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Gender Differentials in Literacy in India: The Intriguing Relationship with Women's Labor Force Participation

APARNA SUNDARAM and REEVE VANNEMAN *
University of Maryland, College Park, USA

Summary. — Contrary to expectations from either human capital or gender empowerment perspectives, analyses across 409 Indian districts show that girls have relatively lower literacy compared to boys in areas where more women are in the labor force. The most likely explanation is that areas with higher women's labor force participation are also areas with higher girls' labor force participation; these higher rates of girls' labor depress their literacy and education. Gender inequalities in literacy are therefore an exception to the usual egalitarian impacts of women's labor force participation and remind us again of the multidimensionality of gender inequalities.

Key words — Asia, India, gender, women's labor force participation, literacy, spatial autocorrelation

1. INTRODUCTION

Women's participation in the labor force has long been central to research on gender inequalities (Boserup, 1970). Much of this research has sought to understand how labor force participation contributes to women's status and to the reduction of gender inequalities. General models of gender inequality (e.g., Chafetz, 1984) tend to emphasize the importance of women's economic roles in determining their position in other spheres, from household bargaining to representation in state governance. Empirical research has found that women's labor force participation is associated with less bias against girls in child mortality (Kishor, 1993; Rosenzweig & Schultz, 1982), better health for girls (Thomas, 1994), and with more say in some household decision making (Dharmalingam & Morgan, 1996; Jejeebhoy & Sathar, 2001; Malhotra & Mather, 1997). Of course, many conditions may limit the liberating impacts of work outside the household (e.g., who controls the income from such work), and, even in the best of circumstances, outside work usually implies a dual burden for wives and mothers.

Nevertheless, it is less often asserted that women's labor force participation actually restrains women's progress toward gender equality. The results we demonstrate below illustrate one such circumstance when higher rates of women's labor force participation contribute to less rather than more gender equality: more women's labor force participation may lead to girls being withdrawn from school and put to work; the frequency of girls' work may restrict their schooling, which widens the gender gap in basic education. None of these linkages (from women's work to girls' work, or from girls' work to less schooling, or even from less girls' schooling to wider gender gaps in educational attainment) is inevitable. Under

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Table 1. *Literacy rates in percents for all ages combined, by sex: India, 1961–2001*

Year	Total percent	Women percent	Men percent	Percentage point difference	Difference in log odds ratios
1961	22.2	11.6	32.1	20.5	−1.3
1971	27.8	17.2	37.7	20.5	−1.1
1981	34.6	23.1	45.4	22.3	−1.0
1991	42.1	31.1	52.3	21.2	−0.9
2001*	65.4	54.2	75.8	21.7	−1.0

Source: Vanneman and Barnes (2003).
* Census of India, 2001.

many conditions, we would expect women's labor force participation to encourage more, not less, education for girls. Nevertheless, the general pattern we review across India provides a cautionary message and reminds us once again of the multidimensionality of gender stratification.

Understanding the multidimensionality of gender stratification (Mason, 1986) also helps us think about other gendered consequences of women's labor force participation. Similar analyses to the one we describe below have demonstrated that women's labor force participation rates lower gender gaps in child mortality (Kishor, 1993). However, while the frequency of women's work may increase girls' economic value, which has positive benefits for their survival (Rosenzweig & Schultz, 1982), girls' economic value may also increase their parents' incentives to keep them out of school to maximize their immediate economic returns. Each dimension of gender inequality requires separate theoretical models; a global construct of gender equality may only interfere with our understanding of how gendered outcomes are generated.

(a) *Literacy*

This analysis focuses on the gender gap in literacy in India. The importance of literacy need not be stressed—it is an end in itself. Moreover, literacy and schooling are important determinants of economic growth (Barro, 2001) and women's education may be especially important for future growth (Klasen, 2002; World Bank, 2001). Within societies, education levels are a principal determinant of adult outcomes: if women are disadvantaged in schooling, that disadvantage will ripple through the entire system of gender stratification (Hill & King, 1993).

While overall literacy levels in India are low (65% of the total adult population in India was literate in 2001), women fare worse than men: in 2001, only 54% of the women were literate compared to 76% of the men. The gap between men and women's literacy has been remarkably stable over the last forty years. Table 1 presents Census data since 1961. The two indices of the gender gap (the percentage point difference and the logged gender odds ratios) tell somewhat different stories. For instance, the percentage point difference indicates that the gender gap in literacy worsened in the 1961–71 period. However, the gender odds ratio indicates that the relative odds of literacy *improved* for women in this time. The absolute difference between male and female literacy percentages can be a misleading indicator since it is necessarily small when literacy rates are low (or high). The gender difference in odds ratios avoids this problem. The use of the odds ratio is also consistent with the general practice of logistic regressions. For these reasons, gender differences are measured throughout this analysis using the difference between girls' log odds of literacy and boy's log odds of literacy (see Tables 2 and 3).

Most states in India, including Kerala, have more literate males than literate females. But the gap between women and men (or between girls and boys) varies widely across the country so we can ask what is different about the areas with smaller gaps from the areas with enormous gender gaps?

(b) *The consequences of women's labor force participation*

Hypothesis 1. Areas with more equal labor force participation by women will also be areas with more equal literacy rates for girls.

At least three overlapping paths may link women's labor force participation to reduced gender inequalities in education. Education is, at least in part, a family investment in their

Table 2. *Gender difference in the log odds of literacy in India: selected states, 1991*

State	Gender gap in literacy
Kerala	−0.13
Punjab	−0.44
Assam	−0.45
West Bengal	−0.49
Tamil Nadu	−0.74
Karnataka	−0.75
Maharashtra	−0.77
Andhra Pradesh	−0.81
Orissa	−0.85
Madhya Pradesh	−0.97
Gujarat	−0.98
Bihar	−1.03
Himachal Pradesh	−1.05
Haryana	−1.07
Uttar Pradesh	−1.08
Rajasthan	−1.61

Source: Vanneman and Barnes (2003).

children's human capital: where both women and men are employed, there is an economic incentive to educate both girls and boys. Even if the income returns to human capital are weaker for working women than for working men, and even if there are other non-employment incentives for educating girls (e.g., their increased value in a marriage market), the additional incentive of returns to schooling in the labor market should lead to a positive association between women's labor force participation and women's schooling, other factors being equal.

