Intergenerational Educational Persistence among Daughters: Evidence from India

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Abstract

We examine educational transmission between fathers (mothers) and daughters in India for daughters born during 1962-1991. We find that educational persistence, as measured by the regression coefficient of father's (mother's) education as a predictor of daughter's education, has declined. However, the correlation between educational attainment of daughters and fathers (mothers), another commonly used measure of persistence, suggests only a marginal decline. Further we decompose the intergenerational correlation. We also find that the probability of a daughter attaining senior secondary or above education (top end of educational distribution) is not only positively associated with father's (mother's) education levels but the gaps in those probabilities have not declined over time. Similarly, there is no convergence over time in the probability of a daughter attaining senior secondary or above education with the same level of father's (mother's) education for daughters belonging to Higher Hindu Castes and disadvantaged groups such as Other Backward Castes or Scheduled Castes/Tribes. Although conditional on having same educated fathers, sons are more likely to achieve senior secondary or above education in each cohort compared to daughters, the gap in those probabilities has declined over time.

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1 Introduction

The empirical literature on intergenerational mobility in developed countries has predominantly focused on sons. Only a few studies do examine intergenerational transmission between fathers and daughters (see, for example, DiPrete and Grusky, 1990; Chadwick and Solon, 2002; Olivetti and Paserman, 2015). Compared to developed countries, the intergenerational mobility in developing countries remains largely an under-researched area although there has been an increasing focus on the topic with the availability of new datasets that contain parents' information. However, the literature in developing countries too has primarily focused on father-son transmission. One of reason for this is non-availability of datasets that contain information on fathers' for women.

Nonetheless, the concerns regarding the equality of opportunities are growing in developing countries.[1] Equality of opportunity is considered a key condition for a society to ensure distributional justice (Rama et al., 2015), and education is perhaps the most important policy instrument in the hands of policymakers in this regard.[2] For example, Stiglitz (2012, P. 275) notes "Opportunity is shaped, more than anything else, by access to education." One of the key roles of publicly provided education in many countries including India has been to increase access to education.[3] Intergenerational persistence in education can undermine the notion of equality of opportunity.[4]

[1] As such this issues is also very important in the US. For example, President Obama's second Inaugural Address reaffirmed America's commitment to the dream of equality of opportunity: "We are true to our creed when a little girl born into the bleakest poverty knows that she has the same chance to succeed as anybody else, because she is an American; she is free, and she is equal, not just in the eyes of God but also in our own."

[2] Equality of opportunity can be broadly defined as: those who have the same talent and ability and have the same willingness to use them should have the same prospects of success regardless of their initial circumstances (Rawls, 1971).

[3] Achievement of universal primary education by 2015 was one of the eight Millennium Development Goals (MDGs) established by United Nations in 2000. The Indian Parliament passed Right to Education Act in 2009 that makes education a fundamental right of every child between the ages of 6 and 14 and specifies minimum norms in elementary schools.

[4] The family background is relevant because the individual has not chosen her family background and thus cannot be held accountable for any impact of family background on her status during adulthood. Therefore, the more important family background is—for instance, as measured by parental education—for final educational achievement, the less equality of opportunity there is (Björklund and Kjell, 2011).

The intergenerational transmission between fathers (mothers) and daughters is quite an important issue per se, however it is comparatively more important in the Indian context because of following reasons. First, the notion of family background (economic and caste) determining destiny is quite pervasive in India. Second, there exists considerable inequality in India. For example, the Gini index for consumption calculated from 2004-05 India Human Development Survey was at 0.34, while the Gini index for income was estimated to be 20 points higher at 0.54.[5] This is more than the income inequality observed in Mexico (Rama et al., 2015). Existing evidence suggests that countries with greater inequality of incomes also tend to be countries in which a greater fraction of economic advantage and disadvantage is passed on between parents and their children (Corak, 2013). Third and most importantly, there exists a strong son preference in Indian society, and the existing evidence suggests pro-male bias in educational investment (Kingdon, 2005). Henceforth, it is important for policy makers to know how the parent-child educational association differ for sons and daughters. For example, if given the same parental background daughters are less likely to achieve education compared to the sons, there is a need for gender specific policy in addition to policies which tries to equate the opportunities irrespective of parental education.

In this paper, we examine the father (mother)-daughter educational persistence for women born during 1962-1991. We use a recently available nationally representative India Human Development Survey (IHDS)-2, 2011-12. The IHDS-2 has a separate women module that asks detailed questions from two women in age 15-49 per household. This helps us to identify fathers' (mothers') information for about 86 (88) percent of women in age 20-49, henceforth giving us a sample of women which is close to the representative sample of women born during 1962-1991.[6] Dividing our sample into birth cohorts, we first examine the evolution of two commonly used measure of persistence: intergenerational regression

[5]The Gini index is based on per capita household consumption expenditure and per capita household income.

[6]For a perfectly representative sample, one needs to know the parent information for all women born during 1962-1991. However, the 14 (12) percent of the women born during 1962-1991 for whom father's (mother's) information is not available is excluded from the analysis.

coefficient and correlation coefficient. To reconcile the differences in trends using these two measures, we further decompose the correlation coefficient. We also examine how father (mother)-daughter educational persistence differ across social groups in different birth cohorts. Moreover, we examine whether the child-parent educational persistence differ for sons and daughter, and how the difference in persistence has evolved over different birth cohorts.

The findings of the paper are as follows. First, when compared to the birth cohort 1962-66, there is a fall in the intergenerational educational persistence, as measured by the regression coefficient of fathers' (mothers') schooling as a predictor of daughters' schooling in the recent birth cohort 1987-91, implying less persistence for more recent cohort in India. Importantly, another commonly used measure of persistence, correlation between fathers' (mothers') and daughters' years of schooling, presents a much sober picture of only a marginal decline in persistence. By decomposing the correlation, we find that persistence at the lower end of the fathers'(mothers') educational distribution has declined (father/mother being below primary educated); however, the persistence has increased in other parts of fathers' (mothers') educational distribution resulting in an overall steady trend in the correlation coefficient. Second, we find that "Equality of Opportunity" remains an elusive goal for India. Not only the probability of a daughter attaining senior secondary or above education (top end of educational distribution) is positively associated with father's education levels, the gaps in those probabilities do not show any sign of convergence. Similarly, the probability of a daughter attaining senior secondary or above education is higher for Higher Hindu Castes (HHCs)' daughters irrespective of parental education. Importantly, there is no sign of any convergence in the probability of a daughter attaining senior secondary or above education even with the same level of father's (mother's) education between Higher Hindu Castes' daughters and daughters belonging to disadvantaged groups such as Other Backward Castes (OBCs) or Scheduled Castes/Tribes (SC/STs). Third, we find that conditional on having same educated fathers, sons are more likely to achieve senior secondary or above education in each cohort compared to daughters; however, the gap in those probabilities has declined

over time.

Our results suggest that the appropriate educational policy need to address differential opportunity based on parental education and caste. It should be noted that SC/STs enjoy affirmative policies under which a certain proportion of seats in educational institutions are reserved for them since independence. The idea of this affirmative policy was to wipe out the differences in opportunity between SC/STs and rest of the society. The fact that the differences between SC/STs and HHCs persist and show little sign of being wiped out calls for polices which potentially can relax credit constraints or reduce cost of education for the disadvantaged groups. The educational outcomes of daughters differ significantly based on parents education suggest that policies that target children based on parental education need to be formulated.

The remainder of the paper is organized as follows. Section 1.1 presents a brief review of the literature on the intergenerational mobility in educational attainment in India, and places our paper in the existing literature. Section 2 discusses the data, Section 3 outlines the analytical framework underlying the empirical analysis. Section 4 presents the results and Section 5 concludes.

1.1 Related Literature

Literature on intergenerational economic mobility in developed countries mostly focuses on intergenerational correlation between fathers' and sons' incomes. Solon (1999), Black and Devereux (2011), and Blanden (2013) provide excellent surveys of the literature in developed countries. Hertz et al. (2007) study trends in intergenerational transmission of education for a sample of 42 countries. Daouli et al. (2010) examine educational transmission for Greek women.

The literature on intergenerational persistence in India has primarily focused on educational persistence and identify parents information through co-resident from cross-sectional

data. Jalan and Murgai (2008) investigate educational mobility for both men and women in the age group 15-19 using 1992-93 and 1998-99 National Family Health Survey (NFHS) data. They rely on co-resident to identify parents' education. Similarly, Maitra and Sharma (2009) use the IHDS-2005, and explore the effect of parental education (both father and mother) on years of schooling of children, identifying parents' information if they resided in the same household. Hnatkovskay et al. (2013) use five rounds of National Sample Survey (NSS) that covers the period 1983-2005, to analyze intergenerational persistence in occupational choices, educational attainment and wages between fathers and sons. They also rely on co-resident to identify fathers' information. Emran and Shilpi (2015) examine correlation and sibling correlation in 16-27-year olds in 1992-93 and 2005-06 NFHS data. They use co-resident to identify parents' education. They find stagnant educational persistence over the two cross-sections using the correlation coefficient.

In contrast to the abovementioned studies on India, Azam and Bhatt (2015) do not rely on co-resident. Their sample include fathers' information for all the adult men (aged 20-65 in 2004-05). They explore transmission of education between fathers and sons for men born during 1940-1985. They find that intergenerational educational persistence in India, as measured by the regression coefficient of fathers' education as a predictor of schooling in the next generation, has decreased significantly across birth cohorts in last 45 years. However, they do not find such a trend in the estimated correlation between father-son educational attainments. They further decompose the correlation and find that the decline in correlation at the lower end of fathers' education distribution is offset by the increase at the top end of fathers' education distribution. They also find a significant difference in the probability of achieving senior secondary or above education based on fathers' education levels. Moreover, they find no evidence for convergence in the probability of a son achieving senior secondary or above education conditional on father's education between Higher Hindu Castes versus others social groups.

Azam and Bhatt (2015) use IHDS 2004-05 data, which although facilitated identification

of fathers for adult men, however, it does not contain same information for adult women. The recently released IHDS 2011-12 data make the study of persistence in daughters' feasible (see Data Section for details). As discussed earlier, the differential treatment of genders remains an important issue in India beside the differential treatment of social groups. Moreover, focusing only on father-son persistence may miss part of the picture. Daughters should be included if we want to know how the average well-being of a generation correlates with that of their parents (Olivetti and Paserman, 2015). In addition, to the extent that mothers play a key role in the human capital accumulation of their children, investment in daughters could have important consequences for the transmission of status across multiple generations.

The paper contributes to the literature in following ways. First, the paper contributes to existing literature on intergenerational educational persistence in India by examining the educational persistence between fathers and daughters and complements Azam and Bhatt (2015) study of educational persistence between fathers and sons. Second, the paper also examine the educational persistence between mothers and daughters. Third and importantly, the paper examine whether the parent-child educational persistence differ for sons and daughters, and how the difference has evolved over birth cohorts. Finally, the paper adds to the limited international literature on intergenerational transmission for women.

2 Data

We use recently available India Human Development Survey-2 (IHDS-2), 2011-2012. IHDS-2 (Desai and Vanneman, 2015) is jointly conducted by National Council of Applied Economic Research and University of Maryland. One of the major problems faced by researchers interested in the study of intergenerational persistence in developing countries is non-availability of long panel data that help to identify parents' information. Researchers have used co-resident (parents and child residing in the same household at the time of survey) in cross-sectional data to identify parents' information. Azam and Bhatt (2015) show that this

condition helps to identify fathers' information for less than a third of adult male population (20-65), and most of those adult males belong to 20-30 age group. The bias induced in mobility estimates because of coresident sample is explored in the literature (Francesconi and Nicoletti, 2006; Emran et al. 2016). Most of the studies which identify their sample based on coresident restrict themselves to sons, as adult women are more likely to reside in a household different than their parental household. In the Indian context, married women generally tend to reside with husbands' family, and household surveys typically collect information on members residing in the same household (through household roster) at the time of survey. Henceforth, it becomes more difficult to get parents information using the coresident condition for women. For example, we are able to identify co-resident father only for 10.5 (20.5) percent of women in age group 20-49 (20-30) in IHDS-2.

This data constraint is relaxed to a large extent in the IHDS-2. IHDS-2 has a separate women module that collected detailed information (including education of biological parents) for two women in age 15-49 in each household.[7,8] This helps us to identify fathers' (mothers') education for 86 (88) percent of women in age group 20-49 (see Table 1 for details). The nationally representative IHDS contain information about 204,506 (120,062 males and 102,506 females) individuals surveyed from 42,152 households across India. We restrict the IHDS cross section data to women in age group 20-49. Out of total female sample of 102,506, 45,319 belonged to age 15-49. We chose the lower age limit at 20 as majority of individuals in India finish their college (about 15 years of education) around this age, and the upper age limit is driven by availability of parental information. We further drop 43 women from our sample as years of education is not reported. We could not identify father's (mother's) years of schooling for 6570 (5588) women. Hence our father (mother)-daughter educational persistence is based on 38706 (39688) women in age 20-49 group.

[7]The IHDS-1 conducted in 2004-05 also contains a separate women module that asks detailed questions from one ever married women in age 15-49 per household. However, IHDS-1 women's module does not contain parental information questions.

[8]These two women are more likely to be married in that household, and are not related by blood.

Since our survey is from 2011-12, this implies we have close to a representative data on daughters born between 1962 and 1991.[9] We divide our sample into six five year birth cohorts: 1962-66, 1967-71, 1972-76, 1977-81, 1982-86, and 1987-91.[10,11] To examine the educational persistence among social groups, we further divide our sample in four social groups: Higher Hindu Caste (HHC), Other Backward Caste (OBC), Scheduled Caste/Tribe (SC/ST), and Muslims. SC/STs are historically disadvantaged groups in India, and have enjoyed affirmative policies in education and employment since the independence. OBCs were given reservation in employment in 1993.[12] Muslims are the largest minority religious group in India, and according to the Government of India (2006), their performance on many economic and education indicators are comparable to SC/STs. There exist certain differences between STs and SCs, however, because of small sample sizes of STs after dividing the data in cohorts, we group SCs and STs together.

