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Effect of Socioeconomic Characteristics on Age at Marriage and Total Fertility in Nepal

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ABSTRACT

In societies where childbearing prior to marriage is not socially acceptable, postponement of marriage contributes significantly to a reduction in fertility level by shortening the total reproductive life of women. This, in turn, reduces the number of children a woman is likely to have and has a negative impact on the population growth rate of a country. This paper examined the effect of socioeconomic characteristics on age at marriage and on total fertility rates in Nepal using a household-level dataset. The estimated results showed that an increase in age at marriage significantly reduced total fertility of women. An increase in the number of children who died had a statistically significant effect on total fertility (child replacement effect). The estimation results also emphasized the role of female education in reducing total fertility and increasing age at marriage. Moreover, female educational effect had a strong inter-generational effect on age at marriage, and this effect was stronger than the effect of male educational attainment. One implication of these results is that from the policy point of view, all other things being equal, governments should accord a significant priority to female education and, in particular, a higher priority compared to male schooling.

Key words: Fertility; Socioeconomic factors; Marriage; Age factors; Nepal

INTRODUCTION

Fertility in Nepal is high and has remained so over the last several decades, although the fertility rate has declined over the last decade or so. The total fertility rate (births per woman) according to the 1981 census was 6.1 and came down to 4.3 by 1999. These are high numbers not only compared to the rates around the world (3.7 and 2.7 in 1981 and 1999 respectively) but also high compared to the averages for low-income countries (5.3 and 3.7 in 1981 and 1999 respectively) and South Asian countries (5.3 and 3.4 in 1981 and 1999 respectively). It is argued that reducing total fertility rates in a country is an essential component of attaining demographic transition in a country and improving the standard of living of its people.

This paper examined the effect of socioeconomic characteristics on the total fertility rates in Nepal using a household-level dataset. Fertility is affected by a number of socioeconomic, cultural and biological factors. Of particular importance is age at marriage. Unlike in western countries where marriage is not a pre-condition to childbearing, in most Asian countries, childbearing prior to marriage is not socially acceptable and is quite uncommon. Postponement of marriage contributes significantly to a reduction in fertility level by shortening the total reproductive span of women. This, in turn, reduces the number of children a woman is likely to have and has a negative impact on the population growth rate of a country. Given this close inter-relationship between fertility and age at marriage, any analysis of fertility behaviour and demographic transition in an Asian country needs to be accompanied with a discussion of age at marriage.

Why is an increase in age at marriage important? Apart from the fact that an increased age at marriage is likely to reduce the reproductive life of women and consequently reduce total fertility rates, a higher age at marriage is expected to be associated with a rise in the status of women, as they enter their reproductive life

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with greater maturity and capabilities. An increase in age at marriage for women is also likely to reduce the age differential between husband and wife. This is likely to increase the bargaining power of the wife and reduce the power imbalance within the family.

While there exists a large volume of literature examining the determinants of total fertility in Bangladesh, India, Pakistan, and Sri Lanka, analysis of the determinants of fertility in Nepal is conspicuously sparse. To the best of my knowledge, the only exception is the study of R.H. Aryal who examined the determinants of total fertility in Nepal and concluded that age at marriage is a significant factor that explains fertility rates in Nepal, and the importance of age at marriage is particularly important given the low contraceptive use-rates (1). There is, however, very little rigorous econometric analysis of the relationship among different socioeconomic variables, age at marriage, and total number of births per woman.

The estimated results emphasize the role of female education in reducing total fertility and increasing age at marriage. Also, the higher the education level of woman, the stronger is the effect of education on age at marriage and total fertility (although the direct effect of education on total fertility is not as strong as the direct effect of education on age at marriage). The fact that educational attainment has a strong effect on both fertility and age at marriage is not surprising. It is argued that women's education increases participation in labour market and provides better employment opportunities, thereby raising their incomes. This raises the status of women both in society and within the family. There are significant positive externalities to such a process—an increase in age at marriage and reduction in fertility rates and a consequent reduction in population growth rate. Evaluation of the benefits from educating women have led economists and policy-makers to argue that educating women yields substantial benefits in the form of higher economic returns compared to similar expenditure on men (2). In poor Asian countries, women often have less say about family decisions compared to their husbands. One of the beneficial roles of women's education is to empower them to assert their preferences more effectively.

Age at marriage indeed has a significant effect on fertility of women—an increase in age at marriage significantly reduces total fertility of women. So, women's education not only has a direct effect in fertility reduction, but also has an indirect effect through effect on age at marriage. Finally, there is strong evidence in favour of child replacement effect—an increase in number of children who have died has a statistically significant effect on total fertility.

MATERIALS AND METHODS

Data and descriptive statistics

The dataset used in the paper was drawn from the Nepal Living Standard Survey (NLSS) data collected in 1995-1996. The survey is part of the Living Standard Measurement Surveys (LSMS) conducted in a number of developing countries around the world (http://www.worldbank.org/html/prdph/lsms/index.htm). The main instrument used was a comprehensive household-level questionnaire covering a wide range of topics, including demography, household services, educational status, remittances, employment and income, health status, and anthropometry. Selected descriptive statistics are presented in Table 1.