Second, general theories of gender stratification emphasize the strengthened bargaining position of women who have independent access to economic resources, enabling them to better resist some aspects of patriarchal domination. Labor force participation usually implies expanded network ties and independent exposure to the broader society that also raises women's bargaining position both within and outside the household. For instance, a study by Dharmalingam and Morgan (1996) on two villages in South India showed that in the village where women's labor force participation was high, women were more likely to have greater mobility, have greater spousal communication, and better control over their households' resources compared with the village where women's labor force participation was low.

These conflict models apply best for adult inequalities. Nevertheless, if we assume that mothers are more apt than fathers to bargain for their daughters' schooling, then mothers' increased bargaining power through economic empowerment might lead to more schooling for their daughters (Thomas, 1994).

A broader, contextual argument traces gender inequalities in schooling to general cultural evaluations of women's worth, which may be improved by women's labor force participation. This more indirect influence depends less on the interpersonal dynamics within households and more on the general expectations of equal treatment in the society. To the extent that these general expectations of equality are influenced by economic roles such as labor force participation, we would expect

Table 3. *Means and standard deviations for the variables used in the analysis: districts in India, 1991*

Variable	*N*	Mean	Std. Dev.	Minimum	Maximum
Gender difference in log literacy odds	409	−0.94	0.44	−2.38	0.16
Gender ratio adult main: non-main	409	−2.26	0.95	−4.98	−0.30
Odds of women being in exogamous unions	409	1.66	0.92	−0.27	4.48
Log ratio boys' literacy/illiteracy 10–14	409	1.47	0.99	−0.44	4.82
Education effort	409	27.22	11.84	8.52	84.09
Housing index	409	35.33	14.38	4.77	88.88
Percent urban in a district	409	21.73	16.66	0.00	100.00
Percent landless in a district	409	36.34	18.11	1.03	81.13
Percent SC in a district	409	16.13	7.56	0.00	51.76
Percent ST in a district	409	10.47	17.88	0.00	94.75
Percent Muslims in a district	409	11.08	11.50	0.07	70.45
Southern states	409	0.20	0.40	0.00	1.00
Log ratio 0–14 boys, main/non-main	409	−3.10	0.70	−6.10	−1.56
Log ratio 0–14 girls, main/non-main	409	−3.77	1.06	−6.47	−1.76

Source: Vanneman and Barnes (2003).

more equal access to schooling for girls and boys.

On the other hand, women's labor force participation is undoubtedly itself influenced by these broader cultural patterns. Thus, where women's independent mobility outside the home is culturally restricted, labor force participation is more unlikely. These mobility restrictions may also affect girls, especially adolescent girls', access to schools. Thus, a positive relationship between women's labor force participation and girls' education may result from their common determination by cultural restrictions on women's free mobility.

(c) *Child labor and schooling*

Hypothesis 2a. Improved odds of female labor force participation will increase rates of girl child labor.

Hypothesis 2b. Areas with high rates of girls' labor force participation will have lower rates of girls' literacy.

While there may be several reasons to expect women's labor force participation to increase girls' education, it could interfere with girls' access to schools if women's labor force participation implies girls' labor force participation or more housework for girls, and if girls' labor-force participation or increased housework reduces their schooling opportunities. There is substantial debate about the relationship between child labor and access to schooling. After an initial public outcry against child labor in developing countries (for a discussion on this see Anker, 2000; Basu, 1999), more careful observers noted that child labor is not necessarily incompatible with schooling (Patrinos & Psacharopoulos, 1997; Probe Team, 1999). Even in the United States, adolescents often are employed and there is little evidence that this youthful employment has negative consequences for their adult outcomes (Carr, Wright, & Brody, 1996).

On the other hand, some types of labor force participation undoubtedly constrain children's access to school. Where girls' labor can contribute to the household's economic standing, parents, especially poor parents, will be tempted to keep their children out of school in order to maximize their immediate economic returns (Basu & Van, 1998; Basu, 1999; Cigno & Rosati, 2000). In this paper, we hypothesize that women's participation in the labor force does pull girls into the official labor force or into more unrecorded domestic and productive work and thus lowers their rate of schooling. Previous research indicates that when women work and earn a wage, girls' labor force participation increases at the cost of their schooling (Basu, 1992; Emerson & Souza, 2003; Levison, Moe, & Knaul, 2000; Ray, 2000). Conversely, Ravallion and Wodon (2000) show that subsidy-induced increases in Bangladeshi children's schooling did result in some decline in their likelihood of working. Thus, women's labor force participation could lead to greater not smaller gender gaps in access to schooling through its effects on girls' labor force participation.

When children are not employed directly in the paid labor force, they are generally expected to help with (often gender segregated) household chores. Where mothers work outside the home, it is likely that daughters are called on to provide more household help, and this extra household burden may also interfere with girls' education. Therefore, a more comprehensive approach to the effect of women's labor force participation would consider both daughters' household labor and their employment (Basu, 1992; Levison et al., 2000). Our data, however, do not allow us to measure children's domestic work, but we would expect similar and probably more dramatic results if these measures were available.

In addition, much of children's non-domestic work goes unrecorded in official censuses and surveys. For instance, girls' collection of fuel wood and crop residues or boys' supervision of household animals is rarely counted in most official statistics but contributes to the household economy and can require a substantial time commitment that makes attending school and completing schoolwork more difficult. Even children's work in their family's fields or at the family store may be intermittent and go unrecorded in government statistics but may be important during peak demands. Family expectations that children contribute to this work may take precedence over attending school.

While it would improve analyses if we had better measures of children's work, this problem may not be so great in area-level analyses if the extent of this unrecorded and domestic work co-varies with the officially recorded employment. This seems likely to be the case especially for girls' work, where even moderate

rates of girls' employment suggest an absence of the cultural proscriptions against children's work that would affect unrecorded and perhaps domestic work as well.