We measure the economic/social status through years of schooling. Although, income (occupation) remains more popular measures of economic/social status in the economics (sociology) literature in developed countries, education is probably more suited in developing countries context for daughters, especially for India. The female labor force participation (LFPR) has been abysmally low in India. For example, in 2011-12, LFPR among women in

[9]We call our sample close to a representative sample because we drop the 14 (12) percent of women surveyed in age 20-49 for whom no father's (mother's) education information can be found in data. These women with no parental information are most probably residing in a household with more than two women in age (15-49), and the women module of IHDS only collected detailed information from two women in age 15-49. A priori, we do not have any specific reason to believe that the representativeness of our sample is compromised because of dropping of those women.

[10]We also considered an alternative cohort definition where we divide our sample in ten three-year birth cohorts.

[11]Our most recent birth cohort 1987-1991 represents age 20-24 in the data. Including this cohort raises the concern that some of the daughters might still be in school and has not completed the maximum schooling. We find that about 16 percent of the daughters in 20-24 age group were still in school and has not completed the maximum 16 years of education. Given that the shares enrolled in school are small and that the true value of schooling is most likely to be just a year or two greater than what is observed for the right-censored observations, any potential bias in regression coefficient caused by their inclusion should be relatively small. Importantly, most of currently enrolled daughters in age group 20-24 has completed 12 years or more. Only 0.2 percent of 20-24 who are still in school have not completed the 12 years of education. In majority of our analysis, we have combined 12-16 years of education as senior secondary or above.

[12]Beteille (2002) provides a useful discussion on the caste-system and affirmative action in India.

age 15-59 was only 24.7 percent compared to 82 percent among men (Government of India, 2013). In addition, majority of those working women are self-employed for whom no wages are reported in household survey datasets. Given the scarceness of information on income and occupation for daughters, education remains a popular choice as a measure of economic status in developing countries. Moreover, there are several advantages of using education as a measure of economic status in developing countries. First, on the measurement side, education is less prone to serious errors than earnings. Second, since most individuals complete their education by early or mid-twenties, life cycle biases are unlikely to bias estimation when compared with earnings. Finally, there is a vast literature that shows that higher education is associated with higher earnings, better health, and other economic outcomes (see Black and Devereux, 2011), rendering a measure of intergenerational transmission based on education a reasonable proxy for mobility in overall economic status.

The years of schooling is reported as a continuous variable in our data, and varies from 0 to 16, with 0 representing illiterate and 16 representing above bachelor degree. In the literature, parental education is proxy by either father's education, or the maximum of father's or mother's education, or the average of both parents education. In our analysis, we use father's years of schooling to proxy for parents' education.[13] In our sample, fathers have either the same or more education for about 94.4 percent of daughters. For 40.2 percent of daughters in our sample, fathers have more education than mothers. Fathers have the same education as mothers for 54.2 percent of daughters. Interestingly, among the daughters who have similarly educated fathers and mothers, more than 90 percent of those fathers and mothers are illiterate. Nevertheless, we also present the results using mothers' years of schooling as proxy for parents' education in an online appendix, and overall conclusions

[13]It is not a priori clear whether one should include spousal education as an additional explanatory variable. Without the inclusion of the partner's schooling, the effect of parental schooling as it is estimated represents both the direct transfer from the given parent and the indirect transfer from the other parent, which is due to assortative mating effects. If we are interested in the schooling of the children, we should not care whether parental schooling effects run through assortative mating or something else, and we can estimate separate regressions for mothers and fathers, without controlling for the spouses' schooling (Holmlund et al., 2011).

remain same.

Table 2 presents the descriptive statistics of our sample. The average years of schooling for daughters has been increasing over time. For example, the daughters born during 1962-66 attended on average of 3.53 years of school, while daughters born during 1987-91 attended about 8.51 years of school on average. This steady increase has been observed among all social groups. Similarly, the average education of fathers and mothers also has improved over time. There are few interesting facts observed in the data. First, fathers tend to have much higher educational attainment compared to mothers among each birth cohort (Table 2). This is true among all social groups. This is not surprising given the patriarchal nature of Indian society. Second, there is a significant advantage witnessed by HHC daughters in terms of parents' education compared to other social groups. For example, the average education of fathers for HHC daughters born during 1962-66 is more than four times higher than SC/ST daughters. This disadvantage of SC/ST daughters has declined over time, however a significant gap remains: the average education of fathers for HHC daughters born during 1986-91 is about 2.3 times higher than SC/ST daughters. Similar is the case for mothers education also. Not surprisingly, a considerable advantage of HHC is also witnessed in daughters' education.

3 Analytical Framework

To capture the intergenerational transmission of education, we estimate the following regression:

$$S_i^d = \alpha + \beta S_i^f + \epsilon_i \tag{1}$$

where S_i^d and S_i^f represent the education of daughter i and education of her father, respectively. ϵ_i is an error term and β is the parameter of interest. The OLS estimate of β is reported as one of the measure of intergenerational persistence of educational attainment.

The $\hat{\beta}$ is given by:

$$\hat{\beta} = \frac{\sigma_{df}}{\sigma_f^2} = \rho_{df}\frac{\sigma_d}{\sigma_f} \tag{2}$$

where σ_d and σ_f are the standard deviations of daughters' and fathers' schooling, σ_{df} is the covariance between daughters' and fathers' schooling, and ρ_{df} is the correlation between daughters' and fathers' schooling. To ensure that the evolution of $\hat{\beta}$ is not entirely driven by the evolution of $\frac{\sigma_d}{\sigma_f}$, we also normalized the years of schooling of daughters and fathers by the corresponding standard deviations and estimate the following equation:

$$\frac{S_i^d}{\sigma_d} = \delta + \rho\frac{S_i^f}{\sigma_f} + \epsilon_i \tag{3}$$

The main difference between the β coefficient in equation (1) and ρ coefficient in equation (3) is that the former by considering the ratio of variances, takes into account a change of inequality of educational outcomes in daughters and fathers generations, providing a relative measure of intergenerational mobility. The latter provides an absolute measure of intergenerational transmission, i.e. cleansed from possible evolution of the distribution of educational attainments, for instance, due to school reforms that increased the average schooling of the population, reducing its variance (Checchi et al., 2008). The changes in the relative standard deviations will cause both measures to evolve differently over time, and evidence (Hertz et al., 2007; Azam and Bhatt, 2015) shows that in several countries β and ρ behave differently. In our empirical results we report both the intergenerational regression coefficient (IGRC) ($\hat{\beta}$) and the intergenerational correlation coefficient (IGC) ($\hat{\rho}$) for each birth cohort. It is common among economists to refer to both intergenerational regression coefficients and correlation coefficients as inverse measures of intergenerational mobility (Solon 1999).

We estimate equation (1) and equation (3) separately for six five-year cohorts starting with 1962.[14] Following Checchi et al. (2013) and denoting the normalized schooling (by

[14]The interpretation of β and ρ is descriptive and not causal. However, assuming that the factors poten-

their corresponding standard deviations) daughters and fathers with d and f, we rewrite the correlation coefficient as:

$$\rho = \int \underbrace{(d - E(d))(f - E(f))}_{A} \underbrace{P(d/f)}_{B} \underbrace{P(f)}_{C} \tag{4}$$

Thus, ρ can change over time because of changes in the dispersion of daughters' and fathers' (standardized) education around their respective means (term A), because of changes in daughters' educational attainment conditional on fathers' education (term B), or because of changes in the unconditional distribution of fathers' education (term C). Term B should be the policy-relevant indicator of intergenerational persistence as changes in term A can be due to uniform convergence towards higher levels of education. In addition, as countries develop, one would expect an increase in the level of education of fathers across generations (Checchi et al., 2013).

To explore the stability of correlation coefficients further, we decompose the correlation coefficient using the empirical analogue of equation (4) (Checchi et al. 2013):

$$\rho = \sum_{d,f} \underbrace{(d - E(d))(f - E(f))}_{A} \underbrace{P(d/f)}_{B} \underbrace{P(f)}_{C} \tag{5}$$

where $d, f = 0, 1, 2, ..., 15, 16$ and thus $\hat{\rho}$ for each cohort is the sum of 289 elements.

4 Results

Panel 1 of Table 3 presents estimates for regression and correlation coefficient measures of educational persistence for six five-year birth cohorts. The regression coefficient declined from 0.627 for birth cohort 1962-66 to 0.535 for birth cohort 1987-91. Thus a one year difference in fathers' education has been associated with a 0.627 (0.535) year difference in

tially biasing the persistence estimates are time invariant, the evolution of these estimates over time can be reliably inferred from the above approach (Checchi et al. 2008).

daughters' education for daughters born during 1962-1966 (1987-1991). A Chi-square test of equality of $\hat{\beta}$ for cohorts 1962-1966 and 1987-1991 rejects the null (p-value=0.000). A Chi-square test of equality of $\hat{\beta}$ for successive cohorts rejects the null for 1962-66 vs. 1967-71, 1972-76 vs. 1977-81, 1977-81 vs. 1982-86, and 1982-86 vs. 1987-91 at 5% significance level. However, we are unable to reject the null of equality of $\hat{\beta}$ between birth cohort 1967-71 and birth cohort 1972-76. There is no discernible trend in IGRC.[15]

The IGC shows a marginal decline of 1.3 points between birth cohorts 1962-66 and 1987-91. A Chi-square test of equality of $\hat{\rho}$ for cohorts 1962-1966 and 1987-1991 rejects the null (p-value=0.022). A Chi-square test of equality of $\hat{\rho}$ for successive cohorts rejects the null for 1962-66 vs. 1967-71, 1967-71 vs. 1972-76, 1972-76 vs. 1977-81, and 1977-81 vs. 1982-86. However, we are unable to reject the null of equality of $\hat{\rho}$ between birth cohort 1982-86 and birth cohort 1987-91.

Panel 1 of Table 3 also presents the standard deviation (SD) in daughters and fathers years of schooling. The SD in daughters' years of schooling has been increasing throughout except for the recent 1987-91 birth cohort. Similarly, SD in fathers' schooling has been increasing over time. Except for the most recent cohort, the variance of daughters' schooling is greater than the variance of fathers' schooling. This implies the ratio of the SD of fathers' years of schooling to that of daughters' years of schooling will be less than one because of which $\hat{\rho}$ is less than $\hat{\beta}$ for all cohorts except the 1987-91 birth cohort.

Panel 2 of Table 3 provides persistence estimates controlling for state fixed effects. Controlling for state fixed effects reduces the persistence estimates marginally but overall trends remain similar. Online appendix Table A1 presents similar results for mother-daughter educational transmission. We find a definite negative trend in the IGRC over the entire period, however no definite trend in the IGC over the entire period. The IGRC fall from implausibly high 1.030 for the 1962-66 birth cohort to 0.640 for the 1987-91 birth cohort. The very high

[15]Online appendix Table A5 presents the persistence estimates for three-year birth cohorts. Overall conclusions remain similar.

IGRC estimates in the earlier cohorts are driven by a large number of zeros in mothers' education.[16]

Table 4 presents decomposition of $\hat{\rho}$ grouped by stages of schooling attended by fathers and daughters.[17] Line 31 of Table 4 reports the correlation coefficient $\hat{\rho}$, which is the sum of each combination of daughter's and father's education. Line 6 shows the total contribution of daughters with uneducated fathers to the intergenerational correlation coefficient. This group accounts for a large part of the correlation in each cohort but its weight declined from about 66 percent to 38 percent over 1962-67 and 1987-91 birth cohort. This is a natural consequence of increase in average education over time starting with a largely uneducated society.

However, this decline in correlation at the lower end of fathers' education distribution is compensated by an increase at the other parts of the fathers' educational distribution. As evident from lines (12), (18), (24), and (30), the contribution of daughters whose fathers have attended primary, middle school, or secondary schools has increased steadily across cohorts. This leads to a steady trend in the overall correlation coefficient. The total contribution of daughters with secondary attended father to the intergenerational correlation coefficient increased from about 10 percent to 24 percent over 1962-67 and 1987-91 birth cohort.

Online Appendix Table A2 presents similar results for mother-daughter transmission. The overall findings are similar to the findings for father-daughter educational transmission. The total contribution of daughters with uneducated fathers to the intergenerational correlation coefficient falls from 83 percent to 61 percent over 1962-67 and 1987-91 birth cohort. This decline in correlation at the lower end of mothers' education distribution is compensated by an increase at other parts of the mothers' educational distribution.

A system would achieve equality of opportunity if the probability of obtaining a particular

[16]For birth cohort 1962-66, about 55 percent of daughters have zero years of schooling while about 83 percent of mothers have zero years of schooling.

[17]Note that here stage of schooling implies attended those stage. For example, a person will be classified as attended primary school if he/she has completed 1-5 years of education.

degree for the daughter was independent of the father's educational achievement, that suggest that term B of equation (4) is the correct measure for analyzing the transmission of education (Checchi et al., 2008, 2013). To investigate the persistence in education, or term B, we collapse our years of schooling into stages of schooling achieved by daughters and fathers. We group the years of schooling into five achievement levels: years of schooling 0-4: below primary, 5-7: primary, 8-9: middle, 10-11: secondary, and 12-16: senior secondary or above.

