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The Effect of Education on the Timing of Marriage and First Conception in Pakistan

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The Effect of Education on the Timing of Marriage and First Conception in Pakistan*

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Abstract

It is often argued that a rapid rise in educational attainment of women, an increase in the age at marriage and an increase in the age at first birth are key features of demographic transition in any country. Education is the prime catalyst in this process because increases in educational attainment are likely to significantly affect both age at marriage and the duration to first conception - in particular increasing both the age at marriage and the time to first child. This paper uses individual level unit record data from Pakistan to examine the effect of education on the age at marriage and on the duration between marriage and first conception. We estimate a structural model, which accounts for the interaction between the three main variables of interest. Our estimation results show that women who have more education delay marriage but increased educational attainment does not have a significant effect on the duration to first conception. Women who marry late have a child faster. Education of the husband significantly affects the time to first conception.

JEL Classification: J13, O10, C41, C24.

Key Words: Education, Age at Marriage, Age at First Conception, Asia, Pakistan.

1. Introduction

It is often argued that a rapid rise in educational attainment of women, an increase in the age at marriage and an increase in the age at first birth are key features of demographic transition in any country. Education is regarded as being the prime catalyst in this process because increases in educational attainment are likely to significantly affect both age at marriage and the duration to first conception. It is argued that increased education is likely to open up economic alternatives to getting married and bearing children. Increased education could imply that for women the utility of being single might exceed the utility of being married (Becker 1974). There also exists a large literature that argues that women are likely to reduce their labour market participation after child bearing and hence the opportunity cost of child bearing could be higher for more educated women. So even after marriage the utility of delaying conception might exceed the utility of having a child immediately.

Over the last few decades education levels have significantly increased in many countries as have the age at marriage and the duration between marriage and first conception. In this paper we use unit record data to examine whether a similar transition has happened in Pakistan. We use data from a national sample of women to examine the changes in educational attainment over the last five decades and the effect of education on the age at marriage and on the duration between marriage and first conception. Over the last fifty years educational attainment among women has increased significantly in Pakistan (the proportion of women having no education has decreased and the proportion of women having primary, secondary and higher secondary schooling has increased). However over the same time period, age at marriage does not show a significant increase

nor does the duration between marriage and first conception. Actually the duration between marriage and first conception shows a marked decline.

We estimate a structural model, which accounts for the interaction between the three main variables of interest. The reason for joint estimation arises from the possible endogeneity of education in the age at marriage equation and the endogeneity of both education and age at marriage in the time to first child equation. Our estimation results show that there are significant marriage cohort effects – the average age at marriage is higher for women who marry after 1980 relative to women who marry prior to 1950 and the duration between marriage and first conception is higher for women who were married prior to 1950. We find older women are less educated and more educated women delay marriage. While the duration between marriage and first conception is not significantly affected by the educational attainment of the woman, it is significantly reduced by an increase in the age at marriage. Women whose husbands have more education conceive faster after marriage. The results improve significantly when we account for the endogeneity of the variables of interest and this highlights the fact that it is important to jointly study these features of demographic transition to rigorously examine fertility trends in Pakistan.

The rest of the paper is organised as follows. Section 2 discusses the data and presents some selected descriptive statistics. Section 3 presents the econometric framework that we use in this paper. It sets out the structural model and discusses the estimation techniques used. Section 4 discusses the results and Section 5 concludes.

2. *Data and Descriptive Statistics*

The data set used is from the Pakistan Integrated Household Survey conducted in 1991 (PIHS). This survey was conducted jointly by the Federal Bureau of Statistics, the Government of Pakistan and the World Bank as a part of the Living Standard Measurement Study (LSMS) household surveys in a number of developing countries. The purpose of these surveys is to provide policy makers and researchers with individual, household and community level data needed to analyse the impact of policy initiatives on living standards of households. The PIHS teams visited 4800 households residing in rural and urban communities. The nation-wide survey gathered individual and household level data using a multi-purpose questionnaire.

