either be a result of a relative increase in productivity of time spent by women in home

[22] Eswaran et al. (2013) suggest that the decline in women's work force participation and increase in their engagement in "status"-related activities are well predicted by rising household incomes in rural India since status is a normal good.

production or a change in preferences of women towards home production as they get more educated. In either case, if the returns to women's time spent in home production are greater than the returns to female education in the labor market, then women with more education are likely to withdraw from the labor market. To investigate this potential explanation, further we use the same decomposition techniques to analyze one measure of home production—domestic work by women in the household—in the NSS.

As shown in Fig. 4, the over two decades' long decline in married women's employment in rural India has occurred alongside increases in the share of women reporting domestic work as their primary activity. Table 6 shows the Blinder-Oaxaca decomposition results for the change in domestic work by women between 1987 and 1999 and 1999–2011. Women's attributes fully account for the rise in domestic work between 1987 and 1999 (columns (1) and (2)) and account for up to 55% of the increase between 1999 and 2011 (columns (3) and (4)) as shown by the row "explained proportion."

The rise in women's education over the first decade in our sample accounts for 45% of the explained proportion of this change in domestic work at the 1987 regression coefficients (specification 1 of Table 6). Similarly, women's education contributes 29% to the explained proportion of the surge in domestic work using the 1999 regression coefficients (specification 3 of Table 6) for the later decade.[23] Controlling for men's education in specifications (2) and (4) reduces these explained proportions by about a third.[24] The growth in household's consumption expenditure also explains a substantial part of the rising proportion of women engaging primarily in domestic work.

To get a better sense of how women might be using their time in domestic work, we analyze patterns in the Indian Time Use Survey from 1998. Because this is the only time use survey data that exist, we cannot assess any changes in domestic activities by married women over the period of our study. Nonetheless, the data provide important details on how much time women spend on domestic chores, including child care, and how this time varies with women's level of education in the cross section.

We restrict the sample to rural married women ages 25 to 65, who have at least one child in the 0 to 15-year-old age group.[25] In Fig. 6a, we show the number of hours that women spend each week on physical care of their children (e.g., washing,

[23] The results at 1999 (for change during 1987–1999) and 2011 (for change during 1999–2011) coefficients and using the DFL decomposition of domestic work give us qualitatively similar results, hence have been omitted for brevity.

[24] The rise in women's and men's education explains 17 and 75% of the increase in domestic work using 1987 regression coefficients, respectively (specification 2 of Table 6) during 1987–1999. Similarly, women's and men's education explains 5 and 18% of the increase in domestic work using 1999 regression coefficients (specification 4 of Table 6) during 1999–2011.

[25] Time use data were collected from 18,591 households across six states of India by the same nodal agency that conducts the NSS to assess the economic contribution of women. The selection of states was purposive. One state from each region of India was chosen (north—Haryana, center—Madhya Pradesh, west—Gujarat, east—Orissa, south—Tamil Nadu, and northeast—Meghalaya), to capture the diversity in gender norms and culture (http://mdgs.un.org/unsd/Demographic/sconcerns/tuse/Country/India/sourceind99b.pdf). While the NSS collects data on aggregate domestic work, the time use survey allows us to break down domestic work into various components, other than leisure.

Table 6 Blinder-Oaxaca decomposition of changes in female domestic work participation

	1987–1999				1999–2011			
	(1)		(2)		(3)		(4)	
Difference in predicted domestic work	− 0.0300		− 0.0300		− 0.1122		− 0.1148	
	1987 coefficients				**1999 coefficients**			
Explained proportion	1.07		1.45		0.54		0.55	
Explained component	− 0.0320	***	− 0.0434	***	− 0.0610	***	− 0.0635	***
Own age group	*− 0.01*		*− 0.01*		*− 0.03*		*− 0.03*	
	0.0004	***	0.0004	***	0.0016	***	0.0019	***
	(0.0001)		(0.0001)		(0.0003)		(0.0003)	
Own education	*0.45*		*0.11*		*0.29*		*0.10*	
	− 0.0143	***	− 0.0050	***	− 0.0178	***	− 0.0063	***
	(0.0007)		(0.0008)		(0.0011)		(0.0013)	
Land ownership of HH	*0.26*		*0.21*		*0.01*		*0.00*	
	− 0.0082	***	− 0.0091	***	− 0.0009	***	0.0002	
	(0.0005)		(0.0004)		(0.0002)		(0.0002)	
Household consumption	*0.31*		*0.17*		*0.72*		*0.61*	
	− 0.0099	***	− 0.0074	***	− 0.0439	***	− 0.0385	***
	(0.0005)		(0.0004)		(0.0018)		(0.0018)	
Male education of HH			*0.52*				*0.33*	
			− 0.0224	***			− 0.0208	***
			(0.0008)				(0.001)	
Observations	139,020		129,977		126,085		118,414	