(d) *Cultural determinants of gender gaps in literacy*

Hypothesis 3. Areas with patriarchal family systems will have larger gender gaps in literacy.

Culture matters as well as economics, and because the two often covary, their roles need to be evaluated independently. While the primary focus of the analysis is on the relationship of girls' and women's labor force participation with girls' schooling, gender differentials in India also reflect family and marriage practices that vary widely across the country. A general cultural attitude endorsing patriarchy, based for instance in religious traditions or in political ideology, may influence gender gaps in literacy as it would other gendered aspects of social life. If cultural practices and beliefs consistently emphasize women's subordinate position, parents will follow custom by educating boys first. Often, specific cultural practices such as the seclusion of women and prohibitions on their free movement will directly limit girls' ability to attend schools (and to work outside the home).

Indian gender stratification, in particular, is interpreted with such cultural schema (Dyson & Moore, 1983; Miller, 1981; Sopher, 1980). The rough geographic division between North and West versus South and East has long been recognized as a cultural line dividing more patriarchal from more egalitarian gender relations. This geographic division may reflect the differential penetration of ancient patriarchal cultures into the subcontinent. The North–South division also describes a variety of family patterns that may underlie women's relative position. In India, patrilocal village exogamy may be especially relevant for a broad range of gendered outcomes in India. When parents expect to see their adult daughters only rarely and rely on eventual support from their adult sons, village exogamy and patrilocal residence combine to reinforce patriarchy (Kishor, 1993). It is not surprising that in these circumstances parents' investments in their sons take priority over investments in their daughters. Literacy may be seen as dispensable for daughters but essential for sons. Therefore, areas with high levels of patrilocal exogamy should be characterized by larger gender gaps in literacy.

Besides exogamy, dowry practices, decision making within the family, and seclusion of women are other aspects of a patriarchal culture that could have broad implications for gender relations, including educational outcomes. These patterns of gender relations within the family are difficult to measure with existing data and so are not specified as separate hypotheses here. We assume that the elements of this patriarchal family pattern tend to cluster together so that our measure of family exogamy probably proxies for the entire set of family differences. Thus, the relationships with marriage exogamy should not be interpreted too narrowly as the outcome of one custom alone.

(e) *Development effects on gender gaps in literacy*

Hypothesis 4. More developed areas will have more gender equal literacy rates.

Neo-classical and modernization theorists often posit that inequalities between men and women will erode with development (Knodel & Jones, 1996; Wils & Goujon, 1998). Beutel and Axinn (2002), for instance, hypothesize that family roles become less important with the spread of modern institutions (schools, wage labor, transportation infrastructure) so that gender differentiation declines with the decline of the family. These modernization theories have been controversial and several studies have shown that gender inequalities are resilient to economic development (Beneria & Sen, 1981; Forsythe, Korzeniewicz, & Durrant, 2000; Kabeer, 1994). If we make a distinction between women's (absolute) status and their (relative) position in the gender stratification system, there may be little expectation of reduced gender gaps with increased development, at least at the early stages of economic growth (Dollar & Gatti, 1999). Gender inequalities may be embedded in the social and cultural structure of the society that is largely unaffected by economic wealth. In fact, because increasing wealth permits more families to enact patriarchal ideals in their daily lives, increasing wealth can sometimes aggravate gender gaps in the society. In India, for instance, the wealthiest areas have experienced the biggest increases in sex selective abortions because those are the

places where sonograms are affordable and most widespread (Arnold, Kishor, & Roy, 2002).

Even when development may not imply any direct changes in the gender system itself, the additional resources available in wealthier societies may still affect the gender gaps in schooling. When families and educational systems follow a gender queuing model of access to schools, more resources may lead to a declining gender gap once the male queue diminishes. The queuing effect suggests that even in areas where son preference is strong and patriarchal norms are entrenched, there might exist a queue for resources with boys at the head of the queue and girls at the back. As resources expand with economic development, girls move to the head of the queue after the boys' queue is exhausted. Since families reach this stage at different times and since other factors enter into the schooling decision, a queuing model does not imply that *all* boys are educated before any girls. However, the queuing model does suggest that the extent of boys' schooling will influence how many girls gain access. While early in the process, the gender gap may widen because boys are the head of the queue, as queues shorten, more education will imply more girls' education.

A model in which girls' education is determined largely by demands of the marriage market predicts a similar result: male college-educated engineers should not marry illiterate wives. So, as boys' education increases, families will be under pressure to educate daughters (although not as much as sons) in order to find suitable matches. In addition, mother's home-teaching roles supplement school based education for their sons and raise the demand for female education (Behrman, Foster, Rosenzweig, & Vashishtha, 1999). Again, girls' educational levels would be driven in part by boys' levels in these models.

The lack of effort at improving educational access may also have an impact on the gender gap in literacy (Banerji, 1997; Dreze & Saran, 1995; Visaria, Gumber, & Visaria, 1993). When there is a scarcity of school resources, it is likely that boys receive access to these scarce resources ahead of girls. However, as educational resources expand, girls begin to benefit. This suggests that in areas where the extent of education is more widespread, the gender gap in literacy will be narrower.

Finally, development may imply not only a higher standard of living but also a closer integration into a world cultural system (Meyer, Ramirez, & Soysal, 1992). To the extent that the world cultural system assumes gender equal access to schools, then educational systems in developing nations will be constrained to incorporate both boys and girls as they become more integrated into the global culture.

2. METHODS

Our hypotheses concern systems of gender equality reflecting macrolevel influences that may or may not be mediated through household level differences. For example, in societies where most women are employed, parents may recognize the advantages of educating daughters, even if the particular mothers of those daughters are not themselves employed. The household characteristics may intensify the relationships, but may not exhaust them. The macrolevel relationships are probably some mix of contextual and household compositional effects. It is not our purpose at this stage to evaluate the relative contributions of those two types of effects but rather to identify the overall macrolevel relationships themselves. We therefore use macrolevel data, not as a substitute for household level data, but as the appropriate level of analysis for our system level hypotheses.