All women aged 15-49 years at the time of the survey were asked about the age when they were married for the first time. All ever-married women aged over 15 years were also asked about their fertility history. In particular, information was collected on the number of livebirths, the date of each birth, the sex of each child, whether the child was alive at the time of the survey and, if not, the duration the child was alive for. The sample used in this paper consists of 4,124 women aged 15-49 years, of whom 918 (22.26%) were never married at the time of the survey. The rest were either married, separated, divorced, or widowed. The minimum number of children born to each ever-married woman was 0 (13.13%), while the maximum was 12 (0.03%). The average number of children born to each ever-married woman was 3.06 (Table 2).

As far as age at marriage is concerned, information on actual age at marriage was available for 3,206 women who were married at the time of the survey. The average age at marriage was 17.16 years. The lowest age at marriage was 12 years (women with age at marriage less than 12 years were rejected), and the highest age at marriage was 44 years. More than 99% of ever-married women were married before reaching the age of 30 years (Table 2).

Table 2 also presents average age at marriage and average fertility rates for women classified by birth cohort. The sample was subdivided as belonging to six different birth cohorts: Born before 1950 (YEARB1),

born between 1950 and 1955 (YEARB2), born between 1955 and 1960 (YEARB3), born between 1960 and 1965 (YEARB4), born between 1965 and 1970 (YEARB5), and finally born after 1970 (YEARB6). Overall fertility rates showed a consistent decline: from 5.16 children per woman born before 1950 to 2.69 children per woman born during 1965-1970 and down to 1.13 children per woman born after 1970. However, one must be slightly careful in interpreting these results because women in the last two birth cohorts might not have completed their fertility. The average age at marriage also showed a downward trend: from 17.70 years for women born prior to 1950 down to 16.57 years for women born after 1970. However, again it must be noted that only 52% of sample women in the last birth cohort were married at the time of the survey.

Table 1. Description of variables and selected descriptive statistics

Variable	Mean	Standard error	Description
YEARB1	0.0672	0.2503	1 if born prior to 1950
YEARB2	0.0958	0.2943	1 if born between 1950 and 1955
YEARB3	0.1103	0.3133	1 if born between 1955 and 1960
YEARB4	0.1331	0.3397	1 if born between 1960 and 1965
YEARB5	0.1622	0.3687	1 if born between 1965 and 1970
YEARB6	0.4314	0.4953	1 if born after 1970
AGE	27.8358	9.3459	Age of woman
AGEHUSB	38.9789	13.0993	Age of husband
EDUC0	0.7039	0.4566	1 if years of education attained is 0
EDUC1	0.0890	0.2848	1 if years of education attained is 1-5
EDUC2	0.1610	0.3676	1 if years of education attained is 6-10
EDUC3	0.0461	0.2097	1 if years of education attained is more than 10
HEDUC0	0.6486	0.4775	1 if years of education attained by husband is 0
HEDUC1	0.1280	0.3342	1 if years of education attained by husband is 1-5
HEDUC2	0.1627	0.3691	1 if years of education attained by husband is 6-10
HEDUC3	0.3441	0.4751	1 if years of education attained by husband is more than 10
MOTHLIT	0.0005	0.0220	1 if mother can read and write
FATHLIT	0.0070	0.0836	1 if father can read and write
RURBORN	0.8603	0.3467	1 if born in a rural area
RURAL	0.6765	0.4679	1 if residing in a rural region
TERAI	0.2927	0.4550	1 if resident of Terai
MOUNTAIN	0.0975	0.2966	1 if resident of a mountainous region
HINDU	0.8693	0.3371	1 if religion (of household head) is Hinduism
NEPALI	0.7544	0.4305	1 if survey conducted in Nepali
BRAHMIN	0.1642	0.3705	1 if ethnicity (of household head) is Brahmin
CHHETRI	0.2034	0.4026	1 if ethnicity (of household head) is Chhetri
NEWAR	0.1098	0.3127	1 if ethnicity (of household head) is Newar
TOTADM	1.1894	0.7532	Total number of males aged 25-60 years
TOTADF	1.2328	0.7212	Total number of females aged 25-60 years
TOTEDM	0.1731	0.3797	Total number of males aged more than 60 years
TOTEDF	0.1552	0.3681	Total number of females aged more than 60 years
FAMSIZE	6.0650	3.1591	Household size
NOTMARRY	0.2226	0.4160	1 if not married
TOTCHILD*	3.0590	2.2262	Total number of children born
TOTDEAD*	0.3899	0.8812	Total number of children who have died
AGEMAR*	17.1563	3.3464	Age at marriage

* Computed only for women who are married
Sample size: 4,124
Sample size of ever-married women: 3,206

The highest education attained by a woman was classified into four categories: (i) woman had no

education; (ii) the highest education attained was 1-5 year(s); (iii) the highest education attained was 6-10 years; and (iv) the highest education attained was more than 10 years. Table 3 presents the birth cohort effects in educational attainment. First overall, more than 70% of all women had no schooling, and this number was as high as 92.78% for women born prior to 1950 and down to 53.69% for women born after 1970. Irrespective of the birth cohort, the proportion of women with more than primary schooling (6-10 years) actually exceeded the proportion of women with only primary schooling [1-5 year(s)]. What appeared to be happening was that, while women were most likely to have no schooling, if they actually went to school, they continued beyond primary schooling.