The dependent variable is a dichotomous variable: a woman is engaged in domestic work if her primary status during the last year was domestic work. The sample includes rural married women aged 25–65. The analysis incorporates the sampling weights in NSS. The explained proportion is the explained component divided by the change in predicted domestic work. Figures in italics are the shares of the overall predicted variation accounted for by a specific characteristic and are estimated by dividing the component explained by the characteristic (below the italic figures) by the explained component for that specification. Standard errors in parenthesis. ***, **, * significant at 1, 5, and 10%, respectively

dressing, feeding, teaching, and instruction of own children). The graph suggests that the time spent on child care increases with the level of education of the woman, particularly when education increases above primary level. Although at all levels of education, total weekly time in dedicated childcare is low (under 10 h). In Fig. 6b, we broaden the definition of domestic activities to include time spent on both exclusive child care and other household chores which typically affect child well-being, such as cooking. The data again indicate that more educated women spend a higher proportion of their time on household chores—now closer to a full working week. This time appears to decline only at a very high level of education, graduate and above.

While these patterns are not causal, they lend support to our contention that as the average educational attainment of rural women rises from the observed low levels of schooling, they engage in more hours of domestic activities, including child care and other home production

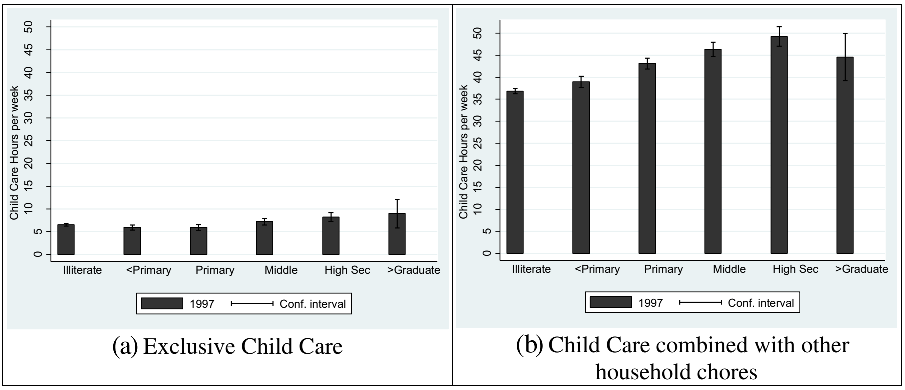

Fig. 6 Female time spent in childcare activities by education level. Sample of rural, married women aged 25–65 living with at least one child aged 0 to 15. *Source:* Author's calculations from the 1998 Indian Time Use Survey. Graph **a** plots hours spent in a week on exclusive child care. This includes time spent on the following activities by a woman: physical care of children (washing, dressing, feeding), teaching training and instruction of own children, accompanying children to doctor/school/sports/other, supervising children, and travel related to care of children. Graph **b** plots hours spent in a week on exclusive child care and other domestic chores which indirectly add to children's well-being or can be done while supervising children. This includes time spent on cooking and cleaning house, clothes, and utensils along with the activities in exclusive child care. "High Sec" refers to secondary and higher secondary level of education. The total number of observations is 7593

activities, relative to participating in the labor market. The same key variables that accounted for a substantial part of the predicted decline in female LFPR over time in both decades—that is, the education variables—may also account for a substantial share of the predicted increase in female domestic work over the same period. These findings are therefore consistent with greater returns to education in home production, relative to the market, being a possible mechanism for the decline in female LFPR in rural India.