The sample in the paper is restricted to 9089 women between the ages 10 and 120. The women are categorised by their birth cohort: women born prior to 1940 (Cohort 1), women born between 1941 and 1950 (Cohort 2), women born between 1951 and 1960 (Cohort 3), women born between 1961 and 1970 (Cohort 4) and finally women born after 1971 (Cohort 5). Our sample consists of 1593 women in Cohort 1, 1033 women in Cohort 2, 1532 women in Cohort 3, 2315 women in Cohort 4 and 1358 women in Cohort 5.

Table 1 presents the proportion of women (categorised by birth cohort) at each of the education categories. The five education categories are defined by the highest level of education attained by the woman: No education (*EDUC*0) primary school (*EDUC*1), secondary school (*EDUC*2), higher secondary school (*EDUC*3) and college (*EDUC*4). Notice that there has been a significant decrease in the proportion of women who have no education: more than 93% of women born prior to 1940 have no education and this

comes down to around 52% for women born after 1970. Likewise the proportion of women who have some primary schooling has increased from 2.70% to 14.53%, the proportion of women who have attended secondary school has increased from 2.45% to 23.17% and the proportion of women who have some higher secondary education has increased from 0.19% to 5.35%. Overall it appears that the extent of female education has increased significantly.

In Figure 1 we present the average age at marriage and the average time to first conception (after marriage) for women classified by year of marriage. Over the forty years (1951 – 1991) the average age at marriage has shown a slight increase. For example, while the average age at marriage for a woman married in 1951 is 16.5 years it goes up to nearly 20 years for women married in 1991. On the other hand the average duration between marriage and first conception has shown a significant decline – from around 7 years for women married in 1961 to a little more than 1 year for women married in 1990.[1]

3. *Econometric Framework*

The first stage of the estimation process is to examine the years of education attained by the woman ($YRSEDUC$). The equation characterising the number of years of education is given by

$$\begin{aligned} \underline{YRSEDUC} = {} & \alpha_0 + \alpha_1 AGEY + \alpha_2 HHINCOME + \alpha_3 MARRY \\ & + \alpha_4 FEDUC1 + \alpha_5 FEDUC2 + \alpha_6 FEDUC3 + \alpha_7 FEDUC4 \\ & + \alpha_8 FEDMISS + \alpha_9 MEDUC1 + \alpha_{10} MEDUC2 + \alpha_{11} MEDUC3 \\ & + \alpha_{12} MEDUC4 + \alpha_{13} MEDMISS + \alpha_{14} REL1 + \alpha_{15} RURAL \\ & + \alpha_{16} SINDH + \alpha_{17} NWFP + \alpha_{18} BALUCH + \varepsilon_1 \end{aligned} \qquad (1)$$

The explanatory variables included are the age of the woman (*AGEY*), household income (*HHINCOME*), a dummy for marital status (*MARRY*), four indicator variables each for the highest level of education attained by the woman's father and mother (primary school, secondary school, higher secondary school and college)[2], two dummy variables for missing education of father (*FEDMISS*) and mother (*MEDMISS*), an indicator as to whether the woman is the head of the household (*REL*1), a dummy variable to capture whether the woman resides in a rural area (*RURAL*) and finally, three province dummies for residence in the North West Frontier Province (*NWFP*), Sindh (*SINDH*) and Baluchistan (*BALUCH*) to account for any unobserved heterogeneity.[3] See Table A1 for a description of the variables.

There are of course different ways of modelling education. For example, Brien & Lillard (1994) assume educational outcomes to result from a series of sequential decisions and estimate the educational outcomes using a sequential probit model while Gangadharan & Maitra (2000) and Kambhampati & Pal (2000) estimate the highest level of education attained using a series of binary probits. In this paper we consider the number of years of education attained by the woman as the relevant measure. In principle the number of years of education attained is a continuous variable. However the data does not allow us to clearly distinguish between the number of years the woman remains in college once she has completed high school. Therefore the number of years of education is censored from above - the actual number of years of schooling is observed if years of schooling is less than or equal to 12 and we observe a limit value if the number of years of schooling exceeds 12. So *YRSEDUC* is estimated as a Tobit.