Table 4 presents average age at marriage and average fertility for women classified by the highest level of education attained. The greater the educational attainment, the higher was the age at marriage—up from 16.94 years for women with no schooling to 20.88 years for women with more than 10 years of schooling. Second, the greater the educational attainment, the lower was the average fertility rate—down from 3.29 children per woman with no schooling to 1.75 children per woman with more than 10 years of schooling. Some primary schooling (opposed to no schooling) did not have a significant effect on age at marriage—there appeared to be a threshold level of education that had to be attained before educational attainment started having a significant effect on age at marriage.

The sample size of women with more than 10 years of schooling was quite small—only 86 (2.68%) of 3,206 women in the sample of ever-married women had more than 10 years of education. Highly-educated women were likely to be highly selective, and as an anonymous referee correctly argued the relationships between education and fertility that were emphasized in this paper might not hold if education becomes more widespread.

Table 2. Average age at marriage and average fertility rate by birth cohort

Birth cohort	Sample size	Average age at marriage*	Average fertility rate*
All women	4,124 (3,206)	17.16	3.06
Born prior to 1950	277 (277)	17.70	5.16
Born between 1950 and 1955	395 (390)	17.26	4.74
Born between 1955 and 1960	455 (448)	17.34	4.18
Born between 1960 and 1965	549 (534)	17.47	3.60
Born between 1965 and 970	669 (625)	17.31	2.69
Born after 1970	1,779 (932)	16.57	1.13

* Average age at marriage and average fertility rate computed only for the ever-married sample
Figures in parentheses indicate the sample size for ever-married women

Table 3. Educational attainment of women by birth cohort

Birth cohort	Years of education attained			
	0	1-5	6-10	10+
All women	0.7039	0.0890	0.1610	0.0461
	(2,903)	(367)	(664)	(190)
Born prior to 1950	0.9278	0.0289	0.0361	0.0072
	(257)	(8)	(10)	(2)
Born between 1950 and 1955	0.9089	0.0203	0.0456	0.0253
	(359)	(8)	(18)	(10)
Born between 1955 and 1960	0.8286	0.0527	0.0901	0.0286
	(377)	(24)	(41)	(13)
Born between 1960 and 1965	0.8470	0.0474	0.0838	0.0219
	(465)	(26)	(46)	(12)
Born between 1965 and 1970	0.7324	0.1016	0.1151	0.0508
	(490)	(68)	(77)	(34)
Born after 1970	0.5369	0.1310	0.2653	0.0669
	(955)	(233)	(472)	(119)

The cell figures indicate the proportion of women in each birth cohort—educational attainment category
Figures in parentheses indicate the sample size

Role of education in affecting fertility and age at marriage

The descriptive statistics presented and the econometric results (below) both emphasize the role of education in affecting fertility and age at marriage. In this section, I briefly discuss the channels through which they work.

Fertility and schooling are generally inversely related (3-6). However, the relationship between women's educational attainment and fertility is quite complex. While many economists and policy-makers have emphasized the fertility-reducing effects of women's education, the relationship is neither simple nor unidirectional. Education affects fertility in a number of ways, some of which increase fertility while others reduce fertility, and the actual number of children born to a particular woman is the net effect of these opposing forces. The relationship between women's education and fertility is often dependent on the level of development, and several studies found that, in the early stages of a country's development, a small amount of education might actually increase fertility. Evidence also suggests that a 'threshold' level of education needs to be attained before fertility declines are perceptible and sustained, and the thresholds are likely to vary across countries. The presence of this threshold effect essentially implies that the total fertility rates of uneducated and highly-educated women are quite similar. Among uneducated women, fertility is often kept below the biological maximum level as a result of prolonged lactation. It has been observed that a modestly-educated woman, while more likely to practise contraception compared to an uneducated woman, is less likely to breastfeed and less likely to practise postpartum abstinence—both, however, enhance fertility. In consequence, modestly-educated women often have more children compared to uneducated women. Only after the threshold level of education has been attained do the fertility-reducing effects of education outweigh the fertility-enhancing effects, and the net effect of women's education on fertility becomes uniformly inverse. This result is fairly general. R.A. LeVine and colleagues, using data from Mexico, found that, in both rural and urban areas, women with six years of schooling were not statistically different from less-educated women in terms of desired family size, and the fertility-reducing effects of education became stronger only for women with seven or more years of education (7). Similar evidence was obtained using data from India, South Africa, and sub-Saharan Africa (8-11). For more educated women, the effects were unidirectional. More educated women are more likely to demand less children. There are several reasons for this behaviour. First, educated women are likely to be more self-reliant economically and consequently less likely to be dependent on children for economic and social survival. For example, more educated women are less likely to be dependent on children for old-age support. Second, both economic and time costs associated with child-rearing are likely to be higher for educated women compared to uneducated women. This is partly because the foregone market wages are likely to be significantly higher for more educated women. In addition, education also results in greater consciousness of child costs and also the desire of parents to have better-educated, higher-quality, and more expensive children, thereby leading to a quantity-quality shift in the demand for children. Third, educated women are generally more confident about the survival prospects of their children and hence are less likely to need as many children to maintain the desired family size. However, this effect is likely to be weaker compared to the first two. There are important policy implications of the strong relationship between women's education and fertility. Many countries are increasingly using subsidized family-planning programmes to reduce fertility. Schultz argues that if family-planning programmes are subsidized, so should education of girls because increased female education is clearly associated with a strong decline in fertility rates (2).