Whether this is due to an actual increase in their home productivity or a shift in preferences is not something we can test in our data. Findings from other research support the interpretation that education makes women more productive in the home. Behrman et al. (1999), using data from the green revolution period in India (1968–1982), find that because households with an educated male member earned larger farm profits, the returns to investing in male education increased. This, in turn, increased the demand for educated women in the marriage market. Women with primary education spent more time at home, and the presence of an educated mother increased time spent by children studying, relative to less educated mothers. Since rural Indian women have had low initial levels of education, recent changes in female education are more likely to have increased women's marginal productivity in the home than in the market, at least for those women with the youngest children—when investments in health and education are critical.[26] Indeed, we find that the decline in the LFPR of women aged 25–45 was greater than the decline for 46–65 year olds in both decades.[27] These younger women are the ones most likely to have young children—

[26] The relative starting position of rural and urban women on the 'U' curve may therefore account for the different relationships between education and changes in female LFPR between urban (Klasen and Pieters 2015) and rural areas (this paper).

[27] The LFPR of 25–45-year-old, married rural women declined 3.4 and 11.2 percentage points during 1987–1999 and 1999–2011, respectively. The corresponding numbers for 46–65-year-old women were 1.8 and 7.5.

almost twice as many 0–14-year-old children in the household as women aged 46–65—in the NSS, and therefore most likely to experience high returns to child care in the home.

Another potential channel through which rising levels of education may have changed relative returns to home and market productivity works directly through the labor market. Researchers have documented that returns to education are positive and larger for higher levels of education in India. Azam (2012) finds that in urban India, increases in the labor market returns to education during 1993–2004 were much higher for workers with secondary and tertiary education. Similarly, Mendiratta and Gupt (2013) find that there has been an increase in returns to education in India during 2004–2011 but only at more than secondary levels of education. These results suggest that for women at the bottom of the education distribution, the market return to getting a primary school level of education is not that large. Over time, the changes in the returns to women's education at these lower levels of schooling may therefore not have increased fast enough to outpace any positive returns to women's labor in home production. We discuss this in more detail below.

4.4.2 Other factors accounting for the unexplained changes in female LFPR

While the changes in demographic and socio-economic attributes of women completely explain the fall in their LFPR during 1987–1999, 44% or more of the fall in women's LFPR in 1999–2011 remains unexplained. What factors might account for this larger unexplained component in the later period?

The unexplained proportion could reflect changes in the demand for women's labor, also proposed as an explanation for the stagnant women's LFPR in urban India (Klasen and Pieters 2015). A lower demand for female labor will reduce the probability of women's participation in the labor market even when their individual and socio-economic characteristics are unchanged. Structural transformation in the economy, in which labor reallocates out of agriculture and into other sectors, as has occurred in India during the last couple of decades, could impact female employment through this labor demand channel (Goldin 1995). Typically, wages in the agriculture sector are the lowest in India, and hence, females are likely to withdraw from this sector as education and real income growth raise their reservation wages.[28] Other sectors—construction, manufacturing, and services—should then grow at a pace that can absorb labor that has withdrawn from agriculture. While economic growth in India in the last few decades has resulted in a decline in the contribution of agriculture to employment growth, it has failed to create concomitant growth in the manufacturing sector where most women with middle to secondary levels of education and from middle income groups are likely to look for employment (Chandrasekhar and Ghosh 2011). During 1999 and 2011, female employment in agriculture fell by 13 percentage points and was stable in manufacturing at around 3.7%. Female employment in the construction sector rose by only 4 percentage points, while there was a small increase in the services sector from 2.8% in 1999 to 3.3% in 2011 (authors' calculations from the NSS 1999 and

[28] Authors' calculations show that in 2011, the daily wage in agriculture, manufacturing, construction, and services sectors were Rs 100, Rs 119, Rs 116, and Rs 209, respectively.

2011). Thus, economic growth has not been able to absorb female workers leaving agricultural work (Chowdhury 2011; Kannan and Raveendran 2012). A modest rise in women's own education from very low levels, coupled with a lack of jobs commensurate with higher reservation wages, may have contributed to the continued decline in female LFPR, especially in the second decade of our sample.[29]

5 Conclusion

In India, women's labor force participation rates have fallen dramatically since the late 1980s, despite the fact that income and education attainment grew rapidly during this period. We show that the decline in LFP has been concentrated among rural, married women. This group has also increased their participation in domestic work over the same period.

We use parametric and semi-parametric decomposition techniques to estimate the proportion of the fall in women's LFPR that is accounted for by the changing observable characteristics of working age women. These observable attributes can account for a large, albeit falling, share of the decline in women's LFPR. While the fall in women's LFPR between 1987 and 1999 is completely explained by the changes in women's demographic and socio-economic characteristics, these factors account for at most 56% of the decline between 1999 and 2011. This leaves a substantial role for unobservables to account for the decline in female LFPR, in the post-1991 reform period.