The age at marriage and the duration between marriage and first conception are both modelled as failure time processes represented by a log hazard of duration equation. Let U denote the set of strategies that a woman might undertake to influence the event (including family planning strategies) and let $u \in U$ denote the actual strategy adopted. Let T be the duration of an event (here the event is either marriage or first conception) and T will depend on a number of factors, not all of which are observable. Let η denote the set of all such unobservable factors that we call individual specific unobserved heterogeneity. The hazard rate of an event T is defined as

$h(t \mid u,\eta) \equiv$ Probability that the event T occurs in the time interval $(t,t+dt)$, given that it has not occurred until t and given the value of individual specific unobserved heterogeneity is η and the actual strategy followed is u.

Let $u=0$ and $\eta=0$ represent a woman with an average level of biological endowments who has not followed any specific strategy to affect the event. Then the baseline hazard function is defined as $\lambda_0(t)=h(t|u=0,\eta\eta=0)$. The effect of a particular strategy adopted or of specific biological endowments is to scale the baseline hazard up or down as follows: $h(t|u,\eta)=\lambda_0(t)\Psi(u,\eta),\Psi>0$. Let X denote the co-variates whose values represent the information available to the woman at time t. The specific strategy adopted will then depend both on X and on the unobserved heterogeneity, so that $u=u(X,\eta)$. If we impose the restriction that $\Psi(u(X,\eta),\eta)=\exp\left[X'\beta+\eta\right]$ then the proportional hazard model for the observed event T can be written as $h(t \mid X,\eta)=\lambda_0(t)\exp\left[X'\beta\right]$. The most general characterisation of the baseline hazard function is the Gamma distribution. In this case the density function is given by:

$$f(t)=\begin{cases}\dfrac{|\kappa\alpha|}{\Gamma\left(\kappa\kappa^{-2}\right)}\left(\kappa\alpha^{-2}\right)^{\kappa\kappa^{-2}}\exp\left[\kappa\alpha^{-2}\left(\kappa\alpha z-\exp[\kappa\alpha z]\right)\right] & \text{if } \kappa\neq 0\\ \dfrac{1}{(2\pi)^{1/2}}\exp\left[\dfrac{-z^2}{2}\right] & \text{if } \kappa=0\end{cases}$$

and $z=\dfrac{\ln t-\lambda}{\sigma}$. We parameterise $\lambda_j=X_j\beta$ and the parameters κ and σ are estimated using the data. Note that the hazard function for the Gamma distribution is very flexible and allows for a large number of possible shapes including as special cases the Weibull distribution where $\kappa=1$, the exponential distribution where $\kappa=1,\sigma=1$ and the lognormal distribution where $\kappa=0$. This flexibility is a useful feature for this study as the hazard of getting married or that of having the first child could be non-monotonic.[4]

The use of proportional hazards to estimate the age at marriage or the duration between marriage and first conception could lead to misleading description of the observed choices and hence result in incorrect policy prescriptions. In particular the proportional hazard model does not take into account the effect of time on the hazard function. To explicitly account for the effect of time we consider the accelerated hazard model. For the accelerated hazard model the parameterisation is done at a different level. Let T_0 denote the duration of the event when for a woman drawn randomly from the population of women who do not take any specific step to effect the age at marriage or the duration between marriage and first conception. The hazard rate of T_0 is given by $\lambda_0(t)$. Then $\lambda_0(t)$ denotes the natural hazard rate and T_0 the natural or baseline duration of the event. The effect of a co-variate X is to scale the natural duration of T_0 up or down by e^{β} accordingly as β is positive or negative. So the accelerated hazard model specifies that $T=T_0\exp\left[X'\beta^*+\eta\right]$ or equivalently $\log T=\eta+X'\beta^*+\sigma e$, where $\log T_0\equiv\sigma e,\sigma>0$ and e has a distribution independent of X. Note that β^* is the set of parameters of interest. The

distribution of e can be derived from the baseline hazard distribution $\lambda_0(t)$ of T_0. It should be noted that the proportional and the accelerated hazard models both estimate the same model though in different metrics – for example if the set of coefficients in the proportional hazard model are denoted by β and the coefficients in the accelerated hazard model are denoted by β^* then $\beta^* = -\frac{\beta}{\kappa}$. A negative coefficient β indicates a higher hazard ratio and a lower age at marriage or a lower duration between marriage and conception.