Table 4. Average age at marriage and average fertility rate by educational attainment

Highest education attained	Sample size	Average age at marriage*	Average fertility rate*
All women	4,124 (3,206)	17.16	3.06
Years of education=0	2,903 (2,565)	16.94	3.29
Years of education=1-5	367 (221)	16.95	2.34
Years of education=5-10	664 (334)	18	2.07
Years of education=10+	190 (86)	20.88	1.75

* Average age at marriage and average fertility rate computed only for ever-married sample
Figures in parentheses indicate the sample size for ever-married women

While education has a direct effect on fertility, it also has an indirect effect on fertility by affecting age at marriage. Marriage is important in fertility analysis because it broadly defines the period of childbearing, particularly in societies where pre-marital childbearing is not socially acceptable. Generally, the literature suggests a strong positive relationship between educational attainment and age at marriage. There are several ways through which education can delay marriage. First, educated women generally have a stronger say in their lives and are likely to play a more active role in selecting husbands and resisting early and arranged marriages. Second, more-educated women are likely to be employed, and depending on the benefits from working, this might result in a postponement of marriage. What is interesting is that pre-marital employment is also resulting in an increase in 'marriageability' of women, and employment is, in many cases, becoming an alternative to dowry. For example, in Sri Lanka, 75% of married men prefer marrying an educated, working woman rather than one who provides dowry (12). Finally, there is evidence of a 'threshold' level of education that must be attained before increases in educational attainment start to consistently increase age at marriage.

Econometric specification

The prime variable of interest is the total number of children born to women aged 15-49 years. Apart from other variables, the total number of children born to any particular woman (the measure of total fertility used in this paper) depends on age at marriage for the particular woman (under the assumption that there are very few out-of-wedlock births, which is a fair assumption in the context of a country like Nepal). The problem is that the unobserved determinants of total fertility for a particular woman are likely to be correlated with her age at marriage. One, therefore, needs to account for endogeneity of age at marriage in estimating equation for the total number of children born to each woman.

Total number of children

Several econometric issues arise in estimating the total number of children. The number of children born to each woman can be zero or be positive integer values and not particularly large values. For example, the maximum number of children born to any particular woman in the sample was 12. The preponderance of small values and the integer nature of the dependent variable imply that one could improve on ordinary least square (OLS) and the linear model using a non-linear specification. A Poisson regression model is used for estimating the number of children born to each woman.

The equation estimating the number of children born to woman $i(i = 1,K, I)$ belonging to household $h(h = 1,K, H)$ over her reproductive life is:

$$TOTCHILD_{ih} = \alpha_0 + \alpha_1 INDIV_{ih} + \alpha_2 HH_h + u_{ih} \quad (1)$$

As mentioned, equation 1 is estimated as a Poisson count model. The set of explanatory variables included are individual and household characteristics. The individual characteristics (INDIV) include age and square of age of woman (AGE and AGE2 respectively) and that of her husband (AGEHUSB and AGEHUSB2 respectively), and dummies for the highest level of education attained by the woman and her husband. Three dummies for the highest level of education attained by the woman are included—the highest education of the woman is between grade 1 and 5 (EDUC1), the highest education attained by the woman is between grade 5 and 10 (EDUC2), and the highest education of the woman is more than grade 10 (EDUC3). The reference category is that the woman has no education. Similarly, three dummies for the highest level of education attained by the husband are included—the highest education of the husband is between grade 1 and 5 (HEDUC1), the highest education attained by the husband is between grade 5 and 10 (HEDUC2), and the highest education of husband is more than grade 10 (HEDUC3). The reference category is that the husband has no education. Several household characteristics (HH) were included: dummies for rural residence, region of residence, religion and ethnicity of household, the language in which the survey was conducted, and the total number of adult (and elderly) males and females in the household. Nepali is the mother tongue of about 50% of the population, although 10 other languages are spoken in the country. Nearly 86% of the population are Hindus, 8% are Buddhists, and 4% are Muslims. The different ethnic groups included are Brahmin, Chhetri, Newar, Magar, Tharu, Tamang, Kami, Yadav, Muslim, Rai, Gurung, Damai, Limbu, Sarki, and all other ethnic groups. The country is divided into 3 zones: Mountains, Hills, and the Terai.

The number of children born to a woman could also depend on the number of children who died (the replacement effect), and hence the total number of

children born to the woman who have died (TOTDEAD) was included as an explanatory variable.

Finally, the log of age at marriage (LAGEMAR) was included as one of the explanatory variables. A priori one expects an increase in age at marriage to reduce total fertility. To correct for endogeneity of age at marriage in the total fertility equation, first, a hazard model was estimated for age at marriage and then the predicted value of log age at marriage was used as an explanatory variable in regressions for the total number of children ever born. Since this predicted log age at marriage was uncorrelated with the unobserved determinants of the total number of children born, the estimates are consistent. This two-stage estimation implies that the estimates, although consistent, might not be efficient. Efficient estimates were obtained using bootstrapping (13).