The decomposition exercise shows that increases in women's own education and that of the men in their household play the most important role in explaining the decline in female LFPR in both decades. At a minimum, increases in women's and men's education explain at least 22 and 53% of the total decline between 1987 and 1999, respectively. Similarly, increases in education of women and men account for at least 8 and 16% of the decline in rural women's LFPR between 1999 and 2011, respectively. While men's education may capture the effects of rising incomes in the household, the fact that increasing women's education plays such a strong role in accounting for the *decline* of women's work is puzzling at face value. However, we highlight that the observed fall in women's LFPR in India in the previous three decades is coupled with an increasing proportion of women engaging primarily in domestic, non-remunerative activities. We suggest a hitherto ignored explanation for the fall in women's LFPR—the returns to women's work (and more educated women's work, in particular) in home relative to market production. Women's decisions about working in the market or at home depend on the relative returns to time spent in each sector. If women obtain more education but the returns to women's home production are greater than the returns in the labor market for educated females, women are likely to withdraw from the labor force and engage in domestic work. We provide evidence that suggests that this may be one credible and important factor, among others proposed in the existing literature, in explaining the long-term trend of declining women's LFPR in rural India.

[29] The observation that the distribution of caste and religious groups—important predictors of social norms regarding women's work force participation in India (Eswaran et al. 2013)—has not changed significantly during 1987–2011 suggests that it is unlikely that social norms either changed significantly or were a significant unexplained determinant of the decline in women's LFPR during the period of our study.

Acknowledgements The authors thank the International Growth Center (IGC)—India Central and the Planning and Policy Research Unit (PPRU) at the ISI (Delhi), for financial support. Abhiroop Mukhopadhyay, Bharat Ramaswami, and two anonymous referees provided valuable inputs. The authors are responsible for any remaining errors.

Funding information This study was funded by IGC—India, Project Code 1-VRA-VINC-VXXXX-89217 and PPRU project "Women and Work in Rural India."

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Appendix 1: Definition of labor force participation rate

The National Sample Survey uses three reference periods for the employment survey: (i) 1 year, (ii) 1 week, and (iii) each day of the previous week. This paper employs the Usual Principal and Subsidiary Status (UPSS) definition. The activity status on which a person spent relatively longer time (major time criterion) during the 365 days preceding the date of survey is considered the Usual Principal Activity Status of the person. Persons are first categorized as those in the labor force and those out of the labor force depending on the major time spent during the 365 days preceding the date of survey. For persons belonging to the labor force, the broad activity status of either "working" (employed) or "not working but seeking and/or available for work" (unemployed) is then determined based on the time criterion. After determining the principal status, the economic activity on which a person spent 30 days or more during the reference period of 365 days preceding the date of survey is recorded as the Subsidiary Economic Activity Status of a person. In case of multiple subsidiary economic activities, the major activity and status based on the relatively longer time spent criterion is considered. If a person is defined to be in the labor force in either the principal activity status or the subsidiary activity status then she is defined to be in the labor force according to the UPSS. A woman who reports her primary activity is domestic production is classified as out of the labor force.

Appendix 2: Explaining the role of interactions in the decomposition

The three-way linear Blinder-Oaxaca decomposition for change in mean outcome of employment (Y) between 1999 and 2011 can be written as

$$
\begin{aligned}
&\overline{Y}^{1999} - \overline{Y}^{2011} \\
&= X^{1999}\beta^{1999} - X^{2011}\beta^{2011} \\
&= \left(X^{1999} - X^{2011}\right)\beta^{2011} + X^{2011}\left(\beta^{1999} - \beta^{2011}\right) + \left(X^{1999} - X^{2011}\right)\left(\beta^{1999} - \beta^{2011}\right)
\end{aligned}
$$

Here, the first term is the ceteris paribus effect of a change in characteristics, the second term is the ceteris paribus effect of a change in coefficients, and the third term is the interaction effect between the changing characteristics and the changing coefficients (Biewen 2012). The corresponding non-linear decomposition for the change in mean employment (Y) is