The use of the hazard analysis also allows us to account for censoring in the sample. The censoring arises from the fact that at each stage (marriage and conception) there are women who have "not exited". These are the women who have never been married or these are the women who are married and are yet to conceive. For women who are married but are yet to conceive, the observed duration is the time period between marriage and the survey date. Women who are not married are not included in the estimation sample in the third stage. In Pakistan conception prior to marriage is not common and not socially accepted. In the estimation sample that we have used in this paper we have ignored the few observed cases of childbearing prior to marriage.

Therefore the log hazard equation that characterises the process leading to marriage by a woman is represented as follows:

$$\begin{aligned}\ln(\underline{AGEMAR}) = {} & \beta_0 + \beta_1 YRMAR2 + \beta_2 YRMAR3 + \beta_3 YRMAR4 + \beta_4 YRMAR5 \\ & + \beta_5 HHINCOME + \beta_6 \underline{YRSEDUC} + \beta_7 FEDUC1 + \beta_8 FEDUC2 \\ & + \beta_9 FEDUC3 + \beta_{10} FEDUC4 + \beta_{11} FEDMISS + \beta_{12} MEDUC1 \\ & + \beta_{13} MEDUC2 + \beta_{14} MEDUC3 + \beta_{15} MEDUC4 + \beta_{16} MEDMISS \\ & + \beta_{17} DFNAGM + \beta_{18} DMNAFGM + \beta_{19} RURAL + \beta_{20} SINDH \\ & + \beta_{21} NWFP + \beta_{22} BALUCH + \varepsilon_2\end{aligned} \qquad (2)$$

The co-variates that we include are four marriage cohort dummies – married between 1950 and 1960 (*YRMAR2*), married between 1960 and 1970 (*YRMAR3*), married between 1970 and 1980 (*YRMAR4*) and born after 1980 (*YRMAR5*), household income (*HHINCOME*), the years of education attained by the woman (*YRSEDUC*), a set of indicator variables categorising the highest level of education attained by the woman's father and mother (including categories for missing education), indicators for the main occupation of the woman's father (*DFNAGM*) and mother (*DMNAGM*), a rural residence dummy and three province dummies.[5]

To examine the how age at marriage has changed over time, we need to control for the time when the woman gets married. There are two ways of doing this - one is using marriage cohort dummies and the other is using birth cohort dummies. Using both would lead to multicollinearity in our model as the two are related. Hence we use marriage cohort dummies in our estimation. We re-estimated the model using birth cohort dummies and the results are similar.

Another variable of interest would be whether the woman is enrolled in school, as enrolment could delay marriage and first conception. However as this survey is not retrospective in nature, the respondents were not asked if they were enrolled in school at the time they got married. The only education data that we use is the stock of education, measured by the number of years of education attained by the woman. Flow variables like school enrolment status at the time of marriage or first conception are excluded from our analysis.

The level of education attained could influence the age at marriage by increasing the opportunity cost of early marriage as more labour market opportunities are likely to

be available for more educated women. At the same time, increasing the age at marriage, would free women to attain more education. Hence education levels are endogenous in the age at marriage equation and estimates would be biased unless this simultaneity is accounted for.

Finally the log hazard equation that characterises the process leading to first conception by a woman is represented as follows:

$$\begin{aligned}\ln(\underline{DURAT}) = {} & \gamma_0 + \gamma_1 YRMAR2 + \gamma_2 YRMAR3 + \gamma_3 YRMAR4 + \gamma_4 YRMAR5 \\ & + \gamma_5 HHINCOME + \gamma_6 \underline{YRSEDUC} + \gamma_7 \underline{LAGEMAR} + \gamma_8 SEDUC1 \\ & + \gamma_9 SEDUC2 + \gamma_{10} SEDUC3 + \gamma_{11} SEDUC4 + \gamma_{12} SEDMISS \\ & + \gamma_{13} DSNAGM + \gamma_{14} RURAL + \gamma_{15} SINDH + \gamma_{16} NWFP \\ & + \gamma_{17} BALUCH + \varepsilon_3\end{aligned} \tag{3}$$