We use district level data from the 1991 Indian Census [1] (Vanneman & Barnes, 2003). Indian states are subdivided into administrative units called districts. In 1991, a district had an average population of about 2,000,000 persons and was about 5,000 km^2 in size. Nine small states and union territories are treated as single districts. [2] The census was not taken in Jammu and Kashmir in 1991. This leaves 409 districts in the analysis.

Spatial autocorrelation is a substantial problem for Indian districts as it is for most geographic analyses. Literacy rates in the Gangetic plain are likely to be similar but different from those in Kerala or those in the Himalayas, even after adjusting for the measurable determinants. Adjacent Indian districts are not independent units, as OLS would assume. The principal dependent variable analyzed here has a spatial autocorrelation, Moran's I, of 0.68 across adjacent districts. Consequently, the results reported here incorporate a control for this spatial autocorrelation using maximum likelihood estimation techniques (Doreian, 1981). We adopt a spatial disturbance model

using methods specified by Ord (1975) that calculate a log likelihood function incorporating alternative estimates of the spatial autocorrelation of the residuals across adjacent districts. The autocorrelation estimate that minimizes this function is selected and then used to calculate the coefficients and their standard errors.

(a) *Dependent variables*

The Indian census defines a literate person as one who can "both read and write with understanding in any language..." In operation, the census mostly accepts the household's own claims to literacy without testing for understanding. Partly because of this minimal requirement, we supplement our analyses with an examination of gender differentials in matriculation from secondary school. There may be additional reasons why the gender inequalities at matriculation may differ from the literacy differentials. Cultural restrictions on adult women's mobility might restrict adolescent girls' school attendance but have less impact on younger girls' primary education.

We have measured the gender gap in literacy by comparing the logged odds of girls 10–14 being literate with the logged odds of boys 10–14 being literate:

$$L_j = \mathrm{Ln}\left[\frac{(F_{\mathrm{literate}}/F_{\mathrm{illiterate}})_j}{(M_{\mathrm{literate}}/M_{\mathrm{illiterate}})_j}\right]$$

where

L_j = The sex difference in literacy.
$F_{\mathrm{literates}}$ = Number of literate girls in age groups 10–14.
$F_{\mathrm{illiterates}}$ = Number of illiterate girls in age groups 10–14.
$M_{\mathrm{literates}}$ = Number of literate boys in age groups 10–14.
$M_{\mathrm{illiterate}}$ = Number of illiterate boys in age groups 10–14.

As noted in the discussion of national literacy rates (Table 1), the difference in logged odds has some advantages over the difference in percentages since it is not mathematically constrained to be small when literacy rates are very low or high. These constraints could be important for Indian data since literacy rates vary so widely across the country. For example, if boys are 95% literate and girls 90% literate, there is only a five percentage point difference, but illiteracy is still *twice* as common for girls. The difference in logged odds captures these gender inequalities better at the high and low literacy levels than does the percentage difference. For example, the 90–95% difference is equivalent in log odds to a 50–68% difference at lower literacy levels.

The 10–14-age category specifies a group who would have acquired literacy recently, reflecting current conditions in the district. Yet, this is still an age by which most people are likely to have acquired literacy. Across India, 69% of the 10–14 age group are literate compared to 57% in the 7–9 age group, 64% in the 15–19 age group, and 56% in the 20–24 age group.

In 1991, 60% of Indian girls 10–14 were literate, compared to 77% of Indian boys. The girls' odds of being literate (1.48:1) were less than half the boys' odds (3.35:1). The odds varied widely across India. In several Kerala districts where children's literacy was nearly universal, girls had a slight advantage over boys. In the Northeast predominantly tribal state of Meghalaya, girls' literacy, 59%, also exceeded boys' literacy, 57%. But in most districts, girls' literacy lagged behind boys'. The largest gaps were found in Rajasthan; in Jalaur district, for instance, 63% of boys were literate compared to only 14% of girls.

(b) *Independent variables*

(i) *Female share of the labor force*

Calculations of women's labor force participation rates are sensitive to the definitions of the labor force. The Indian Census includes two measures of labor force participation. "Main workers" are defined as those who were "economically productive" (i.e., not household work or production for household consumption) for the major part of the year. "Marginal workers" are those who worked during the past year but for less than six months. The marginal worker category typically includes a higher proportion of women and children than does the main worker category. We report the results of the analyses using the main worker definition. We also re-calculated the analyses using the broader definition that includes both main and marginal workers; the results are almost identical.

On average, 21% of the labor force is female, but this varies from about 2% in western Uttar Pradesh (UP) districts to over 45% in the hill districts of Uttaranchal. We use a ratio measure of women's share of the labor force rather than the simpler labor force participation rate. In practice, the two are highly correlated. Because men's labor force participation rates vary only

slightly across India, the gender ratio (or female share) is determined primarily by women's odds of labor force participation. But a few areas do have somewhat lower rates of male labor force participation (e.g., Kerala) than others, so a simple measure of women's odds of labor force participation does not reflect the relative gender equality in participation rates in those areas. A gender ratio therefore captures somewhat better the relative importance of women in the labor force. Our measure is the ratio of adult (i.e., age 15 and over) women's odds of being main workers relative to adult men's odds.

Relative odds of female labor force participation =

$$\ln\left[\frac{\text{adult female workers}_{\text{main}}/\text{adult female non-workers}}{\text{adult male workers}_{\text{main}}/\text{adult male non-workers}}\right]$$

(ii) *Child labor*

The Indian Census reports the number of children 5–14 who are full-year or part-year (marginal) workers. We calculate the odds of girls and of boys being full-year workers, but have also tested the broader, marginal worker, measure. Children were not defined as either main or marginal workers if they were "primarily a student, even if such a person helped in the family economic activity." Thus, the Census measures are quite conservative. Across India, only 4% of children were recorded as being full-year workers and an additional 1% as marginal workers. Boys (mean = 5%) are more likely to be working than girls (3.5%).

Child labor rates vary across the country. The highest levels of girl child labor are in Bellary in Karnataka (15%) and in Karimnagar in Andhra Pradesh (14%), while the lowest levels of girl child labor are in Lakshadweep (0.1%) and in Mainpuri in UP (0.1%). The highest levels of boy child labor are in Jhabua in Madhya Pradesh (17%), while the lowest levels of boy child labor are in Kannur in Kerala (0.2%).