$$
\begin{aligned}
&\overline{Y}^{1999} - \overline{Y}^{2011} \\
&= \sum_{i=1}^{N^{1999}} \frac{F\left(\boldsymbol{X}_i^{1999}\hat{\beta}^{1999}\right)}{N^{1999}} - \sum_{i=1}^{N^{2011}} \frac{F\left(\boldsymbol{X}_i^{2011}\hat{\beta}^{2011}\right)}{N^{2011}} \\
&= \left(\sum_{i=1}^{N^{1999}} \frac{F\left(\boldsymbol{X}_i^{1999}\hat{\beta}^{2011}\right)}{N^{1999}} - \sum_{i=1}^{N^{2011}} \frac{F\left(\boldsymbol{X}_i^{2011}\hat{\beta}^{2011}\right)}{N^{2011}}\right) \\
&+ \left(\sum_{i=1}^{N^{2011}} \frac{F\left(\boldsymbol{X}_i^{2011}\hat{\beta}^{1999}\right)}{N^{2011}} - \sum_{i=1}^{N^{2011}} \frac{F\left(\boldsymbol{X}_i^{2011}\hat{\beta}^{2011}\right)}{N^{2011}}\right) \\
&+ \left[\left(\sum_{i=1}^{N^{1999}} \frac{F\left(\boldsymbol{X}_i^{1999}\hat{\beta}^{1999}\right)}{N^{1999}} - \sum_{i=1}^{N^{2011}} \frac{F\left(\boldsymbol{X}_i^{2011}\hat{\beta}^{1999}\right)}{N^{2011}}\right) - \left(\sum_{i=1}^{N^{1999}} \frac{F\left(\boldsymbol{X}_i^{1999}\hat{\beta}^{2011}\right)}{N^{1999}} - \sum_{i=1}^{N^{2011}} \frac{F\left(\boldsymbol{X}_i^{2011}\hat{\beta}^{2011}\right)}{N^{2011}}\right)\right]
\end{aligned}
$$

The last term in the square brackets is the interaction effect, which is equal to the explained component at 2011 coefficients subtracted from the explained component at the 1999 coefficients. We show an example of including the interaction term in the decomposition in Table 7 below.

Table 7 Blinder-Oaxaca decomposition of change in women's LFPR (three way)

	(1)	(2)	(3)	(4)	(5)
Panel A: 1987–1999					
Change in predicted LFPR	0.0310	0.0310	0.0331	0.0309	0.0331
Explained proportion:					
Characteristics	0.69	1.04	1.12	1.40	1.41
Coefficient	0.32	0.14	0.03	− 0.33	− 0.36
Interaction	*− 0.02*	− 0.18	− 0.14	*− 0.07*	*− 0.06*
Observations	140,842	140,842	139,020	131,682	129,977
Panel B: 1999–2011					
Change in predicted LFPR	0.1041	0.1041	0.1041	0.1057	0.1057
Explained proportion:					
Characteristics	0.15	0.18	0.16	0.21	0.16
Coefficient	0.67	0.64	0.46	0.59	0.44
Interaction	0.18	0.18	0.39	0.20	0.39
Observations	126,089	126,089	126,085	118,418	118,414
Own age group	Yes	Yes	Yes	Yes	Yes
Own education	Yes	Yes	Yes	Yes	Yes
Land ownership of HH		Yes	Yes	Yes	Yes
Consumption of HH			Yes		Yes
Male education of HH				Yes	Yes

The analysis here is based on Table 3, where we have now been explicit in showing the role of the interaction terms in the decomposition. Numbers in italics are statistically insignificant

Table 8 Blinder-Oaxaca decomposition of change in women's LFPR with additional controls

	Women's LFPR			
Change during	**(1987–1999)**		**(1999–2011)**	
Change in predicted LFPR	0.0331		0.1057	
	1987 Coeff.		1999 Coeff.	
Explained proportion	*1.06*		*0.48*	
Explained component	0.0352	***	0.0505	***
Variables				
Own age group	− 0.02		− 0.01	
	− 0.0007	***	− 0.0005	**
	(0.0001)		(0.0002)	
Own education	0.25		0.33	
	0.0088	***	0.0168	***
	(0.0009)		(0.0014)	
Land ownership of HH	0.23		0.04	
	0.0081	***	0.0021	***
	(0.0005)		(0.0002)	
Consumption of HH	0.14		0.43	
	0.0048	***	0.0217	***
	(0.0004)		(0.0019)	
Male education of HH	0.48		0.27	
	0.0168	***	0.0137	***
	(0.0007)		(0.0008)	
Social group	− 0.08		− 0.02	
	− 0.0028	***	− 0.0011	***
	(0.0002)		(0.0002)	
Religion	0.08		0.16	
	0.0027	***	0.0080	***
	(0.0002)		(0.0005)	
Percentage male adults	0.01		0.01	
	0.0005	***	0.0003	***
	(0.0000)		(0)	
Share of children under 5	− 0.02		− 0.05	
	− 0.0008	**	− 0.0023	***
	(0.0003)		(0.0007)	
Household size	− 0.06		− 0.16	
	− 0.0023	***	− 0.0082	***
	(0.0001)		(0.0007)	
	1999 Coeff.		2011 Coeff.	
Explained proportion	*1.10*		*0.11*	
Explained component	0.0364	***	0.0119	***