The co-variates that we include are four indicator variables for marriage birth cohort, household income, the years of schooling of the woman (*YRSEDUC*), the log of the age at marriage (*LAGEMAR*), four dummy variables categorising the highest level of education of her husband (primary school (*SEDUC*1), secondary school (*SEDUC*2), higher secondary school (*SEDUC*3) and college (*SEDUC*4)), missing education of the husband (*SEDMISS*), primary occupation of the husband (*DSNAGM*), a rural residence dummy and a set of province dummies.[6]

Equations (1), (2) and (3) therefore form the complete structural system. Notice that the system is triangular – we assume that the years of education (*YRSEDUC*) effects both the age at marriage (*AGEMAR*) and the duration between marriage and first conception (*DURAT*) and the age at marriage affects the age at first conception.[7] The reason for joint estimation therefore arises from the possible endogeneity of education in the age at marriage equation and the endogeneity of both education and age at marriage in the time to first child equation.

A priori one would expect that the greater the number of years of education the higher is the age at marriage and the greater is the duration between marriage and first conception. There is no economic reason to argue that the relationship between the age at marriage and the time to the first child should go one way or another. However there are non-economic, in particular biological, reasons to argue that the greater the age at marriage the lower should be the time to first conception.

In theory, we should also be including supply side factors in the above equations, for example, the availability of schools, hospitals and fertility clinics in the community could affect education levels and the time to first conception. However the community level characteristics capture supply side effects in 1991, when the survey was conducted, and not when the woman was being educated or getting married or having her first child. As data on these variables are not retrospective in nature, it is difficult to examine the impact of these supply side factors in this study. We include province dummies and these could help in part to capture differences in these kind of unobservable factors.

4. Results

Stage 1 estimates the number of years of education attained by each woman. Table 2 presents the Maximum Likelihood Tobit estimates of equation (1). The dependent variable is the number of years of education attained (*YRSEDUC*). The following results are worth noting. First, *AGEY* is negative and significant implying that older women are less educated than younger women. Second, *HHINCOME* is positive and significant which implies that women belonging to richer households are more educated. However for both *AGEY* and *HHINCOME*, the magnitude of the coefficients is very small

and not economically significant (for example, a ten year increase in the age of the woman reduces education attained by a quarter of a year). Third, parental education has a significant impact on the woman's education. Relative to a woman whose father has no education, a woman whose father has primary schooling has 1.22 more years of education and a woman whose father has completed high school (has some college education) has 6.15 more years of education. Similarly, relative to a woman whose mother has no education, a woman whose mother has primary schooling has 3.15 more years of education and a woman whose mother has completed high school (has some college education) has 5.5 more years of education. Note that the effect of the mother's education (in terms of the number of years of schooling attained by the woman) is stronger at lower levels of education while the effect of the father's education is stronger at higher levels of education. Women residing in rural areas are less educated and relative to women living in the Punjab, women residing in Sindh, NWFP and Baluchistan have less number of years of education. Does marriage reduce educational attainment? Note that the marital status dummy (*MARRY*) is negative and significant and married women on the average have 2.1 less years of education.

In Stage 2 we estimate the accelerated hazard model of the age at marriage. We consider three versions. In the first we assume that education does not have any impact on the age at marriage. In this case we do not include *YRSEDUC* in the set of explanatory variables (Model 1). In the second we assume that education is exogenous (Model 2) and in the third, education is assumed to be endogenous (Model 3). In the third case we use the predicted value of *YRSEDUC* from Stage 1 as the relevant instrument. A negative sign on the coefficient decreases the age at marriage (increases the hazard of an early

marriage) while a positive coefficient increases the age at marriage (decreases the hazard of an early marriage). The estimated acceleration factor is given by e^{β}, where β is the estimated coefficient. The acceleration factor helps in isolating the magnitude of the effect of a particular variable on the time to marriage. If the acceleration factor is greater than unity then the variable increases the age at marriage while if the acceleration factor is less than unity then the variable decreases the age at marriage. The accelerated hazard estimates are presented in Table 3. The proportional hazard coefficients (β) can be recovered as $\beta = -\beta^{*}\kappa$.