While these census rates are low, we suspect the variation in these measures across India may also proxy for a range of work demands on children not captured in full-time labor force participation statistics. Part-time employment, unrecorded work, and perhaps household labor may co-vary with the census measures and these, too, may interfere with children's schooling.

(iii) *Patrilocal exogamy*

The Census provides no direct measure of exogamy. It is estimated by comparing the log odds for women migrating from their birthplace to the log odds for men

Exogamy

$$= \ln\left[\frac{\text{female migrants}/\text{female non-migrants}}{\text{male migrants}/\text{male non-migrants}}\right]$$

The counts of migrants do not distinguish by age or marital status, so both the numerators and denominators include young children who are unlikely to have moved. Nevertheless, the odds of women (and girls) having moved from their birthplace are on average four times as great as men's odds of moving. Exogamy is especially high in Bihar where several districts report over half of the women living in places other than their birthplaces (compared to only 1–2% of men). It is low in the Northeast where in several districts more men have moved than women. The exogamy measure is also low in the major metropolitan areas such as Calcutta, Mumbai, and Delhi reflecting the numbers of male migrants in those cities.

(iv) *Educational development*

Like gender stratification, development is a multidimensional concept. We have included two educational indicators and three economic indicators to capture various aspects of the developmental level of the district

Boys' literacy rate:

= We measure boys' literacy rate as

$$\ln\frac{\#\text{literate boys}_{10\text{–}14}}{\#\text{illiterate boys}_{10\text{–}14}}$$

This ratio is also the denominator of the left side dependent variable and so may at first seem questionable. By including the boys' ratio on both sides of the equation, we are effectively regressing girls' literacy rates, the numerator of the gender literacy ratio, on women's labor force participation and the other independent variables, holding constant boys' literacy. The coefficients and standard errors for women's labor force participation are identical if we include boys' literacy only on the right side or if we also incorporate it as the denominator on the left side. [3] We expect boys' literacy rates to affect the gender gap by affecting the queue for school resources, so boys' literacy may have a curvilinear impact on the gender gap

in literacy. Girls may benefit only after most boys have become literate. Hence, we also include the variable in its quadratic form.

(v) *Educational effort*

We have used the ratio of teachers per 1,000 children of school going age (5–14) as a measure of educational effort. On average, there are about 27 teachers for every 1,000 potential students in a district but this varies from 8 to 84 across the country.

(vi) *Economic development*

Two indicators of economic development are included in this analysis. First, the level of urbanization is measured as the number of persons living in an urban area as a proportion of the total district population

$$\text{Level of urbanization} = \frac{\#\text{persons in urban areas in a district}}{\text{total persons in district}}$$

On average about 22% of the people in each district live in urban areas, but this varies from no urban population in Lahul Spiti and Kinnaur in Himachal Pradesh to 100% urban in Calcutta, Mumbai, Hyderabad, and Chennai. In some preliminary models, we included the proportion of workers employed in manufacturing as a measure of economic development, but the proportion manufacturing is highly correlated with the level of urbanization and results suggested keeping the urbanization variable and omitting the proportion of workers in manufacturing.

Second, we constructed an index of housing quality by averaging the proportions of households with electricity, modern cooking fuel, finished floors, roofs and walls, toilets, and indoor taps. This index resembles a consumption goods ownership index that has been shown to reflect family wealth (Filmer & Pritchett, 2001). It is correlated 0.77 with urbanization.

We also experimented with a direct measure of poverty incomes as reported by the National Sample Survey (NSS) (see Murthi, Guio, & Dreze, 1995). The NSS reports these poverty rates for 75 regions, each of which combines several districts (Dubey & Gangopadhyay, 1998). We assigned the NSS region poverty score to each of these districts, so this is a less geographically detailed measure than the other development indices. Across districts, regional poverty is correlated −0.57 with housing facilities and −0.30 with urbanization. NSS poverty rates have no effect on literacy rates once the other development measures are controlled, so we have not reported these results here.

(vii) *Control variables*

In addition to the gender and development measures described above, we have included four other variables as controls in our model. Each variable represents a segment of the population (scheduled castes, tribals, Muslims, and landless) that might be related to gender-gaps in literacy at the household level. [4] It should be remembered that district-level data might not reflect household effects. Scheduled castes and tribals, being outside the strict Hindu codes of purity and patriarchy, may be freer to adopt gender equal norms within their households (for scheduled castes, see Srinivas, 1989; for tribals, see Agarwal, 1994; Beteille, 1986). Similarly, landless households may be too poor to observe the restrictions on women's mobility typical of more landed households, so this relative freedom may spill over into more gender equality for children's education as well. In contrast, it is sometimes asserted that Muslims are more conservative on gender issues than even higher caste Hindus, although this may depend on whether other household characteristics are held constant. There is no great variation across districts on any of these control variables except for the proportion tribal. Twenty-two districts out of the 409 have tribal majorities. Five districts are Muslim majority districts.

3. RESULTS

(a) *Independent variables*

Table 4 presents results for two models: with and without the controls for the extent of child labor. In the first model, without controls for child labor, girls in areas with a high female share of the labor force have a *lower* chance of becoming literate than in areas where women are less likely to be working. This is the opposite of hypothesis one and counter to what most theories of gender stratification would predict. Higher rates of women's labor force participation should protect girls from discrimination; instead, they appear to reduce girls' chances for literacy.