Table 8 (continued)

	Women's LFPR			
Variables				
Own age group	− 0.01		− 0.18	
	− 0.0005	***	− 0.0022	***
	(0.0001)		(0.0004)	
Own education	0.30		0.71	
	0.0110	***	0.0084	***
	(0.0008)		(0.0018)	
Land ownership of HH	0.33		0.13	
	0.0121	***	0.0016	***
	(0.0006)		(0.0003)	
Consumption of HH	0.11		− 1.03	
	0.0039	***	− 0.0123	***
	(0.0005)		(0.0028)	
Male education of HH	0.33		1.14	
	0.0121	***	0.0136	***
	(0.0007)		(0.0014)	
Social group	− 0.09		0.02	
	− 0.0035	***	0.0002	**
	(0.0002)		(0.0002)	
Religion	0.11		0.48	
	0.0039	***	0.0057	***
	(0.0003)		(0.0005)	
Percentage male adults	0.01		− 0.02	
	0.0005	***	− 0.0002	***
	(0.0001)		(0.0001)	
Share of children under 5	− 0.03		− 0.01	
	− 0.0013	***	− 0.0001	
	(0.0004)		(0.0011)	
Household size	− 0.05		− 0.24	
	− 0.0018	***	− 0.0028	**
	(0.0002)		(0.0012)	
Observations	129,941		118,405	

The first row against each characteristic in the above table reflects the proportion of contribution of a characteristic to the explained component of the decomposition. It is estimated by dividing the component explained by the characteristic (below the italic figures) by the explained component for that specification. Rounding off errors. Standard errors in parenthesis. ***, **, * significant levels at 1, 5, and 10%, respectively

References

Aromolaran AB (2004) Female schooling, non-market productivity and labor market participation in Nigeria. In: Center Discussion Paper No 879. Yale University, USA

Azam M (2012) Changes in wage structure in urban India, 1983–2004: a quantile regression decomposition. World Dev 40(6):1135–1150

Behrman JR, Foster AD, Rosenweig MR, Vashishtha P (1999) Women's schooling, home teaching, and economic growth. J Polit Econ 107(4):682–714

Biewen M (2001) Measuring the effects of socio-economic variables on the income distribution: an application to the east German transition process. Rev Econ Stat 83(1):185–190

Biewen M (2012) Additive decompositions with interaction effects. IZA DP No 6730, IZA, Bonn, Germany

Black D, Tseng Y-P, Wilkins R (2011) Do changes in demographic characteristics explain declining male employment rates? Examination of the Australian case using a propensity score re-weighting decomposition approach. Appl Econ 43(28):4215–4226

Blinder AS (1973) Wage discrimination: reduced form and structural estimates. J Hum Resour 8:436–455

Butcher KF, DiNardo J (2002) The immigrant and native-born wage distributions: evidence from United States censuses. Ind Labor Relat Rev 56(1):97–121

Cameron LA, Dowling JM, Worswick C (2001) Education and labor market participation of women in Asia: evidence from five countries. Econ Dev Cult Chang 49(3):459–477

Chandrasekhar CP and Ghosh J (2011) “Latest employment trends from the NSSO”, the Hindu business line, 12 July http://www.thehindubusinessline.com/opinion/columns/c-p-chandrasekhar/latest-employment-trends-from-the-nsso/article2219107.ece. Accessed 18 Nov 2013

Chatterjee U, Murgai R, Rama M (2014) Job opportunities along the rural-urban gradation and female labor force participation in India. Mimeo, New York

Chowdhury S (2011) Employment in India: what does the latest data show? Econ Polit Wkly 34(32):23–26

Dalmia S (2011) Testing Becker’s efficient marriage market hypothesis and its implications for spouse selection and marital transfers in India. J Bus Econ Res 2(4):1–8

Daly MC, Valletta RG (2006) Inequality and poverty in United States: the effects of rising dispersion of men’s earnings and changing family behavior. Economica 73(289):75–98