Panel 1 of Figure 1 presents the probability of a daughter achieving either below primary or senior secondary or above education conditional on her father's education level. Panel 2 of the Figure 1 presents the probability of a daughter achieving primary, middle, and secondary level of education conditional on her father's education level. Since the convergence in the probability of achieving middle education levels may be misleading as this convergence may be achieved by an increase in the probability of achieving middle levels of education by daughters of low educated fathers, while a decline in the probability of achieving middle levels of education by daughters of high educated fathers as they achieve more higher education, we focus on the probability of achieving top and bottom level of education (panel 1 of Figure 1). As expected, with the expansion of primary education, the probability of a daughter being below primary declines over time with the highest decline witnessed for daughters of below primary or primary educated fathers. Our most recent birth-cohort is 1987-91, which implies that the daughters born during 1987-91 attended primary schools in late 1990s and early 2000s, and not in the last decade. With the near universalization of primary education in recent years, one should expect the probability of below primary education approaches to zero irrespective of the father's education level for daughters born in 1990s and 2000s.

If we consider the probability of a daughter achieving senior secondary or above education (Panel 1 of Figure 1), the differences are quite striking. Importantly, there is no evidence of convergence among daughters of fathers with different levels of education. The probability of a daughter attaining senior secondary or above education increases with the level of father's education. More importantly, there remains a considerable gap in the probability between

top end and bottom end of fathers' education distribution. For example, the gap in the probability of a daughter attaining senior secondary or above education between a daughter of senior secondary or above educated father and a daughter of below primary educated father is about 0.5 points for the 1962-67 birth cohort, and this gap increases to about 0.6 points for the 1987-91 birth cohort. These results are in line with the results reported in Azam and Bhatt (2015) for sons. For example, Azam and Bhatt (2015) finds that the probability of a son achieving senior secondary or above education in the birth cohort 1940-1945 is about 0.75 points higher if father is senior secondary or above educated compared to if father is illiterate/below primary. Moreover, the gap has not declined over time. Overall, we conclude that the probability of achieving higher education is definitely associated with the family background, and there is not much improvement over time.

4.1 Educational persistence by social groups

In Table 5, we present the IGRC and IGC for each social group.[18] There is no distinct trend over the entire period within each social group in both measures of persistence. The IGRC is lower in the 1987-91 birth cohort compared to the 1962-66 birth cohort for HHCs and OBCs, while higher for SC/STs and Muslims. Interestingly, the IGC is also higher (lower) for SC/STs (HHCs) in the 1987-91 birth cohort compared to the 1962-66 birth cohort. For Muslims and OBCs, the IGC provides conflicting evidence. The IGC is lower (the same) for Muslims (OBC) in the 1987-91 birth cohort compared to the 1962-66 birth cohort.

The SD of daughters' schooling shows a declining trend for HHCs, however, an increasing trend in SD is witnessed for rest of the social groups. This is because of largely uneducated

[18]We estimate educational persistence for each group from a subsample of observations belonging to that group. This is useful only in describing the extent of persistence within a group, and cannot be used to compare across social groups. It is because the estimated persistence for any group provides only an estimate of the rate to regression to the mean for that particular group and not for the overall education distribution. See Hertz (2005, 2008) and Mazumder (2011) for a detailed discussion of group-specific measures of intergenerational persistence. In contrast to the persistence measures, one can use the term (B) of equation (4) to compare across groups as we have done later in this section.

daughters to start with. Similarly, the SD of fathers' education has a positive trend for all social groups except for HHCs. For HHCs, the SD of fathers' schooling shows a declining trend in the late 1970s and 1980s after increasing in the 1960s and early 1970s.

To explore differences across social groups, we turn our focus to term B of equation (4). Unlike the regression and correlation coefficients which are not suitable for inter-group comparisons, term B of equation (4) can be used to compare groups (Checchi et al., 2013).[19]

Figure 2 presents the probability of a daughter achieving below primary education conditional on her father's education for different social groups.[20] It is evident that daughters belonging to HHCs have the lowest probability of remaining illiterate/below primary irrespective of fathers' education. The gap between HHCs and other social groups is statistically significant. While the probability of a daughter being illiterate/below primary is more or less similar for SC/STs, OBCs, and Muslims, this probability is much lower for HHCs. Importantly, the probability of being illiterate/below primary declined over time for all social groups. Nevertheless, the probability of getting education is associated with not only father's education (as the probability of a daughter being illiterate/below primary declines as fathers' education level increase irrespective of social group) but also with the social group (as the probability of a daughter being illiterate/below primary is much lower for HHC daughters with the same level of father's education).

Figure 3 plots the probability of a daughter attaining senior secondary or above education conditional on father's education for different social groups. The daughters of HHCs have the highest probability of attaining senior secondary or above education for the same level of fathers' education. The 95% confidence bands for HHCs do not overlap with the confidence bands for other social groups except at few points. In contrast, the confidence bands for rest of the social groups show substantial overlap. What is striking is that the probability of a daughter attaining senior secondary or above education for Muslims is either similar or

[19]This is because the estimated persistence for any group only provides an estimate of the rate to regression to the mean for that particular group and not for the overall education distribution.

[20]Pr(Daughter=Below Primary/Father=Below primary) is excluded from the graph to preserve space.

marginally worse than for SC/ST group.[21] These results for daughters are very similar to results for sons presented in Azam and Bhatt (2015) who find that Muslims sons have a lower probability of achieving secondary or above education for each level of father's education, whereas HHC sons have a significantly higher probability of achieving secondary or above education, compared to any other social group.

The probability of a daughter achieving senior secondary or above education conditional on father's education shows convergence among SC/STs, OBCs, and Muslims. However, there is no convergence of probabilities between HHCs and others. This suggests that not only inequality of opportunities based on caste membership (especially between HHC and others) exists in India but such inequality has shown little improvement over time. These findings are similar to the findings of Azam and Bhatt (2015) for sons who also find no convergence between HHCs and other social groups.

Online Appendix Figure A2 and A3 present corresponding findings for mothers-daughters persistence for each social group. The overall findings are similar to the findings reported for fathers-daughters persistence for social groups.

4.2 Educational persistence differences across sons and daughters

Gender disparity in education is well known problem in many developing countries including India. One of the mechanism of gender disparity is the discrepancy in intra-household resource allocation on education for girls compared to boys in developing countries. Kingdon (2005) uses individual-level education expenditure data from rural India referring to 1993. She finds pro-male bias in the household decision to enroll (or not enroll) children in school, but no evidence of gender bias in education expenditure conditional on enrolling both girls and boys in school. This could potentially lead to lower educational outcomes for daughters compared to sons conditioning on fathers' education levels. Hence, in this section, we explore

[21] Pr(Daughter=Senior Secondary or above/Father=Below primary) is excluded from the graph to preserve space.

whether the educational persistence differs for sons and daughters within each birth cohort. Azam and Bhatt (2015) studies the educational persistence for sons in detail. We identify fathers' education as done in Azam and Bhatt (2015), and we are able to identify fathers' education for 86 percent of sons born during 1962-1991 (for 37,119 men out of 43,118 men in age 20-49 surveyed in IHDS-2).

Figure 4a presents the probability of a child achieving below primary education (include no education) for sons and daughters. Daughters are more likely to remain illiterate/below primary educated compared to sons within the same cohort. This is not unexpected given the other evidence about pro-male bias. Importantly, the overall probability of remaining illiterate/below primary educated for both sons and daughters and the gap in probability across sons and daughters has declined over time.

Figure 4b presents the probability of a child achieving senior secondary or above education. For each level of fathers's education, sons have a higher probability of achieving senior secondary or above education. It is noteworthy that the gaps in the probability between sons and daughters has declined over time. For secondary and above educated fathers, the gap in the probability of a child achieving senior secondary or above education between sons and daughters are no more statistically significant for the most recent birth cohort considered (birth cohort 1987-91).

Online appendix Table A5 and Table A6 present state wise measures of persistence (both regression and correlation coefficients) for two 10-year birth cohorts, 1962-71 and 1982-91. There exists significant variation across states in both measures for both birth cohorts. Azam and Bhatt (2015) also find a considerable state wise variation in educational persistence for sons.

5 Conclusion

We examine the intergenerational education transmission between fathers (mothers) and daughters in India for daughters born during 1962-1991. We find that there has been a significant decline in the probability of a daughter remaining illiterate/below primary irrespective of parents education, yet, those probabilities are associated with parents' education and caste. The probability of a daughter remaining illiterate/below primary is lower for more educated fathers' (mothers'). Similarly, the probability of a daughter remaining illiterate is lowest for Higher Hindu Castes irrespective of fathers' (mothers') education.

The inequality of opportunities is starker once we consider the probability of a daughter attaining senior secondary or above education (top end of education distribution). Not only the probability of a daughter attaining senior secondary or above education is positively associated with father's education levels, the gaps in those probabilities do not show any signs of convergence. For example, the gap in the probability of a daughter attaining senior secondary or above education between a daughter of senior secondary or above educated father and a daughter of below primary educated father is about 0.5 points for the 1962-67 birth cohort, and that increased to about 0.6 points for the 1987-91 birth cohort. Although the probability of a daughter achieving senior secondary or above education conditional on father's education shows convergence among SC/STs, OBCs, and Muslims, there is no convergence of probabilities between Higher Hindu Castes and other social groups. The probability of a daughter attaining senior secondary or above education is higher for Higher Hindu Castes' daughters irrespective of parental education.

Our findings are in line with Azam and Bhatt (2015)' findings for father-son educational persistence. Therefore, one may conclude that 'Equality of Opportunity' remains an elusive goal for India. Educational opportunities still depend on parental background and caste. More importantly, the gap between the Higher Hindu Castes and the disadvantaged groups such as Other Backward Castes, Scheduled Castes/Tribes remains, and does not show any

sign of decline over time. Although conditional on having same educated fathers, sons are more likely to achieve senior secondary or above education in each cohort compared to daughters, the gap in those probabilities have declined over time.

Our paper does not attempt to provide potential mechanism underlying the differential evolution of educational persistence across educational and social groups. The literature traditionally distinguishes between two channels of human capital transmission, namely the nature effect and the nurture effect (Black and Devereux, 2011). The nature effect refers to the role of parents' unobserved heterogeneity, such as innate ability, in determining their children's ability via genetic transmission. The nurture effect is present to the extent that more educated parents can more efficiently bring up their children to acquire education. Our finding that daughters' educational outcome increases with parents' education suggest credit constraints as a possible mechanism. At the same time, the finding that the educational outcome of daughters depend on caste conditional on having similarly educated fathers suggests a possible role of differential returns in labor market and effects of historical factors. We believe that an important area for future research is to understand the mechanisms underlying the differential evolution of educational persistence across educational groups, castes, and states.