Education has a significant impact on the age at marriage irrespective of whether education is assumed to be exogenous or endogenous. However the acceleration factor is higher when education is assumed to be endogenous. An increase in the number of years of education significantly increases the age at marriage. When education is assumed to be endogenous, *YRMAR5* is positive and significant – the age at marriage is higher for women who were married after 1980 relative to women who were married prior to 1950. An increase in household income reduces the age at marriage. Parental education has very little impact on the age at marriage and whatever impact it has is in the opposite direction to what one would expect. For example women whose father have attained secondary schooling marry earlier compared to women whose fathers have no schooling. The results are similar for mothers' education. Finally we find that relative to women living in the Punjab, women living in Sindh and the NWFP marry significantly early.

In stage 3 we estimate the duration between marriage and first conception. As before we present three sets of results. In the first both education and age at marriage are excluded from the set of explanatory variables (Model 1). In the second while both

education and age at marriage are included, they are both assumed to be exogenous (Model 2). The third is the complete structural model where both education and age at marriage are included and are assumed to be endogenous (Model 3). The instruments for *YRSEDUC* and *LAGEMAR* are the predicted values obtained from stages 1 and 2 respectively. As before, a negative sign on the coefficient decreases the age at marriage (increases the hazard of an early marriage) while a positive coefficient increases the age at marriage (decreases the hazard of an early marriage). The estimated acceleration factor is given by e^{γ}, where γ is the estimated coefficient. The results are presented in Table 4. As before the proportional hazard coefficients (γ) can be recovered as $\gamma = -\gamma^{*}\kappa$.

When education and age at marriage are assumed to be endogenous (Model 3), an increase in the age at marriage significantly reduces the duration between marriage and first conception, as one would expect. In this case education does not have a significant impact on the duration. On the other hand, when education and age at marriage are assumed to be exogenous (Model 2), an increase in education attained leads to a significant decline in the duration between marriage and first conception and an increase in the age at marriage increases the duration between marriage and first conception. This surprising result is possibly due to the fact that *LAGEMAR* and *YRSEDUC* are correlated. The structural model takes care of this endogeneity problem and this is reflected in the sign and significance in the estimated coefficient of *LAGEMAR* in Model 3. Our results suggest that education is affecting the duration indirectly via the age at marriage variable and there is no direct effect of education on the duration between age at marriage and first conception.

This raises the question as to why do we expect education to affect the duration between marriage and first conception. As the education level increases so do the employment opportunities for women. The opportunity cost of early conception therefore increases because in many cases women exit the labour force at the time of childbearing. Their employment careers experience a break, which is reflected in lower lifetime earnings. An increase in education attainment therefore should be associated with an increase in the duration between marriage and first conception. In Pakistan we do not find such a relationship. This could be explained in part by the fact that even though the education level of women has increased, women are not putting this increased education to use in labour market. This is reflected in the significantly lower female labour market participation rate in Pakistan (approximately 20% in 1980) relative to the average for the developing countries (around 40% in 1980) and also relative to the average for the South Asian countries (around 34% in 1980).[8]

Turning to the other results, we find that all the marriage cohort dummies are negative and significant. This implies that women who married before 1950 have a higher duration between marriage and first conception relative to women who married after 1950. Household income has no effect on the duration between marriage and first conception. The highest level of education attained by the husband significantly affects the duration between marriage and first conception but in the wrong direction. Relative to a woman whose husband has no education, a woman whose husband has secondary schooling, higher secondary schooling or college education has a lower duration between marriage and first conception. One possible explanation is that men with higher education marry women who are relatively older and these women have a lower duration between

marriage and first conception – similar to the age at marriage effect. Women whose husband is employed in agriculture and a woman residing in a rural area have a smaller duration between marriage and first conception. Finally relative to women who live in the Punjab, women who live in Sindh or the North Western frontier province have a lower duration between marriage and first conception.