Das MB, and Desai S (2003) Are educated women less likely to be employed in India? Social Protection Discussion Paper No. 313, World Bank, Washington DC

Das S, Jain-Chandra S, Kochchar K, and Kumar N (2015) Women workers in India: why so few among so many? IMF Working Paper WP/15/55

DiNardo J (2002) Propensity score reweighting and changes in wage distributions. Mimeo, University of Michigan, Ann Arbor

DiNardo J, Fortin NM, Lemieux T (1996) Labor market institutions and the distribution of wages, 1973-1992: a semiparametric approach. Econometrica 64(5):1001–1044

Eswaran M, Ramaswami B, Wadhwa W (2013) Status, caste, and the time allocation of women in rural India. Econ Dev Cult Chang 61(2):311–333

Fairlie RW (2005) An extension of the Blinder-Oaxaca decomposition technique to logit and probit models. J Econ Soc Meas 30(4):305–316

Gaddis I, Klasen S (2014) Economic development, structural change and women’s labor force participation. J Popul Econ 27(3):639–681

Geruso M (2012) Black-white disparities in life expectancy: how much can the standard SES variables explain? Demography 49(2):553–574

Goldin C (1995) The U-shaped female labor force function in economic development and economic history. In: Paul Schultz T (ed) Investment in Women's Human Capital. University of Chicago Press, Chicago, pp 61–90

Himanshu (2011) Employment trends in India: a re-examination. Econ Polit Wkly 46(37):43–59

Hyslop DR, Mare DC (2005) Understanding New Zealand’s changing income distribution, 1983–1998: a semi-parametric analysis. Economica 72(287):469–495

Kannan KP, Raveendran G (2012) Counting and profiling the missing labor force. Econ Polit Wkly 47(6):77–80

Kapsos S, Silberman A, and Bourmpoula E (2014) Why is female labour force participation declining so sharply in India? ILO Research Paper No. 10

Klasen S, Pieters J (2015) What explains the stagnation of female labor force participation in urban India? World Bank Econ Rev 29(3):449–478

Lahoti R, and Swaminathan H (2013) Economic growth and female labor force participation in India. Working paper no. 414, Indian Institute of Management, Bangalore

Lam D, Duryea S (1999) Effects of schooling on fertility, labor supply, and investments in children, with evidence from Brazil. J Hum Resour 34(1):160–192

Leibbrandt, Murray, Levinsohn, James A., and Justin McCrary. (2010). Incomes in South Africa after the fall of apartheid. J Globalization Dev 1(1)

Lincove JA (2008) Growth, girls' education, and female labor: a longitudinal analysis. J Developing Areas 41(2):45–68

Mammen K, Paxson C (2000) Women's work and economic development. J Econ Perspect 14(4):141–164

Mendiratta P, and Gupt Y (2013) Private returns to education in India by gender and location: a pseudo-panel approach http://www.econcaluniv.ac.in/arthanitiweb/book/2013/PM.pdf. Accessed on 11 Nov 2015

National Sample Survey Office, (2015) Key Indicators of Social Consumption in India Education http://mospi.nic.in/Mospi_New/upload/nss_71st_ki_education_30june15.pdf. Accessed 10 Nov 2015

Neff D, Sen K, and Kling V (2012) The puzzling decline in rural women's labor force participation in India: a re-examination. GIGA working paper no. 196, GIGA Research Unit, Institute of Asian Studies

Oaxaca R (1973) Male-female wage differentials in urban labor markets. Int Econ Rev 14(3):693–709

Sorsa P et al(2015) Determinants of the low female labour force participation in India, OECD Economics Department Working Papers, No. 1207, OECD Publishing, Paris

Tam H (2011) U-shaped female labor participation with economic development: some panel data evidence. Econ Lett 110(2):140–142

Topalova P (2010) Factor immobility and regional impacts of trade liberalization: evidence on poverty from India. Am Econ J Appl Econ 2(4):1–41

United Nations (2013) Millennium Development Goals Report http://www.un.org/millenniumgoals/pdf/report-2013/mdg-report-2013-english.pdf. Accessed 12 Oct 2015

World Bank (2012) World Development Report 2012: Gender Equality and Development http://siteresources.worldbank.org/INTWDR2012/Resources/7778105-1299699968583/7786210-1315936222006/Complete-Report.pdf. Accessed 18 Nov 2013)