Age at marriage

In most Asian countries, including Nepal, marriage marks the beginning of socially-sanctioned exposure to pregnancy and sets the course of subsequent childbearing. Thus, age of a woman at marriage is one of the most important proximate determinants of the aggregate level of fertility. Age at marriage is also an important indicator of women's status. Because of its role in determining the fertility level, improving the health of women and children and enhancing the status of women, increasing age at marriage has been an important domain of public policy-making.

A hazard model was used for estimating the age at marriage equation (14-18). The hazard or risk is the conditional probability of getting married The hazard or risk is the conditional probability of getting married at a given age provided that the woman is not yet married. The instantaneous hazard function at time t is assumed to take the following form:

$$\lambda_i(t)= \lambda_0 (t)\varepsilon_i \exp\{X_i(t)\beta\}=\lambda_0(t)\exp\{X_i(t)\beta +\log \varepsilon_i\} \quad (2)$$

Here $\lambda_0(t)$ is an unknown baseline hazard at t, $X_i(t)$ is a vector of explanatory variables, β is the corresponding parameter vector, and ε is a random variable that accounts for unobserved heterogeneity. There are several ways (parametric and non-parametric) of characterizing the baseline hazard function. It is assumed that the baseline hazard function follows a Weibull distribution. The robustness of this distributional assumption was examined by (i) re-estimating the model parametrically under the assumption that the baseline hazard function follows a Gamma distribution, which is the most general form of the baseline hazard and (ii) re-estimating the model semi-parametrically using Cox's proportional hazard model, where no distributional assumption was imposed on the baseline hazard function.

The use of hazard model allows us to account for censoring in the sample. Censoring is needed because the survey dataset contains data on women who have not yet 'exited'—these are women who were not married at the time of the survey. The hazard equation for marriage is defined from the time the individual becomes at risk of marriage (this is assumed to be age 11 years) until the time of marriage or until the time the process is censored by the survey date. OLS estimation will be unable to account for this censoring.

The hazard of marriage is assumed to depend on a set of individual and household characteristics. Five birth cohort dummies—born before 1950 (YEARB1), born between 1950 and 1955 (YEARB2), born between 1955 and 1960 (YEARB3), born between 1960 and 1965 (YEARB4), and born between 1965 and 1970 (YEARB5)—were included. The reference category was the woman who was born after 1970. The birth cohort dummies control for age of the woman and also incorporate birth cohort differences in the hazard of marriage. Parental characteristics, particularly parental education, are likely to have a significant effect on the hazard of marriage. Two dummies were included to indicate whether the woman's parents are literate (MOTHLIT and FATHLIT). Three dummies were included for the highest level of education attained by the woman—the highest education of the woman is between grade 1 and 5 (EDUC1), the highest education attained by the woman is between grade 5 and 10 (EDUC2), and the highest education of the woman is more than grade 10 (EDUC3). The reference category was the woman who had no education. A dummy variable was also included to indicate whether the woman was born in a rural area (RURBORN).

The household-level variables that could affect the hazard of marriage were controlled for. Included were dummies for rural residence, region of residence, ethnicity and religion of household, the language in which the survey was conducted, and the total number of adult (and elderly) males and females in the household.

Identification of two equations (characterizing total fertility and age at marriage) was ensured by exclusion restrictions. Parental educational characteristics were included in the set of explanatory variables in age at

marriage regressions. On the other hand, characteristics of the husband were included in the set of explanatory variables in total fertility regressions. It is unlikely that the characteristics of the husband will have significant effects on age at marriage of women, and on the other hand, parental characteristics are unlikely to have significant effects on post-marital decisions, in the South Asian context. Likewise, the dummy variable RURBORN (born in a rural area) was included in age at marriage hazard but not in total fertility equation because this variable is more likely to have an effect on age at marriage compared to total fertility.

RESULTS

Age at marriage

Table 5 presents the estimates of age at marriage equation, where the baseline hazard is parameterized as having a Weibull distribution. The coefficient estimates and the standard errors (that were computed robustly to account for arbitrary heteroscedascity) are presented in the table [The hazard ratios (exponentiated coefficients) are available from the author on request]. A positive and statistically significant coefficient associated with a particular explanatory variable implies that this variable increases the hazard of marriage and, therefore, reduces age at marriage. Likewise, a negative and statistically significant coefficient associated with a particular variable reduces the hazard of marriage and increases age at marriage.