For the basic model (to estimate the duration between marriage and first conception) we do not include any of the characteristics of the woman's parents. This is because given the social structure in Pakistan, after marriage the woman leaves her parents' home and goes to live with her husband and therefore after marriage the woman's parents have very little impact on decisions made by the woman. However one could argue that attitudes matter and attitudes are strongly affected by parental characteristics. As a test of robustness we therefore include indicators for the highest level of education attained by parents in the set of explanatory variables. In the complete structural model (Model 3) both fathers' education and mother's education have a significant effect on the duration between marriage and first conception (see Table 5). Relative to the case where the father has no education, primary or secondary schooling of the father significantly increases the duration between marriage and first conception. Similarly relative to the case where the mother has no education, primary or secondary schooling of the mother significantly increases the duration between marriage and first conception. Parental education does not have a significant effect on the duration between marriage and first conception in Model 1 and Model 2.

5. *Conclusion*

In this paper we estimate a structural model of education attainment, age at marriage and age at first conception among women in Pakistan. The reason for joint estimation arises from the possible endogeneity of education in the age at marriage equation and the endogeneity of both education and age at marriage in the duration to first child equation. We find that over the last few decades there has been a significant increase in education attainment among women in Pakistan but there has not been a corresponding increase in the age at marriage and the duration between marriage and first conception – in fact the duration between marriage and first conception shows a significant decline.

Our estimation results show that older women are less educated and more educated women delay marriage. Educational attainment is significant in increasing the age at marriage, but it does not have a statistically significant effect on the duration between marriage and first conception. An increase in the age at marriage significantly reduces the duration between marriage and first conception. Education of the husband significantly affects the time to first conception. There are also significant marriage cohort effects – the average age at marriage is higher for women who marry after 1980 relative to women who marry prior to 1950 and the duration between marriage and first conception is higher for women who were married prior to 1950. The results improve significantly when we account for the endogeneity of the variables of interest and this highlights the fact that it is important to jointly study these features of demographic transition to rigorously examine fertility trends in Pakistan.

End Notes

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[1] This finding is similar to Donaldson & Nichols (1978) and Rindfuss & Morgan (1983), who argue that it is the increase in the age at marriage that has resulted in a significant increase in early female conception. Feng & Quanche (1996) find a similar path for age at marriage and first conception using a national sample of women from China. They argue that the reason for this is that sexual behaviour has changed in China.

[2] *FEDUC1, FEDUC2, FEDUC3, FEDUC4* (for father) and *MEDUC1, MEDUC2, MEDUC3, MEDUC4* (for mother).

[3] The reference categories are: the father and mother have no education and the woman lives in the Punjab.

[4] Test for $\kappa = 1$ and $\kappa = 0$ are both rejected using the 95% confidence interval.

[5] The reference categories are: the woman married before 1950, the father and mother have no education and the woman lives in the Punjab. The rest of the explanatory variables are the same as in equation (1).

[6] The reference categories are: the woman married before 1950, the husband has no education and the woman lives in the Punjab. The rest of the explanatory variables are the same as in equations (1) and (2).

[7] Remember that in Pakistan there is essentially no childbearing prior to marriage. Therefore age at first conception does not affect the age at marriage. The few cases of childbearing prior to marriage have been ignored from our analysis.

[8] The PIHS is not retrospective and the survey questions do not track down labour force participation at different stages of the woman's life. The figures on female labour force participation rates have been obtained from the World Bank database.

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Table 3:
Hazard Analysis of Age at Marriage