The paradox is clarified in the second model once controls are entered for the chance of boys and girls working. In areas where girls below 15

Table 4. *Maximum likelihood estimates of selected independent variables on the gender gaps in literacy: districts in India, 1991*

Variable	Model 1	Model 2
Constant	−1.349***	−1.072***
	(−9.34)	(−6.80)
Gender ratio adult main:non-main	−0.078**	0.191***
	(−3.12)	−4.47
Odds of women being in exogamous unions	−0.141***	−0.146***
	(−5.19)	(−5.81)
Log ratio boy's literacy/illiteracy 10–14	−0.233***	−0.175**
	(−4.39)	(−3.31)
(Log ratio boy's literacy/illiteracy 10–14)^2	0.052***	0.041***
	(4.62)	(3.82)
Education effort	0.008***	0.007***
	(3.98)	(3.65)
Housing index	0.005*	0.004†
	(2.13)	(1.96)
Percent urban in a district	−0.001	−0.000
	(−0.32)	(−0.30)
Percent landless in a district	0.006***	0.006***
	(5.18)	(5.40)
Percent SC in district	0.002	0.000
	(0.90)	(0.18)
Percent ST in district	0.002†	0.002†
	(1.81)	(1.89)
Percent Muslims in a district	0.001	−0.001
	(0.54)	(−0.77)
Southern districts	−0.079	−0.024
	(−1.07)	(−0.32)
Log ratio 5–14 girls main/non-main	–	−0.336***
		(−7.68)
Log ratio 5–14 boys main/non-main	–	0.285***
		(5.63)
Rho (Spatial autocorrelation)	0.818***	0.769***
	(26.37)	(21.31)

– Not applicable.
Note: Numbers in parentheses are t-statistics.
Source: Vanneman and Barnes (2003).
† $p < 0.1$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

enter the labor force, they have lower chances of becoming literate. Once girls' labor force participation rates are held constant, the coefficient for adult women's labor force participation flips to the expected positive sign and is statistically significant.

Girls work primarily in areas that already have high labor force participation rates for adult women ($r = 0.8$). This correlation between girls' and adult women's labor force participation is responsible for the negative association of adult women's work and girls' literacy as shown in model 1. That is, adult women's labor force participation appears to hurt girls' chances of literacy because it opens up the possibility for girls to work. The close association between adult women's and girls' employment probably results from joint determination by cultural restrictions on female mobility and by patterns of industrial demand for female labor in a gender segregated labor force. However, where adult women work and young girls do *not* (model 2), girls actually have a better chance of going to school and becoming literate than in areas where women do not work. This is what we would expect from most theories of gender stratification and from human capital models of returns to schooling. However, this effect is not strong enough to counterbalance the negative impact of girls' work that tends to come together with adult women working.

We need to be cautious in interpreting the negative coefficient for girls' work on girls' literacy as a causal effect. As we noted above, many have argued that it may be higher rates of girls working are a *consequence* of girls not going to school. Probably some of the negative relationship between girls' work and girls' literacy is a result of this effect of low schooling on more work. However, the high correlation between adult women's labor force participation and girls' labor force participation suggests that girls' work rates are determined primarily by cultural and economic factors and not from their schooling opportunities. The chance of girls' working is predicted quite well by the rates of adult women's work: where women work, girls are more likely to work too. We might even interpret the negative effects of adult women's labor force participation as shown in model 1 as an instrument for the effect of girls' labor force participation. It appears that girls' work rates reduce their literacy rates more than the reverse. Parents are more likely to keep their daughters at home from school if they can put them to work. As a result, model 1 documents an unusual finding in the gender stratification literature: higher rates of women's labor force participation actually *increase* some gender inequalities.

Alternative causal interpretations of the negative association of women's or girls' labor force participation and girls' schooling seem harder to sustain. Unmeasured cultural proscriptions on girls' or women's mobility outside the house would produce a positive, not a negative, association between work and schooling. Poor schooling opportunities that would reduce girls' education and increase girls' work

would not likely increase *adult women's* labor force participation. [5] The most plausible interpretation of the negative association of women's labor force participation and girls' education would seem to us the greater work (and household) demands on girls where their mothers are in the labor force.

The other indicator of gender stratification in the model, patrilocal exogamy, has the expected negative sign and is statistically significant. In areas of high patrilocal exogamy, girls are much less likely to be literate than boys. Parents' investment in a daughter's human capital is more likely when she lives in the same village after marriage.

As expected, girls' equality with boys' literacy rates follows a U-shaped relationship. Initially, as the odds of male literacy improve, girls' odds fall further behind and the gender gap widens. However, eventually, when boys' literacy rates pass a certain level, the odds of girls' literacy begin to catch up with boys' and the gender gap in literacy narrows. The point at which the gender gap begins to narrow can be estimated as the inflection point of the quadratic curve. These calculations reveal that when boys' literacy levels have reached 93%, the gender gap in literacy begins to decline. This result suggests that the queuing effect may be very strong. Only when almost all boys are literate does the gender gap begin to narrow.

Fortunately, other development effects tend to narrow the gender gap in literacy. Most interestingly, educational effort, as measured by the number of teachers in the district, has an important positive association with girls' literacy. The more teachers available, the lower the gender gap in literacy rates. Girls' education appears to be *especially* responsive to educational effort, a result that confirms findings from other countries (Filmer, 1999; Lloyd, El Tawila, Clark, & Mensch, 2001). Again, we need to be cautious about inferring a causal effect here since it is quite plausible that where daughters are sent to school, more teachers are required. But if some part of this association is due to the causal impact of schooling opportunities on girls' equality, this association has important policy implications: investments in education (teacher salaries are a majority of education expenses) not only raise overall literacy levels, but also tend to reduce gender inequalities in literacy.

District wealth also helps to reduce gender inequalities in literacy. Even controlling for investments in education and for the education of sons, households in wealthier areas are more likely to educate their daughters. These results are similar to the development effects on girls' school attendance found in household surveys in rural areas (Dreze & Kingdon, 2001). It is not clear what mechanism would be linking district wealth and gender equality once boys' literacy and educational effort are controlled. The positive coefficient may even reflect the endogeneity of wealth: educating women produces more wealth (World Bank, 2001), so the causal direction may flow from gender equality to wealth.