The estimated results showed that, relative to the reference category of women born after 1970, age of marriage was significantly lower for women born between 1960 and 1965 (YEARB4) and for women born between 1965 and 1970 (YEARB5). All the three education dummies were negative and statistically significant. Age at marriage was significantly higher for educated women compared to women who had no formal education. Moreover, it was observed that the higher the education level of woman, the stronger the effect of educational attainment on age at marriage. Both FATHLIT and MOTHLIT were negative and statistically significant. This implies that the age at marriage was significantly higher for women with literate parents. Further, the mother's literacy had a stronger effect on age at marriage of her daughters compared to father's literacy. This result is indicative of an inter-generational transmission of the effect of educational attainment on age at marriage. It has been found that parental educational attainment significantly increased age at marriage. For example, L. Gangadharan and P. Maitra, using data from Pakistan, found that women with literate parents had a significantly higher probability of continuing in school and also had a significantly lower hazard of marriage (and consequently higher age at marriage) (8). Turning to the other household characteristics, age at marriage was significantly lower for women belonging to Brahmin households, those belonging to Hindu households, and those residing in the Terai and other mountainous regions and was significantly higher for women belonging to Newar households (remember the reference category is that the ethnicity of woman is 'other' [Other includes Magar, Tharu, Tamang, Kami, Yadav, Muslim, Rai, Gurung, Damai, Limbu, Sarki, and all other ethnic groups]). Finally, household composition had a significant effect on age at marriage. It has been argued that ethnicity significantly affects the timing of

Table 5. Hazard estimation of age at marriage using Weibull distribution

Variable	Coefficient	Robust standard error
YEARB1	-0.1087	0.1337
YEARB2	-0.0116	0.1085
YEARB3	0.1128	0.0941
YEARB4	0.1465**	0.0725
YEARB5	0.4223***	0.0611
EDUC1	-0.2005***	0.0771
EDUC2	-0.5468***	0.0796
EDUC3	-1.1339***	0.1416
MOTHLIT	-10.5891***	1.3508
FATHLIT	-2.4742**	1.0199
RURBORN	-0.1511	0.1001
RURAL	0.1018	0.0819
TERAI	0.4366***	0.0777
MOUNTAIN	0.1684**	0.0726
HINDU	0.1753**	0.0818
NEPALI	-0.0741	0.0704
BRAHMIN	0.2174**	0.0848
CHHETRI	-0.0042	0.0789
NEWAR	-0.2977***	0.1020
TOTADM	0.2229***	0.0426
TOTADF	-0.4396***	0.0477
TOTEDM	-0.1643	0.1104
TOTEDF	-0.2230**	0.0930
CONSTANT	-13.5537***	0.3138
α	1.5264***	0.0221

Sample size: 4,124
Number censored: 918
Wald χ^2 (23): 692.08***
Significance: ***=1%; **=5%; *=10%

marriage, the time of first birth, and hence total fertility, independent of socioeconomic factors (19-22). In the context of Nepal as well, the ethnic factor was a major determinant of the timing of family formation (23).

Total fertility

Table 6 presents the maximum likelihood Poisson estimates for the total number of children born to each married woman in the sample. Three sets of estimates are presented. In Specification I, age at marriage (LAGEMAR) is exogenous. However, as we have argued, age at marriage could be correlated with the unobserved determinants of total fertility leading to inconsistent estimates. To control for this potential endogeneity of age at marriage in the total fertility equation, the predicted value of age at marriage from the first stage hazard estimates of age at marriage was used as the relevant instrument. By construction, this is uncorrelated with the unobserved determinants of total fertility. This gives us Specification II. In both Specification I and Specification II, standard errors were computed robustly to account for arbitrary heteroscedascity. There is, however, one potential problem with this two-step estimation. The estimates, thus, obtained are consistent but they might not be efficient. To obtain efficient estimates, standard errors (with 1,000 replications) were bootstrapped following the methodology suggested by W. Guan (13). This gives us Specification III in Table 6. Table 6 presents the coefficient estimates, the bootstrap standard errors, and the 95% confidence intervals computed using the 2.5^{th} and 97.5^{th} percentiles of computed distribution. The coefficient estimates of Specification II and Specification III are, by definition, identical.

A comparison of the standard errors of Specification II and Specification III showed that, while the bootstrapped standard errors were slightly different from the robust standard errors, in no case was the difference significant. In fact, the bootstrapped standard errors were not consistently lower than the robust standard errors. Further, the maximum difference between the robust standard errors and the bootstrapped standard errors was 5.4%. One way of interpreting these results is that the loss of efficiency from using the two-step methodology of Specification II is minimal. Therefore, only the results for Specification II were discussed.

An increase in age at marriage (LAGEMAR) had a negative and statistically significant effect on total fertility. An increase in age at marriage, therefore, reduced lifetime fertility. While the coefficient estimate of LAGEMAR was negative and statistically significant in both Specification I and Specification II, the effect was actually stronger in Specification II. This implies that the effect of age at marriage on total fertility is underestimated if we do not account for potential endogeneity of age at marriage in the total fertility equation.

Educated women generally had fewer children. Holding all other variables constant, relative to the reference category of woman having no formal education, women with more than secondary schooling had significantly fewer children (the coefficient estimate of EDUC3 was negative and statistically significant). The coefficient estimate of EDUC2 (the highest education attained by woman was between grade 5 and 10) was also negative although not statistically significant. Finally, the coefficient of EDUC1 (the highest education attained by woman was between grade 1 and 5) was positive although not statistically significant. The signs and statistical significance of coefficient estimates imply that there is evidence of some kind of threshold that must be attained before education starts affecting fertility. Moreover, the modest positive relationship between a few years of schooling and fertility has been observed for other countries as well. A positive relationship typically implies that even one year of primary schooling induces a large change in behaviours and outlook that indirectly affect fertility. However, the realities of primary schooling in Nepal (high drop-outs and absenteeism, low salary of teachers, poor infrastructure) cast doubt on this interpretation. Most probably what is happening is that women who end up with only a few years of schooling are those who enrolled in school as they were waiting to get married and then stopped once they got married and had children. Another possible explanation is that the cost of having children is not particularly high for women with a few years of schooling—low wage returns to a few years of schooling. Total fertility was higher for older women but there was significant non-linearity in effect of the age of the woman on total fertility.