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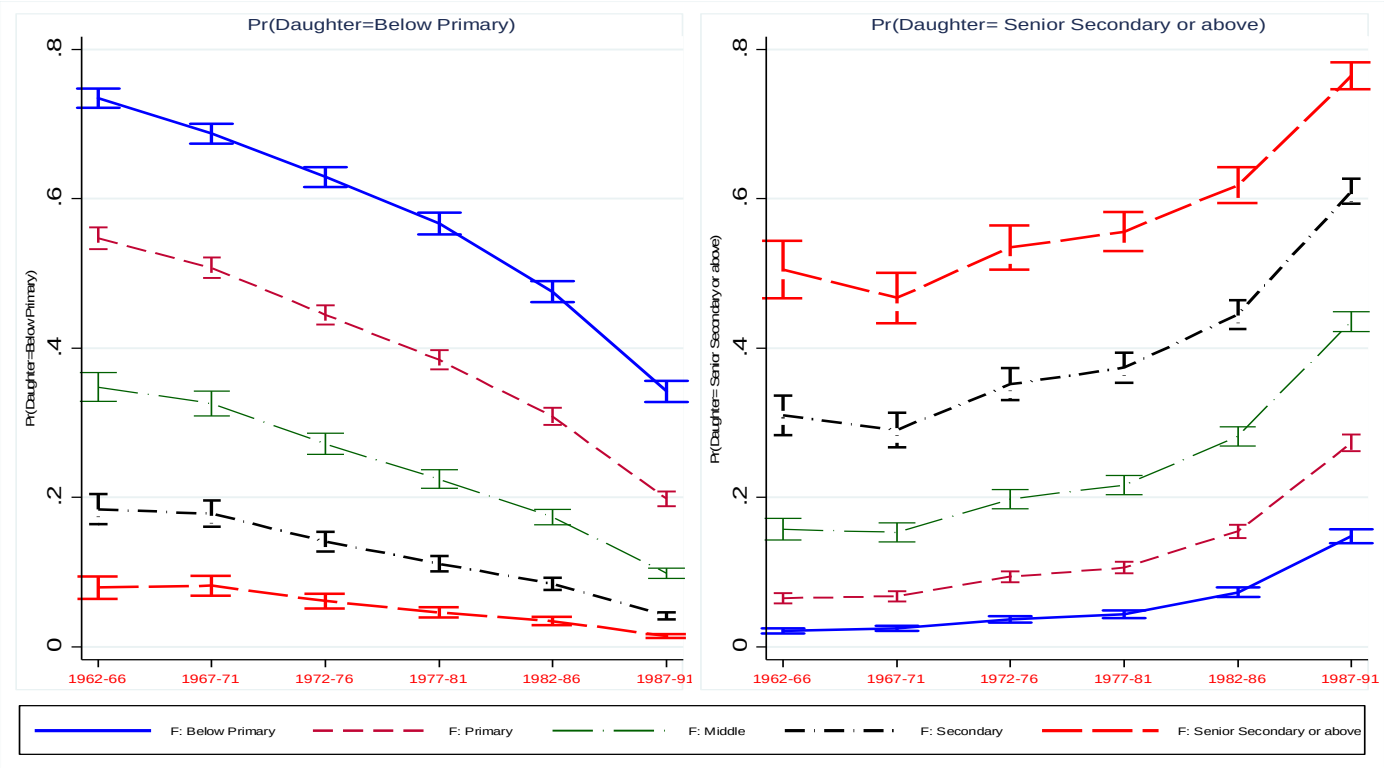
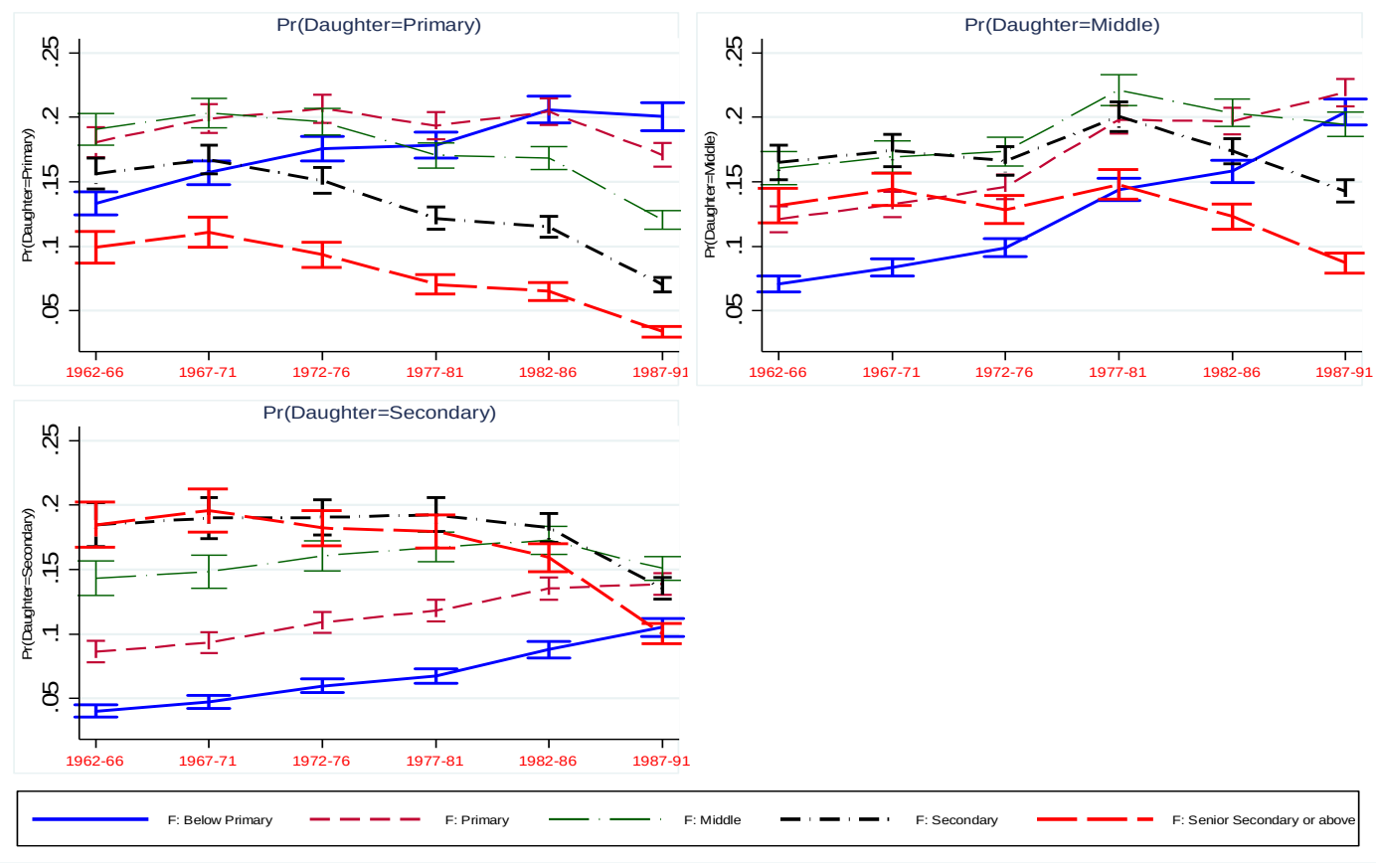
Figure 1: Probability of daughters' education conditional on fathers' education

Panel-1

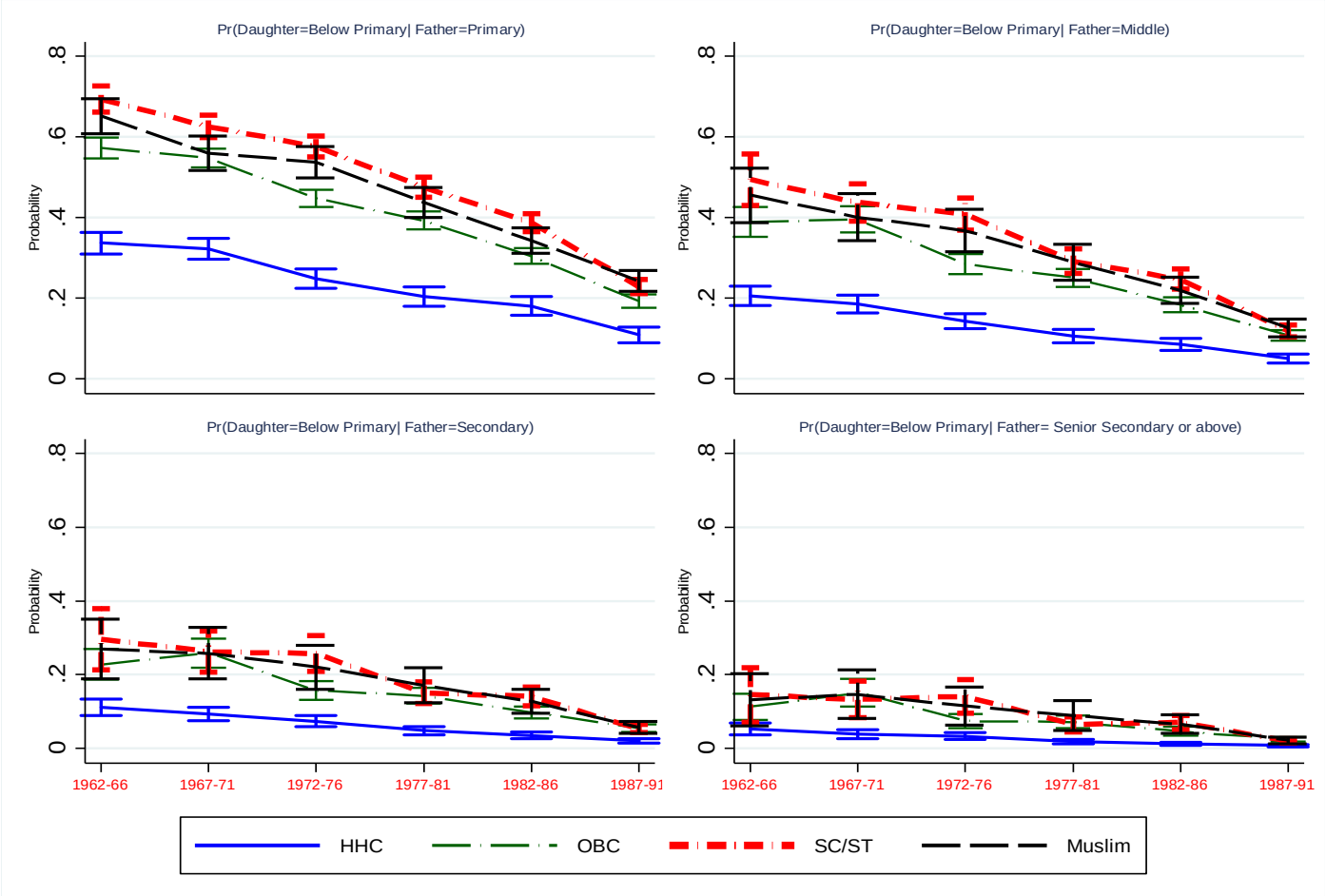


Panel-2



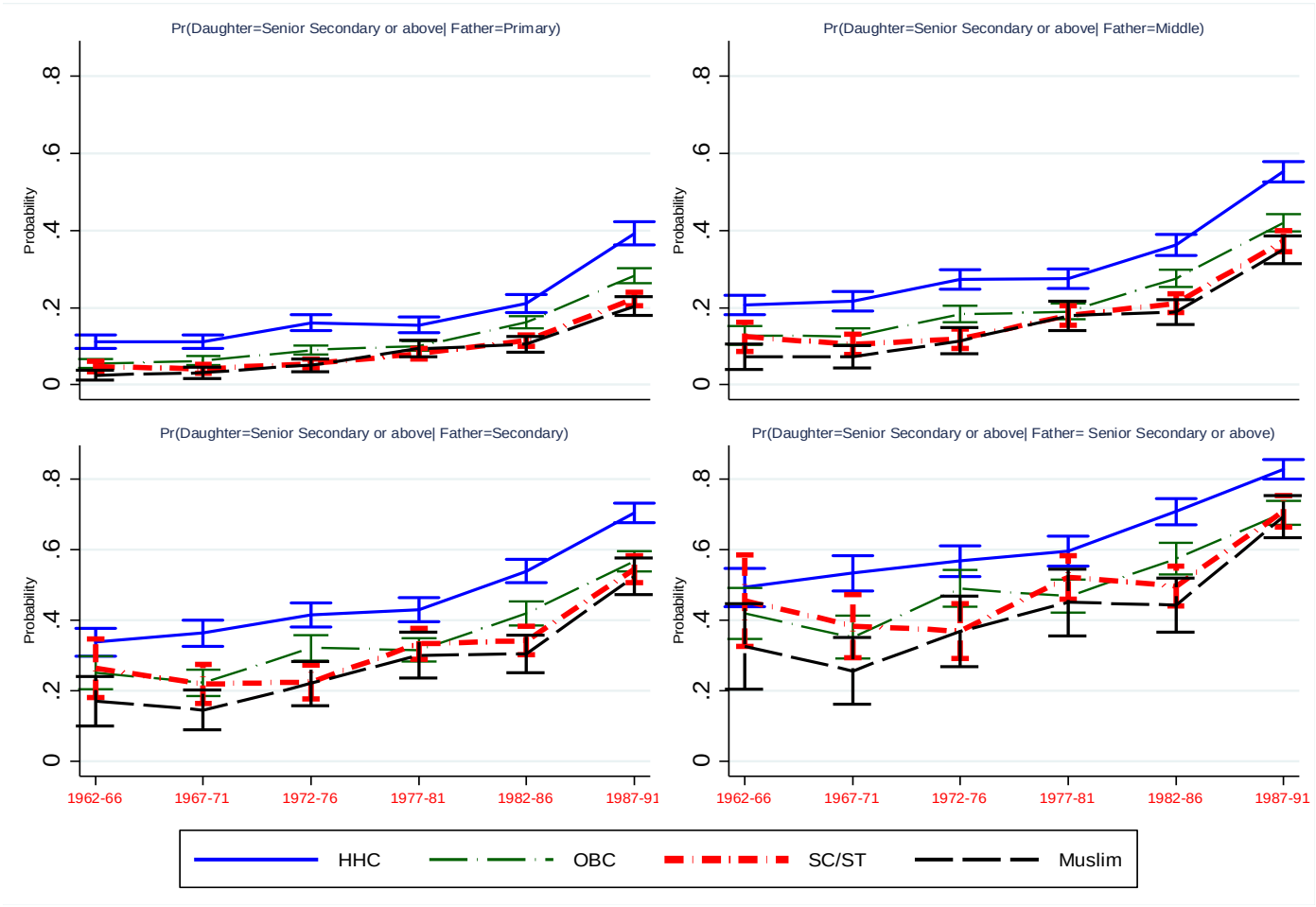
Note: The caps represent 95% confidence intervals. The scales for y-axis differ across panel 1 and panel 2.