The only development measure that is unrelated to gender equality is urbanization. While it is true that girls in urban areas do have higher literacy rates that are closer to boys' rates, this is a function largely of greater wealth and secondarily of more teachers. Beyond these greater resources found in cities and towns, there is no tendency toward more equal schooling of boys and girls because of urban life. [6]

(b) *Control variables*

Of the remaining variables, percent landless has the strongest relationship with the gender gap in literacy. As predicted, areas with high landlessness are associated with more equal odds of boys' and girls' literacy. In India, groups that are more dominant tend to be more patriarchal, so it is not surprising that districts with more landed households have more unequal access to schooling. Tribal areas also tend to have more equal literacy rates, although this effect is observed only after controls for wealth (tribal areas tend to be poorer) and child labor (girls work more often in tribal areas and this suppresses their literacy rates). The coefficients for percent scheduled caste and percent Muslim are not statistically significant. However, these proportions do not vary dramatically across this sample of districts, so it may be difficult to detect whether they have any general social structural effects. In addition, it is worth noting again that these district-level coefficients should not be interpreted as if they were household level measures. Finally, South India is not more gender equal for literacy rates, as it tends to be for other dimensions of gender equality. [7]

So far, the analysis has investigated gender differences in literacy only. Because literacy rates approach 100% in some districts, gender differences in these districts may be muted by ceiling effects. Thus, it is useful to test whether the results reported in Table 4 also hold for higher levels of education achieved by only a minority of Indians. Table 5 reports results

Table 5. *Maximum likelihood estimates of selected independent variables on the gender gap in literacy and matriculation ages 20–24: districts in India, 1991*

Variable	Literacy without child labor	Literacy with child labor	Matriculates without child labor	Matriculates with child labor
Constant	−2.225***	−1.751***	−2.299***	−2.305***
	(−11.45)	(−7.28)	(−7.63)	(−7.04)
Gender ratio adult main:non-main	−0.109***	0.111*	−0.092***	0.007
	(−4.15)	(2.42)	(−3.64)	(0.16)
Odds of women being in exogamous unions	−0.141***	−0.143***	−0.176***	−0.179***
	(−4.88)	(−5.20)	(−6.33)	(−6.49)
Log ratio boys literacy/illiteracy 20–24	−0.073	0.061	–	–
	(−0.41)	(0.32)		
(Log ratio boys literacy/illiteracy 20–24)^2	0.077	0.106	–	–
	(0.82)	(1.13)		
Log ratio boys matriculates/non-matriculates 20–24	–	–	–0.473*	−0.523*
			(−2.00)	(−2.20)
(Log ratio boys matriculates/non-matriculates 20–24)^2	–	–	−0.082	−0.092
			(−1.33)	(−1.50)
Education effort	0.007***	0.006***	0.006***	0.006***
	(4.41)	(4.14)	(4.31)	(3.96)
Housing index	0.010***	0.009***	0.011***	0.011***
	(3.65)	(3.62)	(4.42)	(4.44)
Percent urban in a district	−0.225	−0.244	0.082	0.089
	(−1.41)	(−1.60)	(0.52)	(0.57)
Percent landless in a district	0.006***	0.005***	0.003**	0.003**
	(4.44)	(4.32)	(2.79)	(2.71)
Percent SC in district	−0.001	−0.002	0.000	0.000
	(−0.33)	(−1.00)	(0.05)	(−0.20)
Percent ST in district	0.002†	0.001	−0.001	−0.001
	(1.65)	(1.35)	(−0.49)	(−0.54)
Percent Muslims in a district	−0.001	−0.003†	−0.002	−0.003†
	(−0.61)	(−1.82)	(−1.35)	(−1.80)
Southern districts	0.095	0.133	−0.040	−0.014
	(1.08)	(1.62)	(−0.47)	(−0.180)
Log ratio 5–14 girls main/non-main	–	−0.274***	–	−0.122*
		(−5.85)		(−2.58)
Log ratio 5–14 boys main/non-main	–	0.270***	–	0.080
		(5.26)		(1.63)
Rho (Spatial autocorrelation)	0.817***	0.796***	0.802***	0.787***
	(−26.31)	(23.91)	(24.54)	(22.97)

– Not applicable.
Note: Numbers in parentheses are t-statistics.
Source: Vanneman and Barnes (2003).
† $p < 0.1$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

for gender differences in Matriculation (10 years of education in the Indian school system). The appropriate age range has been adjusted to men and women 20–24 years old and the comparisons with literacy for this age group are also reported. In 1991, only 33% of Indian men 20–24 had matriculated (compared to 72% who were literate), and only 17% of Indian women of that age had matriculated (compared to 44% who were literate).

The determinants of gender differences in matriculation are quite similar to the determinants of literacy. Most importantly, districts with higher adult women's labor force

participation have lower levels of girls' matriculation relative to boys' just as they have lower relative levels of girls' literacy. [8] Similarly, most of the other coefficients in the equation for girls' relative matriculation are quite similar to the coefficients for girls' relative literacy. The factors that impede girls' literacy appear to impede girls' higher levels of education.

The effects of girls' and boys' work are similar for gender differentials in matriculation as for differentials in literacy. The effect sizes are, surprisingly, somewhat smaller for the matriculation differentials when one might have expected that work would have been more of an obstacle for adolescent girls' schooling than for young girls'. Nevertheless, districts where more girls work are districts where fewer girls matriculate relative to boys. Adding the effects of girls' work again changes the sign of the coefficient for women's work to positive, although not statistically significant as was the case for girls' literacy. On the whole the results for matriculates reinforce the results obtained for literacy.

4. DISCUSSION

The results of our analyses are interesting and rather unexpected. A widening gender gap in education is associated with *higher* proportions of women in the labor force. Theories as disparate as human capital and feminist empowerment would suggest that adult women's employment should encourage girls' education. In India, this is not the case. In fact, girls' literacy is further behind boys' literacy in districts with more adult women's employment. The best explanation for this seems to be that the more adult women who work, the more girls who work. Where girls are in the labor force, they have less of a chance of attending school and learning to read and write. We suspect, although we could not test, that the greater demands for daughters' housework in households where their mothers work outside the house also helps mediate this effect of women's labor force participation on lower girls' education.