The educational attainment of the husband has a similar effect on total fertility. In particular, HEDUC3 (the highest education attained by the husband was more than grade 10) was negative and statistically significant and HEDUC2 (the highest education attained by the husband was between grade 5 and 10) was negative although not statistically significant. The total fertility

Table 6. Maximum likelihood Poison estimates of total number of children born

Variable	Specification I		Specification II		Specification III		
	Coefficient	Robust standard error	Coefficient	Robust standard error	Coefficient	Bootstrapped standard error	95% confidence interval
AGE	0.3946***	0.0105	0.4034***	0.0106	0.4034	0.0103	0.3841, 0.4244
AGE2	-0.0047***	0.0002	-0.0049***	0.0002	-0.0049	0.0002	-0.0052,-0.0046
EDUC1	0.0437	0.0435	0.0119	0.0432	0.0119	0.0439	-0.0754, 0.0897
EDUC2	0.0657*	0.0391	-0.0281	0.0388	-0.0281	0.0386	-0.1036, 0.0462
EDUC3	-0.0627	0.0831	-0.2770***	0.0840	-0.2770	0.0825	-0.4408,-0.1294
AGEHUSB	-0.0503***	0.0062	-0.0508***	0.0063	-0.0508	0.0063	-0.0627,-0.0385
AGEHUSB2	0.0004***	0.0001	0.0004***	0.0001	0.0004	0.0001	0.0002, 0.0005
HEDUC1	0.0239	0.0249	0.0242	0.0248	0.0242	0.0257	-0.0276, 0.0736
HEDUC2	-0.0059	0.0247	-0.0071	0.0248	-0.0071	0.0254	-0.0581, 0.0413
HEDUC3	-0.4214***	0.0377	-0.4163***	0.0373	-0.4163	0.0389	-0.4920,-0.3422
RURAL	0.1974***	0.0269	0.1907***	0.0269	0.1907	0.0276	0.1354, 0.2394
TERAI	-0.0563**	0.0250	0.0283	0.0243	0.0283	0.0256	-0.0216, 0.0797
MOUNTAIN	-0.0570*	0.0315	-0.0323***	0.0318	-0.0323	0.0327	-0.0987, 0.0325
HINDU	-0.0663**	0.0282	-0.0334	0.0277	-0.0334	0.0276	-0.0858, 0.0231
NEPALI	0.0577**	0.0231	0.0525**	0.0229	0.0525	0.0231	0.0076, 0.0978
BRAHMIN	0.0283	0.0291	0.0611**	0.0291	0.0611	0.0287	0.0071, 0.1157
CHHETRI	-0.0169	0.0267	-0.0217	0.0269	-0.0217	0.0273	-0.0748, 0.0307
NEWAR	-0.0015	0.0367	-0.0524	0.0367	-0.0524	0.0367	-0.1209, 0.0225
TOTADM	0.0954***	0.0180	0.1312***	0.0183	0.1312	0.0184	0.0946, 0.1680
TOTADF	-0.1513***	0.0204	-0.2053***	0.0208	-0.2053	0.0218	-0.2512,-0.1650
TOTEDM	0.0662**	0.0285	0.0399	0.0282	0.0399	0.0283	-0.0154, 0.0921
TOTEDF	-0.0303	0.0264	-0.0520**	0.0257	-0.0520	0.0262	-0.1034,-0.0035
TOTDEAD	0.1583***	0.0079	0.1586***	0.0078	0.1586	0.0080	0.1431, 0.1747
LAGEMAR	-0.7629***	0.0515	-0.8223***	0.0782	-0.8223	0.0762	-0.9835,-0.6819
CONSTANT	-3.0408***	0.2167	-5.1699***	0.1625	-5.1699	0.1562	-5.4998,-4.872
Sample size	3,206		3,206		3,206		
Log pseudo Likelihood	-5784.7431		-5795.5274				
Pseudo R^2	0.3960		0.3949				
Wald $\chi^2(24)$	7,693.23***		7,666.02***				
No. of replications					1,000		

Specification I: Age at marriage exogenous
Specification II: Age at marriage endogenous, robust standard errors
Specification III: Age at marriage exogenous, bootstrapped standard errors. 1,000 replications
Sample includes ever-married women
Significance: ***=1%; **=5%; *=10%

rate was lower for women with more-educated husbands, and the effect was stronger as more educated the husband was. Husband's education is often used as a proxy for permanent income of the household. The fact that HEDUC3 is negative and statistically significant could imply that we are capturing the quality-quantity trade-off—richer households are substituting the quantity of children by increasing the quality of the existing children.