Figure 2: Probability of daughters achieving Below Primary conditional on fathers' education by caste



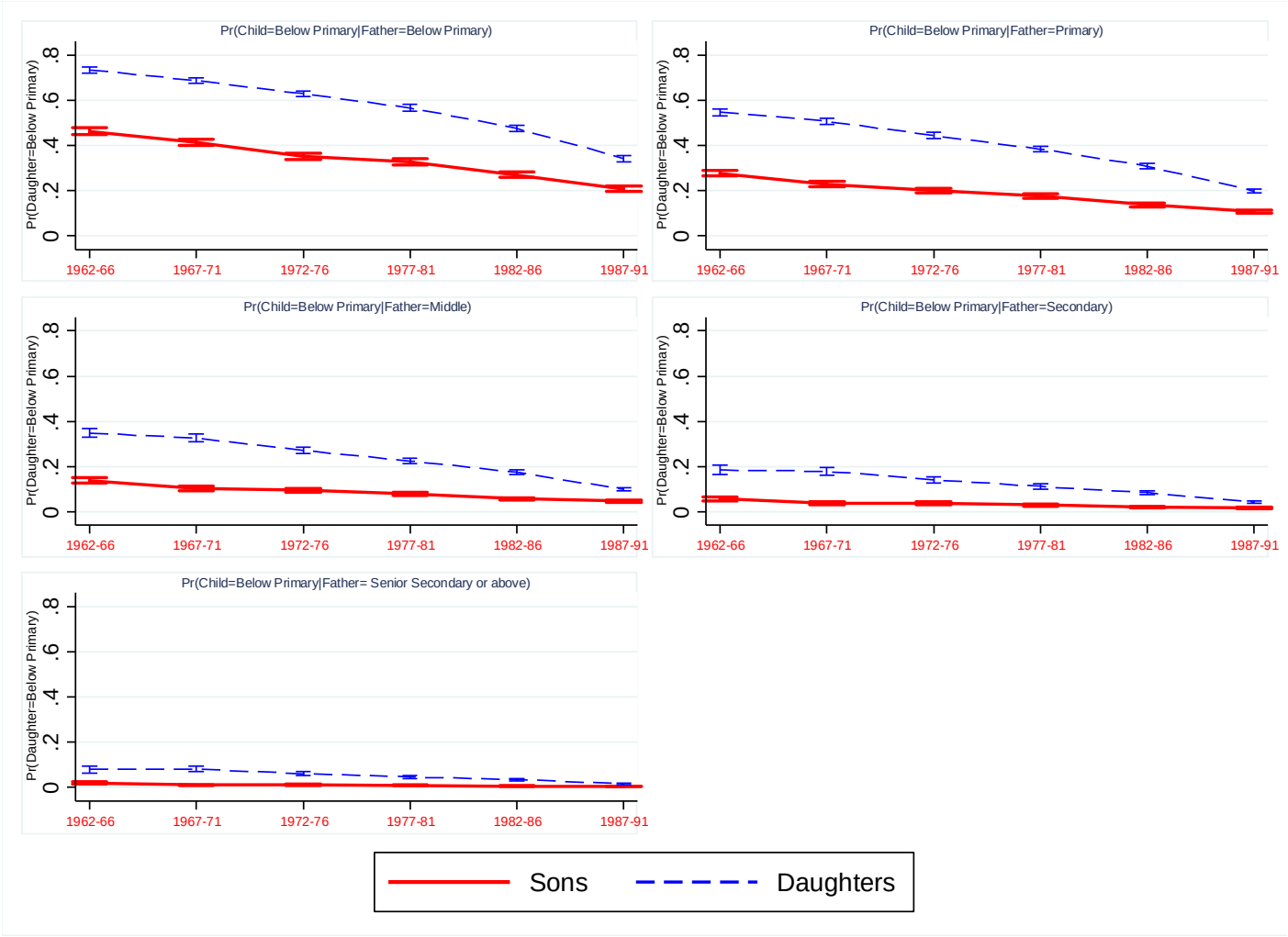
Note: The caps represent 95% confidence intervals. HHC = Higher Hindu Castes, OBC = Other Backward Castes, SC/ST = Scheduled Castes/Scheduled Tribes.

Figure 3: Probability of daughters achieving Senior Secondary or above conditional on fathers' education by caste



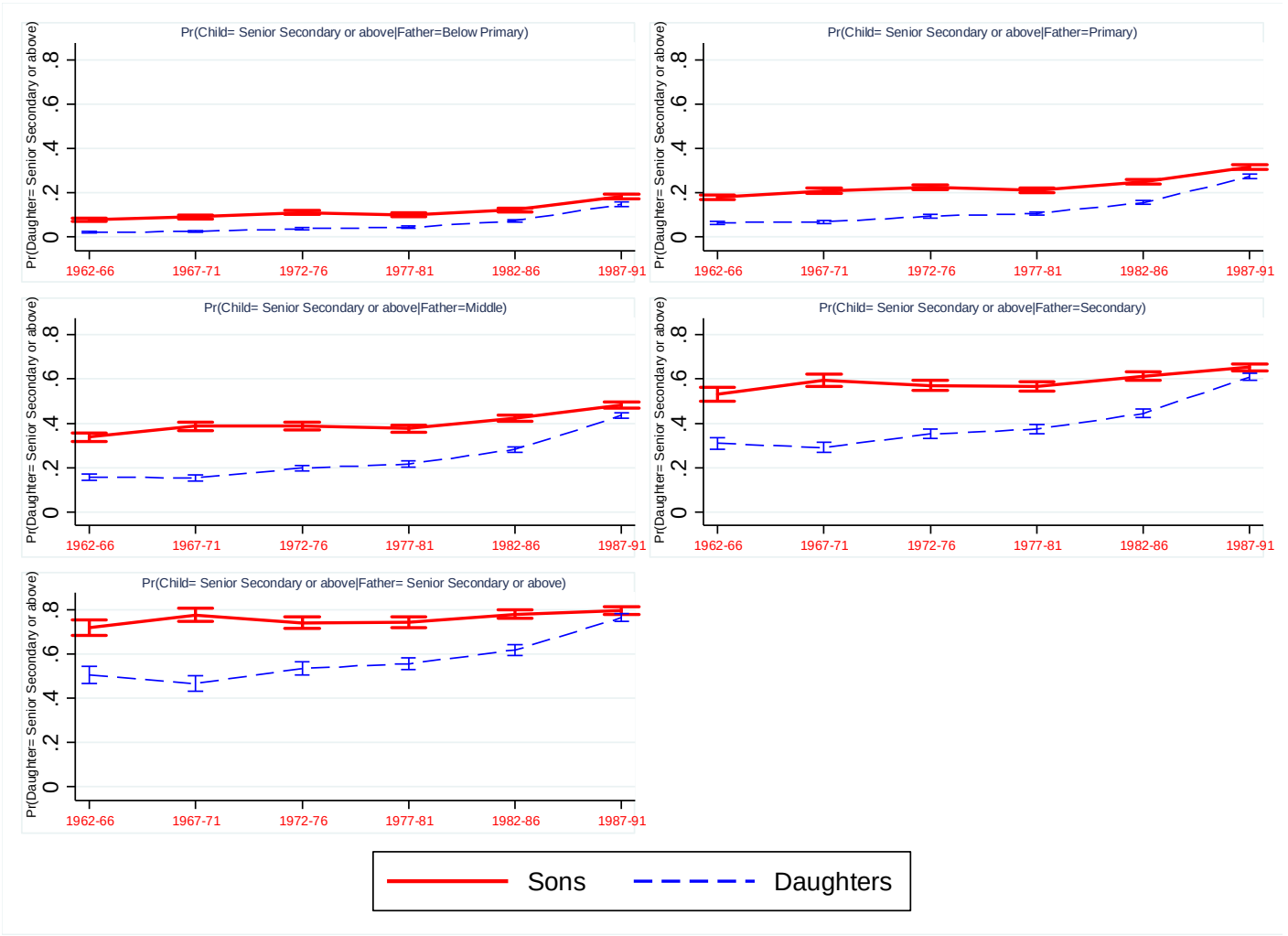
Note: The caps represent 95% confidence intervals. HHC = Higher Hindu Castes, OBC = Other Backward Castes, SC/ST = Scheduled Castes/Scheduled Tribes.

Figure 4a: Probability of sons/daughters achieving below primary education conditional on fathers' education



Note: The caps represent 95% confidence intervals.

Figure 4b: Probability of sons/daughters achieving Senior Secondary or above conditional on fathers' education



Note: The caps represent 95% confidence intervals.

Table 1: Identification of parents' education for adult women in age 20-49

Year of birth	**Total surveyed women with non-missing education information***	Father years of education from women's module	Father years of education from household roster-co-resident father	*Number of women for whom father's years of education is available*	***% of surveyed women for whom father's years of education is available***
Panel A: Identification of fathers' years of schooling					
1962-66	6,129	5,458	25	5,483	***89.5***
1967-71	6,473	5,915	38	5,953	***92.0***
1972-76	7,157	6,456	97	6,553	***91.6***
1977-81	7,150	6,105	214	6,319	***88.4***
1982-86	8,512	6,147	773	6,920	***81.3***
1987-91	9,855	4,209	3,269	7,478	***75.9***
Total	**45,276**	**34,290**	**4,416**	**38,706**	***85.5***

Year of birth	**Total surveyed women with non-missing education information***	Mother years of education from women's module	Mother years of education from household roster-co-resident father	Number of women for whom mother's years of education available	***% of surveyed women for whom mother's education is available***
Panel A: Identification of mothers' years of schooling					
1962-66	6,129	5,481	50	5,531	***90.2***
1967-71	6,473	5,928	72	6,000	***92.7***
1972-76	7,157	6,480	157	6,637	***92.7***
1977-81	7,150	6,113	299	6,412	***89.7***
1982-86	8,512	6,162	961	7,123	***83.7***
1987-91	9,855	4,220	3,765	7,985	***81.0***
Total	**45,276**	**34,384**	**5,304**	**39,688**	***87.7***

Note: * IHDS surveyed 45319 women in age group 20-49. 43 observations are dropped because of missing education information.

Table 2: Descriptive statistics

Cohort	Sample size	Years of schooling-daughters		Years of schooling-fathers		Years of schooling-mothers	
		Mean	***SD***	***Mean***	***SD***	***Mean***	***SD***
All sample							
1962-66	5483	3.53	4.55	2.51	3.99	0.97	2.41
1967-71	5953	4.01	4.66	2.93	4.27	1.15	2.70
1972-76	6553	4.86	4.90	3.44	4.50	1.45	3.03
1977-81	6319	5.76	5.08	4.11	4.80	1.87	3.44
1982-86	6920	6.66	5.12	4.31	4.84	2.01	3.54
1987-91	7478	8.51	4.97	5.29	4.99	2.84	4.09
All	***38706***	***5.70***	***5.19***	***3.84***	***4.70***	***1.77***	***3.35***
Social Group: Higher Hindu Castes (HHC)							
1962-66	1318	6.45	4.99	4.72	4.89	2.01	3.26
1967-71	1401	6.72	4.92	5.15	4.99	2.26	3.54
1972-76	1478	7.80	4.83	5.90	5.21	2.77	3.92
1977-81	1387	8.62	4.64	6.82	5.14	3.70	4.37
1982-86	1426	9.29	4.77	6.87	5.19	3.92	4.50
1987-91	1520	10.91	4.12	8.20	4.99	5.29	4.74
All HHC	***8530***	***8.35***	***4.95***	***6.32***	***5.20***	***3.36***	***4.25***
Social Group: Other Backward Castes (OBC)							
1962-66	1826	3.19	4.25	2.30	3.72	0.73	2.09
1967-71	1984	3.56	4.40	2.69	4.00	0.97	2.42
1972-76	2289	4.67	4.76	3.24	4.26	1.28	2.79
1977-81	2141	5.57	4.94	3.97	4.55	1.59	3.08
1982-86	2262	6.57	5.07	4.23	4.68	1.73	3.20
1987-91	2304	8.73	4.90	5.56	4.81	2.73	3.93
ALL OBC	***12806***	***5.47***	***5.10***	***3.72***	***4.51***	***1.54***	***3.07***
Social Group: Scheduled castes/Tribes (SC/ST)							
1962-66	1514	1.70	3.33	1.14	2.64	0.32	1.44
1967-71	1738	2.48	3.89	1.59	3.25	0.46	1.78
1972-76	1847	3.10	4.14	1.97	3.49	0.63	1.98
1977-81	1866	4.16	4.71	2.65	4.16	1.02	2.64
1982-86	2137	5.25	4.80	2.96	4.24	1.06	2.61
1987-91	2361	7.16	4.94	3.53	4.41	1.57	3.13
ALL SC/ST	***11463***	***4.19***	***4.78***	***2.40***	***3.90***	***0.89***	***2.43***
Social Group: Muslims							
1962-66	630	2.45	3.67	1.96	3.75	0.77	2.07
1967-71	626	3.19	4.03	2.44	4.03	0.80	2.15
1972-76	769	3.60	4.26	2.74	3.97	1.06	2.47
1977-81	761	4.70	4.77	3.01	4.21	1.18	2.68
1982-86	931	5.71	4.76	3.54	4.42	1.60	3.04
1987-91	1107	7.18	4.85	4.22	4.61	1.99	3.46
Muslims	***4824***	***4.80***	***4.78***	***3.14***	***4.29***	***1.32***	***2.82***

Note: SD implies Standard Deviation.

Table 3: Intergenerational persistence in educational attainment among daughters

Panel-1*: Dependent variable*: Daughter's years of schooling	(1) 1962-66	(2) 1967-71	(3) 1972-76	(4) 1977-81	(5) 1982-86	(6) 1987-91
Father's years of schooling	0.627***	0.584***	0.589***	0.595***	0.569***	0.535***
$(\hat{\beta})$	(0.019)	(0.017)	(0.015)	(0.014)	(0.014)	(0.013)
Father's years of schooling	0.550***	0.535***	0.542***	0.561***	0.537***	0.537***
$(\hat{\rho})$	(0.017)	(0.015)	(0.013)	(0.014)	(0.013)	(0.013)
Mean of daughter's years of schooling	3.53	4.01	4.86	5.76	6.66	8.51
Mean of father's years of schooling	2.51	2.93	3.44	4.11	4.31	4.97
SD in daughter's years of schooling (σ_d)	4.548	4.663	4.899	5.085	5.123	4.969
SD in father's years of schooling (σ_f)	3.993	4.271	4.505	4.796	4.836	4.995
σ_f/σ_d	0.878	0.916	0.920	0.943	0.944	1.005
Observations	5,483	5,953	6,553	6,319	6,920	7,478
R-squared	0.303	0.286	0.294	0.315	0.288	0.289
Panel-2: control state fixed effects						
Father's years of schooling	0.605***	0.571***	0.583***	0.577***	0.563***	0.521***
$(\hat{\beta})$	(0.018)	(0.015)	(0.014)	(0.013)	(0.013)	(0.013)
Father's years of schooling	0.531***	0.523***	0.536***	0.544***	0.532***	0.524***
$(\hat{\rho})$	(0.016)	(0.014)	(0.013)	(0.013)	(0.013)	(0.013)
R-squared	0.402	0.401	0.397	0.422	0.398	0.384

Note: SD implies Standard Deviation. *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors in parentheses.