The linkage between child labor and schooling has been much debated recently (Anker, 2000; Basu, 1999). Work does not *necessarily* imply withdrawal from school. Many children both attend school and engage in economically productive work before and after school hours, or during school vacations. Sometimes the additional income from child labor can finance school expenses (Patrinos & Psacharopoulos, 1997) although household strategies that send girls to work to finance boys' schooling would increase gender inequalities (Greenhalgh, 1985). Some of the association between child labor and school withdrawal undoubtedly reflects a causal flow from school withdrawal to work, rather than the other way around. However, even with these reservations, the Indian data provide evidence that a higher proportion of girls in the labor force reduces their opportunities for literacy.

As expected, indicators of male patriarchy like patrilocal exogamy increase the gender gap in education. Unlike the results for women's labor force participation, this finding is consistent with prior research on other gender inequalities. Areas where marriage patterns require wives leaving their natal communities, the gender gap in child mortality is wide (Kishor, 1993). Thus, gender gaps in education are part of patriarchal systems that generate gender inequalities in other areas. Educating girls is not simply a question of more universal education so that girls can catch up with boys. Educational attainment is gendered; in some places, girls start out further behind boys, regardless of the resources available. How much further behind they are depends on the more general patterns of gender values in the culture.

A second surprise, although others might not find this so unexpected, is the consistent positive relationship between economic development and more gender equality in literacy. The availability of teachers and household wealth are associated with both boys' and girls' education, but the association is stronger with girls' education so that economic development reduces the gap between boys' and girls' outcomes. The development effects are also consistent with the strong queuing effects: the gap between boys' and girls' literacy does not begin to narrow until almost all boys are literate. In that environment, more family and community resources differentially benefit girls whose education is a lower priority when resources are scarce.

The research literature is mixed on the relationship between development and gender outcomes. For example, Indian district level analyses on child survival do not find that girls' chances for survival are any better in more developed districts (Kishor, 1993) nor is there evidence of gender queuing in child survival. For literacy, however, more developed areas have lower gender gaps. This analysis therefore provides some support for a modernization the-

sis for the reduction of gender inequality at least in the area of literacy. While past work focuses more on the role of urbanization and industrialization as agents of modernization (Kabeer, 1994; Kuznets, 1955), our analysis finds neither to be important once educational effort and wealth are controlled. This seems to indicate that narrowing the gender gap in education is primarily a question of the availability of economic resources.

This study lies at the crossroads of the gender inequality discourse on one hand and the literacy discourse on the other. We feel that these results will help further our understanding of both areas. Gender stratification research is again reminded that outcomes are different, and gender gaps in educational attainment are generated quite differently than gender gaps in other areas. In particular, women's access to work does not reduce *all* gender inequalities. For young girls, adult women's participation in the labor force sometimes means that girls will also work, thus reducing their opportunities for school. Educational research is reminded that decisions to educate children remain a gendered process. In most part of India, girls' schooling remains a second priority. As a result, women's ability to read and write is poorly developed. Without these skills, their access to and understanding of the many changes surrounding their lives remains limited. These limitations will be a persistent drag on attaining gender equalities in all other aspects of life.

NOTES

1. The 1991 data offer some advantages in completeness. We believe these relationships between women's labor force participation and gender differentials in literacy reflect enduring constraints on Indian households. We have tested a similar model with 1981 data, although with a somewhat different measure of economic development, and find a similar pattern of results. (Results available on the website.)

2. These include Arunachal Pradesh, Delhi, Goa, Manipur, Meghalaya, Nagaland, Pondicherry, Sikkim, and Tripura. The two island territories, Lakshadweep, and the Andaman and Nicobar Islands, have been dropped because their lack of contiguous neighbors precludes their inclusion in the spatial autocorrelation adjustments. In addition, the small disconnected district of Daman and Diu is not included in the analysis.

3. This can be shown algebraically (where G = the ratio of literate to illiterate girls and B = the ratio of literate to illiterate boys):

$$\ln(G/B) = b_0 + b_1 \ln B + \sum b_i x_i. \quad (1)$$

Adding ln B to both sides:

$$\begin{aligned} \ln G &= b_0 + b_1 \ln B + \ln B + \sum b_i x_i \\ &= b_0 + (b_1 + 1) \ln B + \sum b_i x_i. \end{aligned} \quad (2)$$

4. These controls are also related to women's labor force participation rates in India. Analyses available on the website show that adult women tend to work in tribal areas, in the South, and areas with low Muslim populations and less landlessness. Girls' labor force participation is related to much the same set of factors. If the (strong) relationship with women's labor force participation rates is held constant, poverty emerges as an additional factor predicting girls' work.

5. It is still possible that this interpretation has the causal order reversed. We might imagine that girls' illiteracy could cause higher women's labor force participation: low chances for girls' schooling could cause high work rates for girls, and these higher rates as young girls could cause higher work rates for adult women because of their childhood experience. But this scenario seems less plausible.

6. We had speculated that economic development and educational effort might affect the gender gap in literacy by affecting how quickly the schooling queue was educated so that there might be curvilinear associations of development with gender equality. In analyses not reported in detail here, we entered a quadratic term for each of these development variables. These models failed to show any curvilinear relationship of wealth or urbanization with gender equalities of literacy. Unlike the Dollar and Gatti (1999) crossnational curvilinear results, Indian districts have only a restricted range of development that corresponds better with the earlier development stages where they found a weaker positive relationship. There was some evidence of a curvilinear effect of educational effort: the positive relationship became weaker at high levels of educational effort.

7. Although these other factors reviewed above are also associated with gender differentials in literacy, they do not affect the labor force participation relationships that are the focus of these analyses. In a test for the

robustness of our conclusions, we calculated a series of models that sequentially dropped each control variable. In all results, women's labor force participation had a statistically significant negative association with girls' relative literacy before controls for child labor and a statistically significant positive association after controls for child labor. (Results available on the website.)

8. Some of this effect on gender differences in matriculation rates is a result of the gender differences in literacy rates. Girls who never become literate have no chance of becoming matriculates. Therefore, if women's labor force participation reduces girls' literacy, it will reduce girls' matriculation as well. In analyses not reported in detail here, we investigated the relative odds of girls' matriculation among literates only, that is, girls' relative odds of going beyond literacy to matriculation. For these analyses too, adult women's labor force participation was associated with reduced chances of girls' matriculation.

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