An increase in the total number of children who died (TOTDEAD) had a positive and statistically significant effect on total fertility supporting the replacement hypothesis. Total fertility was higher for women who resided in rural areas (RURAL), women belonging to Brahmin households, and for women who were interviewed in Nepali but was significantly lower for women residing in the mountainous regions. Finally, household composition had a significant effect on total fertility.

DISCUSSION

Robustness of results

How sensitive are the results to alternative distributional assumptions and alternative sample stratifications? I now examine the robustness of the results [No robustness results are presented. They are, however, available from the author on request.]

The first stage estimation of the hazard of marriage assumed a Weibull distribution for the baseline hazard. Are the results specific to this distributional assumption? I re-estimated the hazard of marriage (equation 2) using two alternative specifications: in the first, the baseline hazard was specified as a Gamma distribution, and in the second, I did not make any distributional assumption and estimated the marriage hazard semi-parametrically, using a Cox proportional hazard model. The following results are worth noting. First ceteris paribus, all the birth cohort dummies were positive and statistically significant—the age at marriage was higher for women born before 1970 compared to the reference category of women born after 1970; second, all the three education dummies were negative and statistically significant. Age at marriage was, therefore, significantly higher for educated women relative to women who had no formal education. Moreover, the higher the education level of woman, the stronger the effect of educational attainment on age at marriage. Third, parental education generally appeared to have a significant effect on the age at marriage—age at marriage was generally significantly higher for women with literate parents. However, the standard error associated with MOTHLIT in the Cox proportional hazard model turned out to be very high, implying that the associated estimate was quite inaccurate. Finally, both the specifications also agreed that age at marriage was higher for women residing in rural areas. Although there were some differences compared to the Weibull hazard estimates presented in Table 5, the differences were not significant, and we can conclude that the results are fairly robust to the distributional assumptions concerning the baseline hazard.

There is an important censoring issue that arises from the inclusion of women who have not yet completed their fertility. Women who were in the initial stages of their reproductive life (for example, those who are aged less than 20 years) could not really be compared to women who were in the later stages of their reproductive life (for example, women who are aged more than 40 years). If a woman in her 20s was observed to have a lower number of pregnancies compared to a woman aged more than 40 years, it did not necessarily allow us to conclude that there has been a change in preferences and that younger women now prefer having fewer children. Therefore, the robustness of the results was re-estimated by examining the total number of children born to women aged above 40 years (who are likely to have completed their fertility). In this case, however, the sample size fell significantly, and the efficiency of the estimates might be open to question. The total fertility equation was re-estimated but this time restricting the sample to women aged more than 35 years. Age at marriage continued to have a negative and statistically significant effect on total fertility. Educational attainment of the woman and that of her husband no longer had a statistically significant effect on total fertility and, finally, the replacement effect continued to be strong—TOTDEAD was positive and statistically significant in both the sets of estimates.

This paper estimated total fertility of married women in Nepal and also examined the relationship between age at marriage and total fertility. This is an important issue because it is generally argued that a reduction in age at marriage is an important pre-condition of the demographic transition of any country. Unlike in western countries where marriage is not a pre-condition to childbearing, childbearing prior to marriage is not socially acceptable in most Asian countries, and is, therefore, extremely uncommon. Postponement of marriage, therefore,

contributes significantly to reduction in fertility levels by shortening the total reproductive life of women, which, in turn, reduces the number of children a woman is likely to have and hence reduces the population growth rate of a country.

Econometrically, this paper accounted for the discrete nature of the dependent variable and the fact that age at marriage is likely to be endogenous in estimating total fertility. Age at marriage, indeed, had a significant effect on fertility of women—an increase in age at marriage significantly reduced total fertility of women. An increase in the number of children who died had a statistically significant effect on total fertility. Age at marriage was significantly higher for women with literate parents. Further, mother's literacy had a stronger effect on age at marriage of her daughters compared to father's literacy. This result is indicative of an inter-generational transmission of the effect of educational attainment on age at marriage. Finally, the estimation results emphasize the role of female education in reducing total fertility and increasing age at marriage. Age at marriage is, therefore, significantly higher for educated women compared to women who have no formal education. Moreover, the higher the educational level of woman, the stronger was the effect of educational attainment on age at marriage. Educated women had fewer children. Holding all other variables constant, relative to the reference category of the woman having no formal education, women with more than secondary schooling had significantly fewer children. This is evidence of some sort of threshold level of education that must be attained before education starts having a significant effect on the number of children. It must, however, be noted that the direct effect of education on fertility was not as strong as one would expect, and it appeared that the effect of educational attainment on fertility worked more indirectly through the age-at-marriage effects, which as we have noted are fairly strong.

The major policy implication that follows immediately is that more emphasis should be made to educate girls. Increased women's education significantly increased age at marriage, which, in turn, has a strong effect on fertility. In addition, female educational attainment has a direct effect on fertility as well, although this direct effect is significant only if the woman is 'highly' educated. Further, women's education appeared to have a strong inter-generational effect as well—age at marriage was significantly higher for women with literate parents, and it is important to note that mother's literacy has a stronger effect on age at marriage of her daughters compared to father's literacy. From the policy point of view, all other things being equal, governments should accord a significant priority to female education and, in particular, a higher priority compared to male schooling.

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