Table 4: Decomposition of persistence measured by correlation (ρ)

	Daughter-stage attended	*Father-stage attended*	1962-66	1967-71	1972-76	1977-81	1982-86	1987-91
1	D:No education	F:No education	0.249	0.210	0.173	0.149	0.113	0.062
2	D:Primary	F:No education	0.057	0.055	0.060	0.049	0.047	0.037
3	D:Middle	F:No education	0.031	0.035	0.035	0.043	0.047	0.041
4	D:Secondary	F:No education	0.023	0.026	0.033	0.038	0.046	0.053
5	D:College	F:No education	0.002	0.002	0.003	0.003	0.006	0.010
6	***Total contribution to the correlation coefficient of the group of daughters with not educated father***		***0.362***	***0.329***	***0.304***	***0.283***	***0.259***	***0.203***
7	D:No education	F:Primary	*0.033*	*0.031*	*0.028*	*0.025*	*0.019*	*0.014*
8	D:Primary	F:Primary	0.015	0.015	0.018	0.014	0.013	0.012
9	D:Middle	F:Primary	0.012	0.013	0.014	0.017	0.017	0.018
10	D:Secondary	F:Primary	0.013	0.015	0.020	0.023	0.025	0.035
11	D:College	F:Primary	0.002	0.002	0.003	0.004	0.006	0.013
12	***Total contribution to the correlation coefficient of the group of daughters with Primary attended father***		***0.075***	***0.077***	***0.084***	***0.082***	***0.080***	***0.092***
13	D:No education	F:Middle	0.011	0.012	0.011	0.011	0.009	0.006
14	D:Primary	F:Middle	*0.008*	*0.009*	*0.010*	*0.008*	*0.008*	*0.007*
15	D:Middle	F:Middle	0.008	0.009	0.010	0.013	0.013	0.012
16	D:Secondary	F:Middle	0.013	0.015	0.020	0.025	0.028	0.033
17	D:College	F:Middle	0.004	0.004	0.005	0.007	0.010	0.019
18	***Total contribution to the correlation coefficient of the group of daughters with Middle attended father***		***0.045***	***0.049***	***0.057***	***0.063***	***0.068***	***0.077***
19	D:No education	F:Secondary	0.007	0.008	0.008	0.009	0.006	0.004
20	D:Primary	F:Secondary	0.007	0.008	0.009	0.009	0.008	0.006
21	D:Middle	F:Secondary	*0.010*	*0.012*	*0.012*	*0.017*	*0.016*	*0.014*
22	D:Secondary	F:Secondary	0.020	0.025	0.032	0.047	0.045	0.053
23	D:College	F:Secondary	0.011	0.011	0.015	0.023	0.028	0.050
24	***Total contribution to the correlation coefficient of the group of daughters with Secondary attended father***		***0.056***	***0.064***	***0.075***	***0.105***	***0.103***	***0.127***
25	D:No education	F:College	0.000	0.000	0.000	0.000	0.000	0.000
26	D:Primary	F:College	0.000	0.001	0.001	0.001	0.000	0.001
27	D:Middle	F:College	0.001	0.001	0.001	0.002	0.002	0.001
28	D:Secondary	F:College	*0.004*	*0.006*	*0.008*	*0.010*	*0.009*	*0.011*
29	D:College	F:College	0.004	0.005	0.008	0.011	0.013	0.024
30	***Total contribution to the correlation coefficient of the group of daughers with College attended father***		***0.009***	***0.013***	***0.018***	***0.023***	***0.025***	***0.037***
31	**Correlation Coefficient**		**0.547**	**0.531**	**0.538**	**0.557**	**0.535**	**0.535**

Note: The continuous years of schooling is grouped to refer attended stages of schooling. No education: 0 years; Primary: 1-5 years; Middle: 6-8 years; Secondary: 9-12 years; and College: 13 -16 years.

Table 5: Intergenerational persistence in educational attainment among daughters by social groups

	(1)	(2)	(3)	(4)	(5)	(6)
	1962-66	1967-71	1972-76	1977-81	1982-86	1987-91
Social Group= Higher Hindu Castes						
Father's years of schooling	0.527***	0.555***	0.476***	0.506***	0.537***	0.416***
$(\hat{\beta})$	(0.027)	(0.025)	(0.028)	(0.027)	(0.037)	(0.026)
Father's years of schooling	0.516***	0.563***	0.514***	0.560***	0.584***	0.504***
$(\hat{\rho})$	(0.027)	(0.026)	(0.030)	(0.030)	(0.041)	(0.031)
SD in daughter's years of (σ_d)	4.993	4.919	4.827	4.640	4.767	4.121
SD deviation in father's years (σ_f)	4.886	4.992	5.207	5.136	5.188	4.993
σ_f/σ_d	0.979	1.015	1.079	1.107	1.088	1.211
Observations	1,318	1,401	1,478	1,387	1,426	1,520
R-squared	0.266	0.318	0.264	0.313	0.342	0.254
Social Group= Other Backward Castes						
Father's years of schooling	0.554***	0.480***	0.561***	0.523***	0.524***	0.494***
$(\hat{\beta})$	(0.041)	(0.034)	(0.026)	(0.027)	(0.025)	(0.026)
Father's years of schooling	0.486***	0.437***	0.503***	0.481***	0.483***	0.484***
$(\hat{\rho})$	(0.036)	(0.031)	(0.024)	(0.025)	(0.023)	(0.025)
SD in daughter's years of (σ_d)	4.247	4.397	4.758	4.943	5.070	4.902
SD deviation in father's years (σ_f)	3.724	4.004	4.262	4.554	4.675	4.809
σ_f/σ_d	0.877	0.911	0.896	0.921	0.922	0.981
Observations	1,826	1,984	2,289	2,141	2,262	2,304
R-squared	0.236	0.191	0.253	0.232	0.233	0.234
Social Group= Scheduled Castes/Tribes						
Father's years of schooling	0.518***	0.520***	0.511***	0.599***	0.505***	0.540***
$(\hat{\beta})$	(0.051)	(0.040)	(0.035)	(0.035)	(0.033)	(0.026)
Father's years of schooling	0.410***	0.435***	0.431***	0.529***	0.446***	0.482***
$(\hat{\rho})$	(0.041)	(0.034)	(0.029)	(0.031)	(0.029)	(0.023)
SD in daughter's years of (σ_d)	3.331	3.893	4.136	4.711	4.797	4.935
SD deviation in father's years (σ_f)	2.640	3.251	3.490	4.163	4.237	4.408
σ_f/σ_d	0.793	0.835	0.844	0.884	0.883	0.893
Observations	1,514	1,738	1,847	1,866	2,137	2,361
R-squared	0.168	0.189	0.186	0.280	0.199	0.232
Social Group= Muslims						
Father's years of schooling	0.504***	0.451***	0.454***	0.515***	0.498***	0.523***
$(\hat{\beta})$	(0.053)	(0.047)	(0.047)	(0.041)	(0.037)	(0.031)
Father's years of schooling	0.516***	0.452***	0.423***	0.454***	0.463***	0.497***
$(\hat{\rho})$	(0.054)	(0.047)	(0.043)	(0.037)	(0.034)	(0.029)
SD in daughter's years of (σ_d)	3.667	4.028	4.256	4.774	4.755	4.853
SD deviation in father's years (σ_f)	3.750	4.030	3.971	4.212	4.416	4.613
σ_f/σ_d	1.023	1.001	0.933	0.882	0.929	0.951
Observations	630	626	769	761	931	1,107
R-squared	0.266	0.204	0.179	0.206	0.214	0.247

Note: SD implies Standard Deviation. *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors in parentheses.

Intergenerational Educational Persistence among Daughters: Evidence from India

Mehtabul Azam

Oklahoma State University & IZA

Online Appendix

Table A1: Intergenerational persistence in educational attainment between mothers and daughters

Panel-1: Dependent variable: Daughter's year of schooling	(1) 1962-66	(2) 1967-71	(3) 1972-76	(4) 1977-81	(5) 1982-86	(6) 1987-91
Mother's years of schooling ($\hat{\beta}$)	1.030***	0.936***	0.865***	0.814***	0.772***	0.640***
	(0.030)	(0.025)	(0.020)	(0.017)	(0.014)	(0.013)
Mother's years of schooling ($\hat{\rho}$)	0.549***	0.538***	0.532***	0.548***	0.544***	0.528***
	(0.016)	(0.014)	(0.012)	(0.011)	(0.010)	(0.010)
Mean of daughter's years of schooling	3.53	4.01	4.86	5.76	6.66	8.51
Mean of mother's years of schooling	0.97	1.15	1.45	1.87	2.01	2.84
SD of daughter's years of schooling (σ_d)	4.537	4.689	4.931	5.111	5.136	4.975
SD of mother's years of schooling (σ_m)	2.417	2.695	3.035	3.440	3.618	4.101
σ_m/σ_d	0.533	0.575	0.615	0.673	0.704	0.824
Observations	5,531	6,000	6,637	6,412	7,123	7,985
R-squared	0.299	0.292	0.286	0.303	0.295	0.282
Panel-2: control state fixed effects						
Mother's years of schooling ($\hat{\beta}$)	0.937***	0.851***	0.786***	0.732***	0.710***	0.595***
	(0.030)	(0.024)	(0.020)	(0.017)	(0.015)	(0.013)
Mother's years of schooling ($\hat{\rho}$)	0.498***	0.491***	0.486***	0.495***	0.499***	0.493***
	(0.016)	(0.014)	(0.012)	(0.012)	(0.010)	(0.011)
	0.359	0.359	0.344	0.365	0.361	0.343

Note: SD implies Standard Deviation. *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors in parentheses.

Table A2: Intergenerational persistence in educational attainment among daughters by social groups

	(1) 1962-66	(2) 1967-71	(3) 1972-76	(4) 1977-81	(5) 1982-86	(6) 1987-91
Social Group= Higher Hindu Castes						
Mother's years of schooling	0.763***	0.737***	0.628***	0.571***	0.596***	0.448***
$(\hat{\beta})$	(0.046)	(0.039)	(0.033)	(0.028)	(0.035)	(0.023)
Mother's years of schooling	0.497***	0.529***	0.510***	0.539***	0.575***	0.518***
$(\hat{\rho})$	(0.030)	(0.028)	(0.027)	(0.027)	(0.033)	(0.026)
SD in daughter's years of schooling (σ_d)	4.996	4.917	4.831	4.623	4.782	4.108
SD deviation in mother's years (σ_f)	3.254	3.532	3.925	4.361	4.614	4.756
σ_f/σ_d	0.651	0.718	0.812	0.943	0.965	1.158
Observations	1,329	1,411	1,490	1,410	1,463	1,629
R-squared	0.247	0.280	0.260	0.290	0.331	0.269
Social Group= Other Backward Castes						
Mother's years of schooling	1.029***	0.877***	0.887***	0.811***	0.793***	0.608***
$(\hat{\beta})$	(0.057)	(0.054)	(0.036)	(0.031)	(0.028)	(0.025)
Mother's years of schooling	0.512***	0.482***	0.520***	0.508***	0.506***	0.490***
$(\hat{\rho})$	(0.028)	(0.030)	(0.021)	(0.019)	(0.018)	(0.020)
SD in daughter's years of schooling (σ_d)	4.260	4.394	4.788	4.945	5.086	4.858
SD deviation in mother's years (σ_f)	2.119	2.415	2.808	3.098	3.246	3.915
σ_f/σ_d	0.497	0.550	0.586	0.627	0.638	0.806
Observations	1,844	2,001	2,318	2,169	2,309	2,444
R-squared	0.262	0.232	0.270	0.258	0.256	0.240
Social Group= Scheduled Castes/Tribes						
Mother's years of schooling	1.031***	0.985***	0.844***	0.887***	0.776***	0.714***
$(\hat{\beta})$	(0.090)	(0.052)	(0.045)	(0.039)	(0.035)	(0.025)
Mother's years of schooling	0.445***	0.450***	0.409***	0.498***	0.434***	0.466***
$(\hat{\rho})$	(0.039)	(0.024)	(0.022)	(0.022)	(0.020)	(0.016)
SD in daughter's years of schooling (σ_d)	3.327	3.900	4.154	4.721	4.815	4.928
SD deviation in mother's years (σ_f)	1.435	1.784	2.011	2.649	2.693	3.218
σ_f/σ_d	0.431	0.457	0.484	0.561	0.559	0.653
Observations	1,529	1,754	1,874	1,895	2,213	2,522
R-squared	0.198	0.203	0.167	0.248	0.188	0.217
Social Group= Muslims						
Mother's years of schooling	0.850***	0.913***	0.746***	0.832***	0.719***	0.709***
$(\hat{\beta})$	(0.097)	(0.064)	(0.093)	(0.059)	(0.048)	(0.035)
Mother's years of schooling	0.487***	0.483***	0.435***	0.468***	0.464***	0.500***
$(\hat{\rho})$	(0.056)	(0.034)	(0.054)	(0.033)	(0.031)	(0.024)
SD in daughter's years of schooling (σ_d)	3.604	4.052	4.234	4.762	4.771	4.882
SD deviation in mother's years (σ_f)	2.066	2.144	2.471	2.677	3.078	3.448
σ_f/σ_d	0.573	0.529	0.584	0.562	0.645	0.706
Observations	632	630	781	768	968	1,184
R-squared	0.237	0.233	0.190	0.219	0.215	0.250

Note: SD implies Standard Deviation. *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors in parentheses.

Table A3: Decomposition of persistence measured by correlation (ρ) between daughters and mothers years of schooling

	Daughter- stage attended	*Mother-stage attended*	1962-66	1967-71	1972-76	1977-81	1982-86	1987-91
1	D:No education	M:No education	0.281	0.248	0.200	0.173	0.134	0.072
2	D:Primary	M:No education	0.077	0.080	0.085	0.070	0.067	0.051
3	D:Middle	M:No education	0.049	0.058	0.057	0.070	0.077	0.066
4	D:Secondary	M:No education	0.042	0.049	0.064	0.076	0.089	0.107
5	D:College	M:No education	0.004	0.004	0.006	0.008	0.013	0.027
6	***Total contribution to the correlation coefficient of the group of daughters with not educated mother***		***0.453***	***0.438***	***0.412***	***0.397***	***0.381***	***0.324***
7	D:No education	M:Primary	0.015	0.013	0.013	0.013	0.009	0.006
8	D:Primary	M:Primary	0.010	0.009	0.011	0.009	0.008	0.007
9	D:Middle	M:Primary	0.010	0.011	0.011	0.014	0.014	0.012
10	D:Secondary	M:Primary	0.017	0.017	0.022	0.028	0.029	0.034
11	D:College	M:Primary	0.005	0.004	0.006	0.008	0.010	0.019
12	***Total contribution to the correlation coefficient of the group of daughters with Primary attended mother***		***0.058***	***0.055***	***0.062***	***0.071***	***0.070***	***0.079***
13	D:No education	M:Middle	0.002	0.002	0.002	0.003	0.002	0.001
14	D:Primary	M:Middle	0.002	0.002	0.003	0.003	0.002	0.002
15	D:Middle	M:Middle	0.003	0.004	0.004	0.006	0.006	0.005
16	D:Secondary	M:Middle	0.009	0.012	0.014	0.019	0.021	0.023
17	D:College	M:Middle	0.006	0.007	0.008	0.011	0.015	0.025
18	***Total contribution to the correlation coefficient of the group of daughters with Middle attended mother***		***0.020***	***0.027***	***0.031***	***0.041***	***0.046***	***0.056***
19	D:No education	M:Secondary	0.000	0.000	0.000	0.001	0.000	0.000
20	D:Primary	M:Secondary	0.000	0.000	0.001	0.001	0.000	0.001
21	D:Middle	M:Secondary	0.001	0.001	0.002	0.003	0.002	0.003
22	D:Secondary	M:Secondary	0.004	0.006	0.010	0.014	0.013	0.019
23	D:College	M:Secondary	0.006	0.008	0.012	0.016	0.020	0.036
24	***Total contribution to the correlation coefficient of the group of daughters with Secondary attended mother***		***0.011***	***0.016***	***0.025***	***0.034***	***0.036***	***0.059***
25	D:No education	M:College	0.000	0.000	0.000	0.000	0.000	0.000
26	D:Primary	M:College	0.000	0.000	0.000	0.000	0.000	0.000
27	D:Middle	M:College	0.000	0.000	0.000	0.000	0.000	0.000
28	D:Secondary	M:College	0.000	0.000	0.000	0.001	0.001	0.001
29	D:College	M:College	0.001	0.002	0.002	0.005	0.006	0.010
30	***Total contribution to the correlation coefficient of the group of daughters with College attended mother***		***0.001***	***0.002***	***0.003***	***0.005***	***0.007***	***0.011***
31	**Correlation Coefficient**		**0.544**	**0.538**	**0.532**	**0.548**	**0.540**	**0.529**

Note: The continuous years of schooling is grouped to refer attended stages of schooling. No education: 0 years; Primary: 1-5 years; Middle: 6-8 years; Secondary: 9-12 years; and College: 13 -16 years.

Table A4: Intergenerational persistence in educational attainment among daughters, alternative cohort definition

	1962-64	1965-67	1968-70	1971-73	1974-76	1977-79	1980-82	1983-85	1986-88	1989-91
Panel-1										
Father's years of schooling	0.632***	0.636***	0.591***	0.578***	0.588***	0.588***	0.600***	0.562***	0.582***	0.522***
($\hat{\beta}$)	(0.024)	(0.024)	(0.022)	(0.019)	(0.018)	(0.020)	(0.018)	(0.019)	(0.017)	(0.015)
Father's years of schooling	0.546***	0.573***	0.536***	0.527***	0.535***	0.557***	0.561***	0.524***	0.555***	0.532***
($\hat{\rho}$)	(0.021)	(0.022)	(0.020)	(0.017)	(0.017)	(0.019)	(0.017)	(0.018)	(0.016)	(0.016)
Observations	2,621	3,537	3,191	4,351	4,289	3,480	3,778	4,111	4,388	4,960
R-squared	0.296	0.327	0.289	0.282	0.292	0.313	0.317	0.278	0.306	0.284
Panel-2										
Mother's years of schooling	1.009***	1.033***	0.947***	0.877***	0.880***	0.808***	0.810***	0.777***	0.718***	0.628***
($\hat{\beta}$)	(0.042)	(0.033)	(0.035)	(0.028)	(0.024)	(0.021)	(0.022)	(0.018)	(0.018)	(0.015)
Mother's years of schooling	0.533***	0.574***	0.539***	0.521***	0.538***	0.553***	0.545***	0.552***	0.532***	0.528***
($\hat{\rho}$)	(0.022)	(0.018)	(0.020)	(0.016)	(0.014)	(0.014)	(0.015)	(0.013)	(0.013)	(0.013)
Observations	2,636	3,574	3,217	4,395	4,346	3,532	3,834	4,231	4,613	5,310
R-squared	0.281	0.329	0.292	0.274	0.294	0.310	0.299	0.305	0.279	0.284

Note: *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors in parentheses.

Table A5: State wise educational persistence among daughters (with respect to fathers) for 1962–1971 and 1982–1991 birth cohorts

	Birth cohort 1962-1971					Birth cohort 1982-1991				
	Sample size	$\hat{\beta}$	se($\hat{\beta}$)	$\hat{\rho}$	se($\hat{\rho}$)	Sample size	$\hat{\beta}$	se($\hat{\beta}$)	$\hat{\rho}$	se($\hat{\rho}$)
Andhra Pradesh	637	0.591	(0.074)	0.460	(0.058)	835	0.531	(0.039)	0.437	(0.032)
Assam	295	0.666	(0.078)	0.516	(0.060)	419	0.497	(0.045)	0.576	(0.052)
Bihar	431	0.471	(0.058)	0.564	(0.069)	680	0.700	(0.037)	0.684	(0.037)
Chhattisgarh	388	0.668	(0.050)	0.645	(0.048)	561	0.577	(0.043)	0.595	(0.044)
Delhi	317	0.545	(0.052)	0.521	(0.050)	492	0.385	(0.044)	0.416	(0.047)
Gujarat	660	0.711	(0.042)	0.612	(0.036)	896	0.789	(0.030)	0.733	(0.027)
Haryana	483	0.620	(0.057)	0.592	(0.054)	929	0.463	(0.035)	0.490	(0.037)
Himachal Pradesh	446	0.587	(0.044)	0.560	(0.042)	621	0.454	(0.036)	0.527	(0.041)
Jammu & Kashmir	252	0.702	(0.074)	0.605	(0.064)	463	0.515	(0.048)	0.517	(0.048)
Jharkhand	228	0.410	(0.072)	0.402	(0.071)	402	0.507	(0.058)	0.526	(0.060)
Karnataka	1,180	0.676	(0.036)	0.515	(0.027)	1,757	0.487	(0.027)	0.456	(0.026)
Kerala	546	0.555	(0.056)	0.549	(0.055)	460	0.443	(0.032)	0.559	(0.041)
Madhya Pradesh	829	0.554	(0.041)	0.565	(0.042)	1,264	0.577	(0.030)	0.565	(0.030)
Maharashtra	1,090	0.588	(0.036)	0.518	(0.031)	1,485	0.443	(0.021)	0.540	(0.026)
North East	276	0.626	(0.067)	0.590	(0.063)	416	0.450	(0.047)	0.500	(0.052)
Orissa	630	0.725	(0.044)	0.642	(0.039)	915	0.645	(0.037)	0.606	(0.035)
Punjab	605	0.554	(0.053)	0.499	(0.048)	816	0.569	(0.037)	0.628	(0.041)
Rajasthan	745	0.626	(0.039)	0.659	(0.041)	1,259	0.685	(0.028)	0.632	(0.026)
Tamil Nadu	640	0.708	(0.046)	0.560	(0.036)	676	0.518	(0.040)	0.545	(0.042)
Uttar Pradesh	1,045	0.525	(0.038)	0.551	(0.040)	1,823	0.513	(0.031)	0.496	(0.030)
Uttarakhand	129	0.432	(0.077)	0.488	(0.087)	229	0.545	(0.058)	0.574	(0.061)
West Bengal	750	0.629	(0.031)	0.639	(0.032)	969	0.601	(0.031)	0.590	(0.030)

Notes: $\hat{\beta}$ and $\hat{\rho}$ are regression and correlation coefficients. Sample size is the number of daughter–father pairs used to estimate $\hat{\beta}$ and $\hat{\rho}$. The standard errors of the estimates are shown in parentheses.

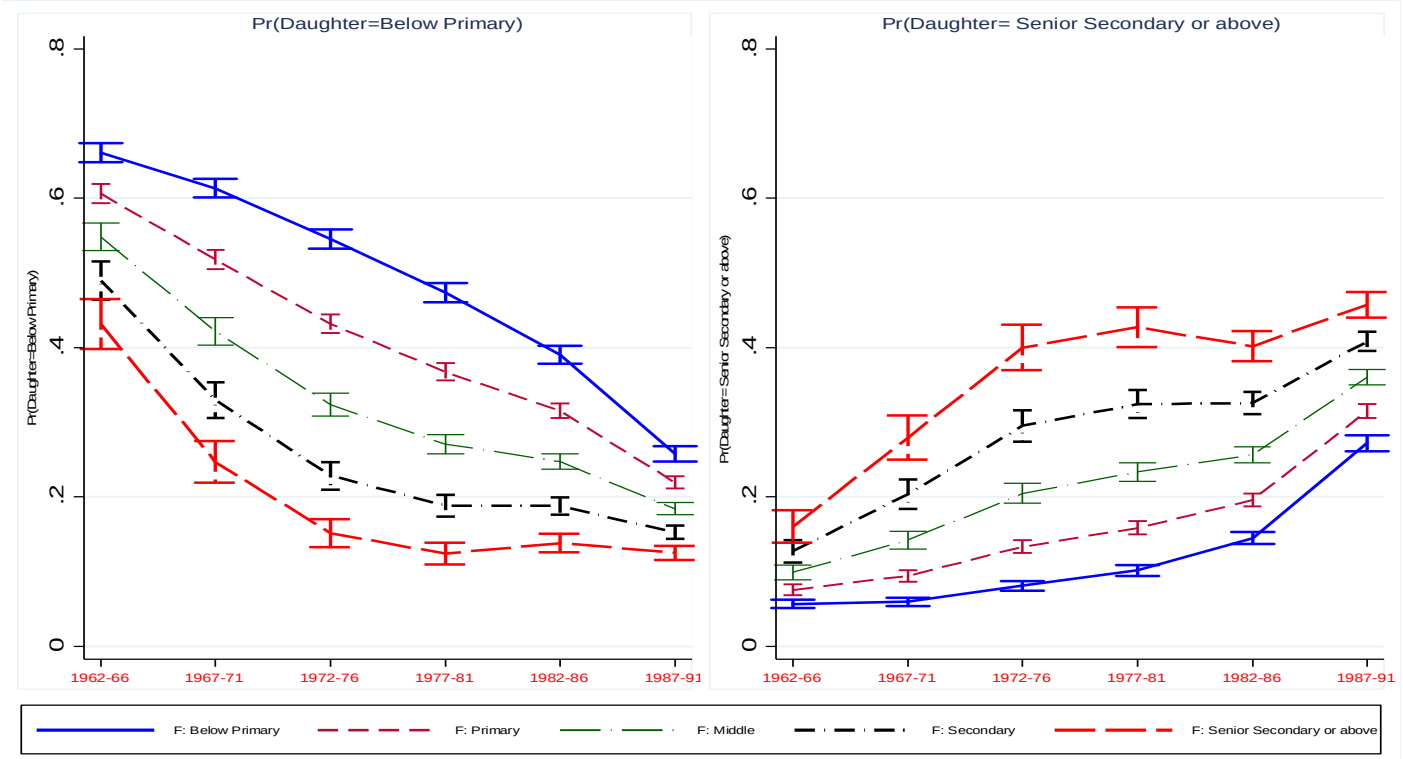
Table A6: State wise educational persistence among daughters (with respect to mothers) for 1962–1971 and 1982–1991 birth cohorts

	Birth cohort 1962-1971					Birth cohort 1982-1991				
	Sample size	$\hat{\beta}$	se($\hat{\beta}$)	$\hat{\rho}$	se($\hat{\rho}$)	Sample size	$\hat{\beta}$	se($\hat{\beta}$)	$\hat{\rho}$	se($\hat{\rho}$)
Andhra Pradesh	637	0.894	(0.119)	0.420	(0.056)	835	0.666	(0.047)	0.381	(0.027)
Assam	295	0.804	(0.137)	0.433	(0.074)	419	0.555	(0.050)	0.546	(0.049)
Bihar	431	0.745	(0.121)	0.490	(0.079)	680	0.915	(0.051)	0.601	(0.033)
Chhattisgarh	388	1.073	(0.122)	0.597	(0.068)	561	0.789	(0.060)	0.507	(0.038)
Delhi	317	0.967	(0.068)	0.596	(0.042)	492	0.405	(0.034)	0.414	(0.035)
Gujarat	660	0.956	(0.068)	0.556	(0.039)	896	0.794	(0.031)	0.684	(0.027)
Haryana	483	1.109	(0.101)	0.553	(0.051)	929	0.542	(0.042)	0.424	(0.033)
Himachal Pradesh	446	0.930	(0.072)	0.445	(0.034)	621	0.550	(0.039)	0.507	(0.036)
Jammu & Kashmir	252	1.036	(0.116)	0.472	(0.053)	463	0.436	(0.044)	0.356	(0.036)
Jharkhand	228	0.915	(0.186)	0.390	(0.079)	402	0.752	(0.062)	0.522	(0.043)
Karnataka	1,180	0.912	(0.045)	0.525	(0.026)	1,757	0.564	(0.031)	0.442	(0.025)
Kerala	546	0.640	(0.050)	0.579	(0.045)	460	0.474	(0.029)	0.647	(0.039)
Madhya Pradesh	829	1.058	(0.073)	0.547	(0.038)	1,264	0.735	(0.037)	0.538	(0.027)
Maharashtra	1,090	0.809	(0.056)	0.428	(0.030)	1,485	0.524	(0.023)	0.544	(0.024)
Meghalaya	276	0.783	(0.074)	0.589	(0.056)	416	0.528	(0.044)	0.552	(0.046)
Orissa	630	0.928	(0.132)	0.529	(0.075)	915	0.792	(0.047)	0.561	(0.033)
Punjab	605	0.764	(0.065)	0.438	(0.037)	816	0.601	(0.035)	0.599	(0.035)
Rajasthan	745	1.230	(0.091)	0.584	(0.043)	1,259	0.909	(0.044)	0.511	(0.025)
Tamil Nadu	640	0.868	(0.055)	0.523	(0.033)	676	0.565	(0.037)	0.534	(0.035)
Uttar Pradesh	1,045	1.111	(0.070)	0.516	(0.033)	1,823	0.697	(0.036)	0.459	(0.024)
Uttarakhand	129	0.516	(0.232)	0.276	(0.124)	229	0.518	(0.064)	0.444	(0.055)
West Bengal	750	0.924	(0.039)	0.626	(0.027)	969	0.787	(0.035)	0.605	(0.027)

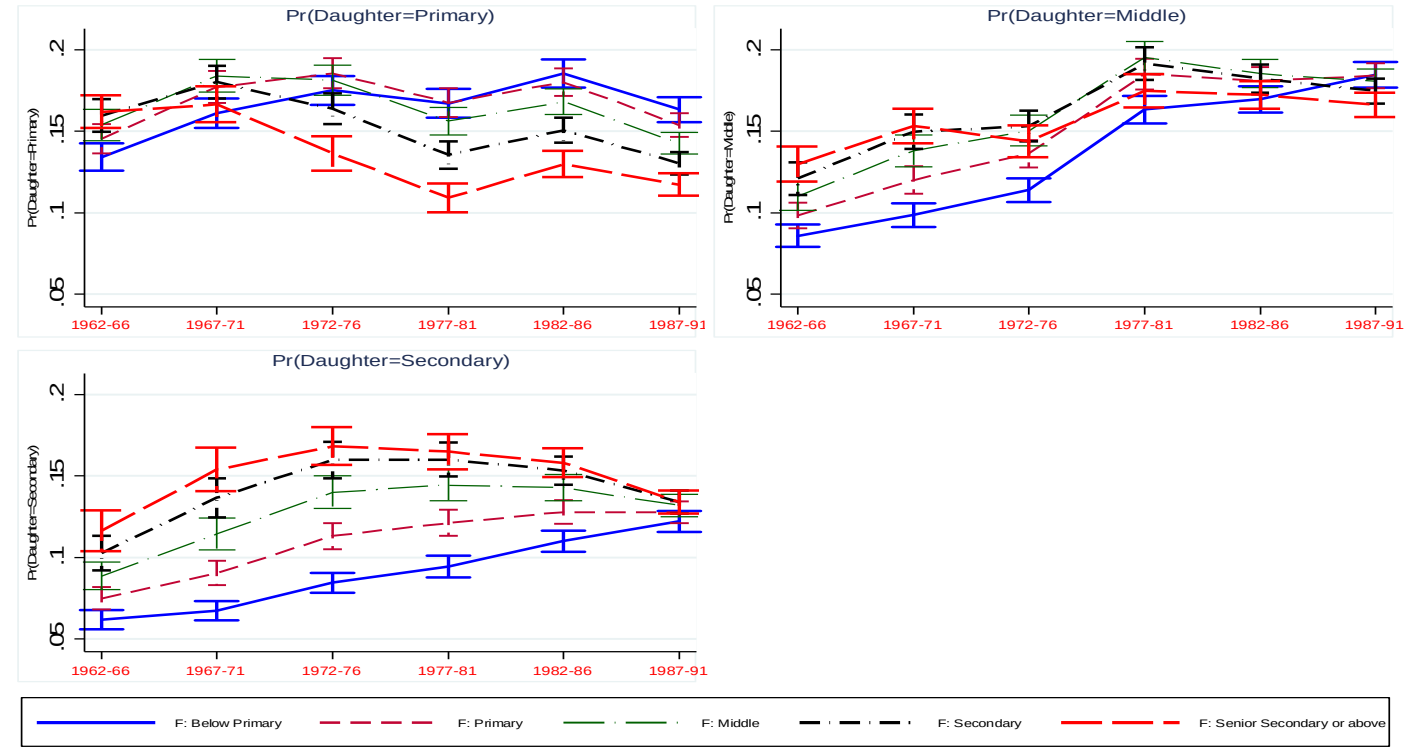
Notes: $\hat{\beta}$ and $\hat{\rho}$ are regression and correlation coefficients. Sample size is the number of daughter–mother pairs used to estimate $\hat{\beta}$ and $\hat{\rho}$. The standard errors of the estimates are shown in parentheses.

Figure A1: Probability of daughters education conditional on mothers' education

Panel-1

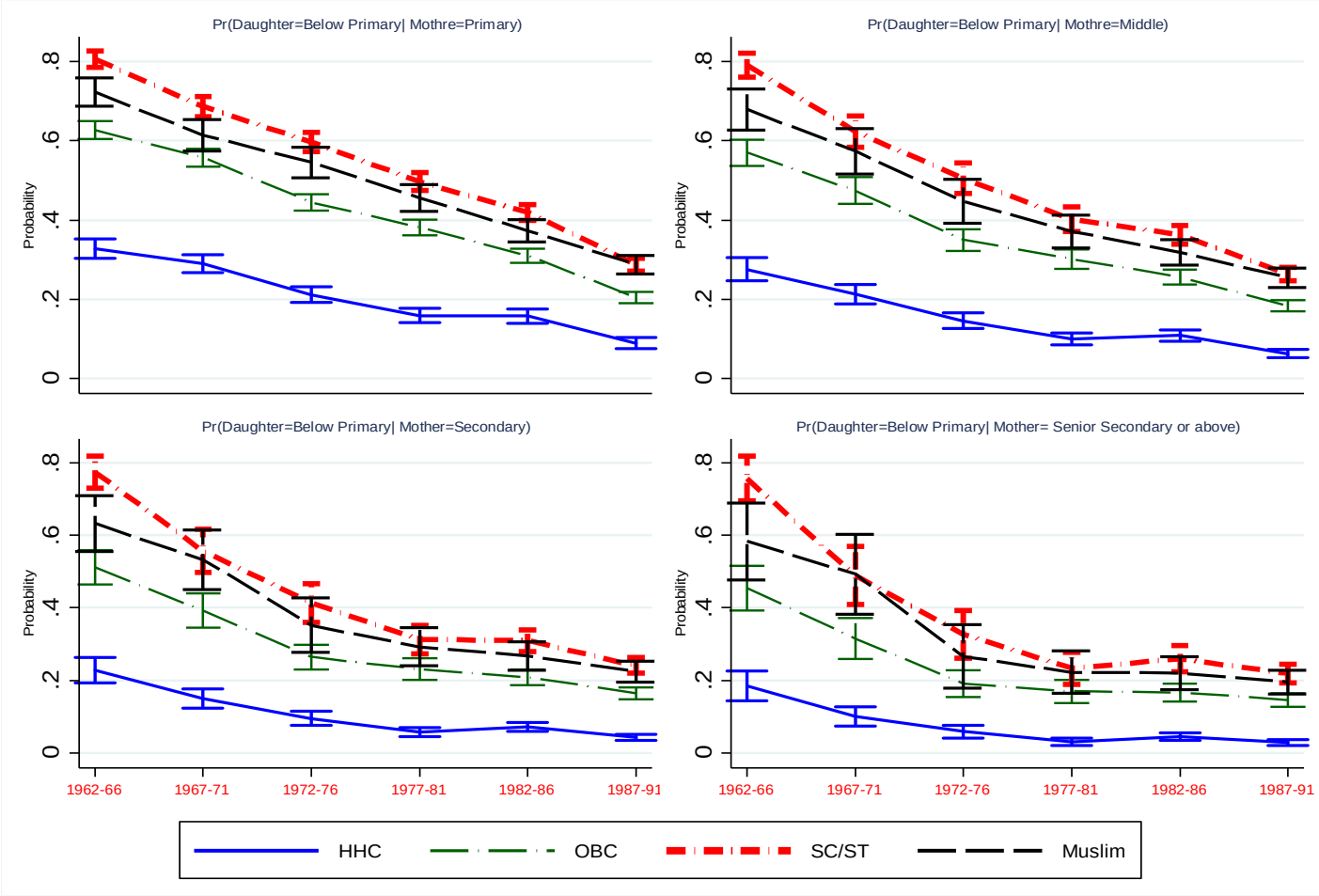


Panel-2



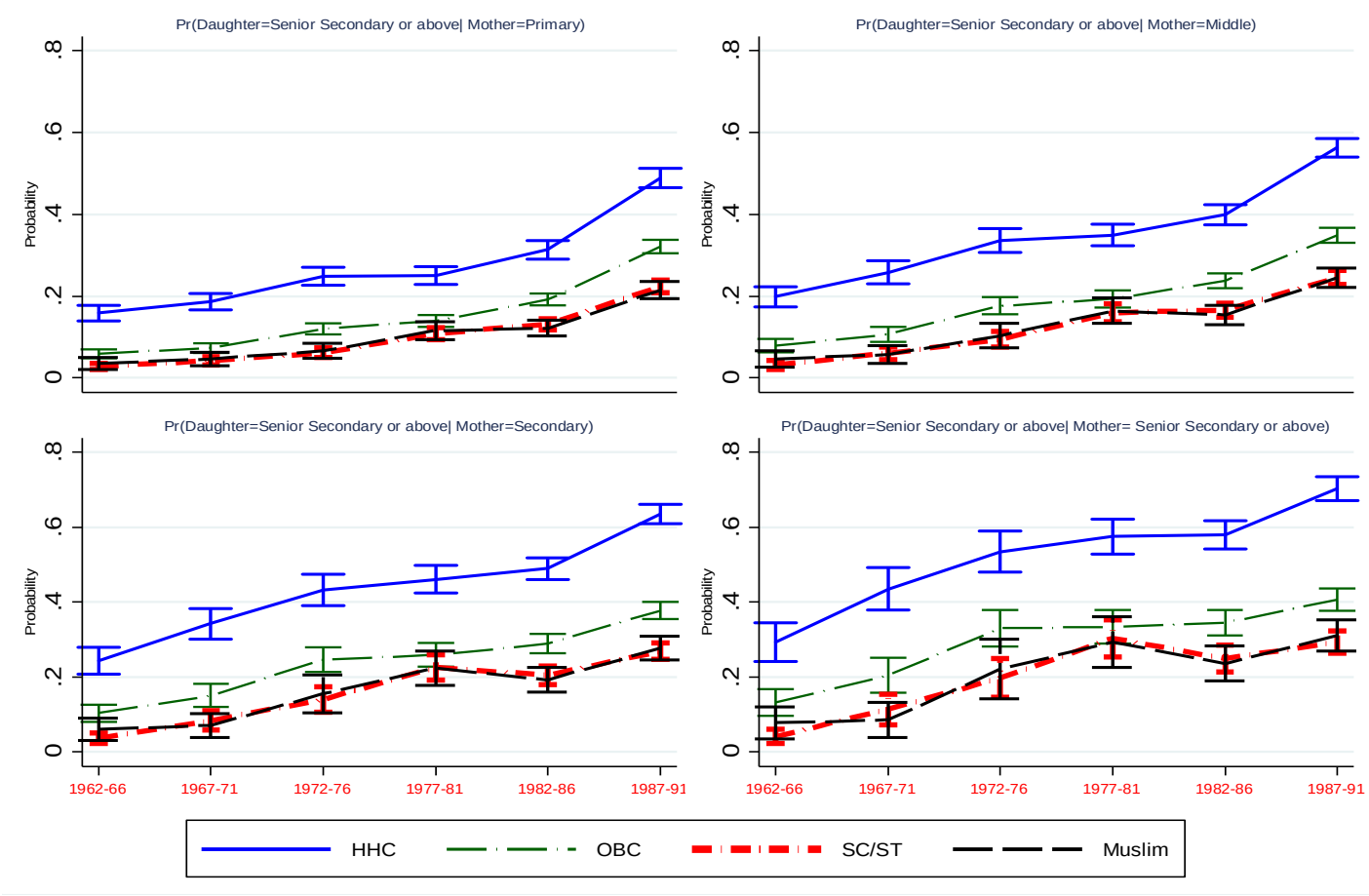
Note: The caps represent 95% confidence intervals.

Figure A2: Probability of daughters achieving Below Primary conditional on mothers' education by caste



Note: The caps represent 95% confidence intervals. HHC = Higher Hindu Castes, OBC = Other Backward Castes, SC/ST = Scheduled Castes/Scheduled Tribes.

Figure A3: Probability of daughters achieving Post-Secondary conditional on mothers' education by caste



Note: The caps represent 95% confidence intervals. HHC = Higher Hindu Castes, OBC = Other Backward Castes, SC/ST = Scheduled Castes/Scheduled Tribes.