VARIABLE	MODEL 1			MODEL 2			MODEL 3		
	COEFF	STD. ERROR	ACCL. FACTOR	COEFF	STD. ERROR	ACCL. FACTOR	COEFF	STD. ERROR	ACCL. FACTOR
INTERCPT	1.085*	0.007	2.959	1.077*	0.007	2.937	1.061*	0.008	2.890
YRMAR2	0.001	0.003	1.001	0.001	0.003	1.001	-0.002	0.003	0.998
YRMAR3	0.010*	0.003	1.010	0.009*	0.003	1.009	0.001	0.003	1.001
YRMAR4	0.014*	0.003	1.014	0.010*	0.003	1.010	-0.001	0.003	0.999
YRMAR5	0.027*	0.003	1.028	0.022*	0.003	1.022	0.007*	0.004	1.007
HHINCOME	8.601E-09*	3.528E-09	1.000	3.357E-09	3.450E-09	1.000	-1.710E-08*	4.651E-09	1.000
YRSEDUC					2.840E-04				
				0.004*		1.004	0.020*	0.002	1.020
FEDUC1	0.031*	0.014	1.032	0.028*	0.014	1.028	-0.002	0.016	0.998
FEDUC2	0.029*	0.013	1.030	0.016	0.013	1.016	-0.032*	0.016	0.968
FEDUC3	0.923	153.290	2.516	0.902	169.358	2.465	0.868	130.802	2.382
FEDUC4	0.060**	0.033	1.062	0.028	0.034	1.028	-0.073**	0.039	0.930
FEDMISS	-0.002	0.008	0.998	-0.008	0.008	0.992	-0.038*	0.010	0.963
MEDUC1	0.024	0.024	1.024	0.010	0.024	1.010	-0.046**	0.028	0.955
MEDUC2	0.021	0.020	1.021	-0.004	0.021	0.996	-0.064**	0.024	0.938
MEDUC3	0.318	239.919	1.374	0.296	501.276	1.345	0.201	386.821	1.222
MEDUC4	0.438	211.406	1.549	0.475	457.168	1.607	0.310	341.864	1.363
MEDMISS	-0.037*	0.007	0.963	-0.030*	0.007	0.970	-0.016*	0.007	0.984
DFNAGM	-0.018	0.012	0.982	-0.018	0.012	0.983	-0.017	0.013	0.983
DMNAGM	-0.033**	0.020	0.967	-0.027	0.020	0.973	-0.027	0.021	0.973
RURAL	-0.009*	0.002	0.991	-0.002	0.002	0.998	0.032*	0.005	1.032
SINDH	-0.025*	0.002	0.975	-0.025*	0.002	0.976	0.021*	0.002	0.979
NWFP	-0.017*	0.002	0.983	-0.014*	0.002	0.986	-0.004	0.003	0.996
BALUCH	-0.009*	0.003	0.991	-0.004	0.003	0.996	0.020*	0.005	1.020
κ	0.070	0.001		0.069	0.001		0.070	0.001	
σ	0.064	0.010		0.067	0.010		0.084	0.012	

W(1)	864900*	866761*	864900*
W(0)	4900*	4761*	4900*

Notes:

Acceleration Factor given by e^{β}, where β is the estimated Coefficient

*: Significant using the 95% confidence interval

**: Significant using the 90% confidence interval

MODEL 1: No Education included

MODEL 2: Education assumed to be Exogenous

MODEL 3: Education assumed to be Endogenous

Test: $\kappa = 0$: $W(0) \sim \chi^2(1)$

Test: $\kappa = 1$: $W(1) \sim \chi^2(1)$

Table 4:
Hazard Analysis of Duration Between Marriage and First Child

VARIABLE	MODEL 1			MODEL 2			MODEL 3		
	COEFF	STD. ERROR	ACCL. FACTOR	COEFF	STD. ERROR	ACCL. FACTOR	COEFF	STD. ERROR	ACCL. FACTOR
INTERCEPT	3.289*	0.136		2.446*	0.219		16.055*	2.587	
YRMAR2	-1.032*	0.127	0.356	-1.062*	0.129	0.346	-0.892*	0.128	0.410
YRMAR3	-1.688*	0.126	0.185	-1.723*	0.128	0.178	-1.421*	0.131	0.242
YRMAR4	-2.354*	0.126	0.095	-2.387*	0.129	0.092	-2.006*	0.136	0.135
YRMAR5	-3.016*	0.130	0.049	-3.052*	0.133	0.047	-2.486*	0.153	0.083
HHINCOME	-9.865E-08*	4.765E-08	1.000	-8.364E-08	4.794E-08	1.000	8.968E-08	6.767E-08	1.000
LAGEMAR				0.316*	0.066	1.372	-12.176*	2.514	0.000
YRSEDUC				-0.026*	0.005	0.975	-0.067	0.042	0.935
SEDUC1	-0.019	0.039	0.981	-0.011	0.039	0.989	-0.016	0.039	0.984
SEDUC2	-0.086*	0.036	0.917	-0.048	0.037	0.953	-0.08**	0.036	0.916
SEDUC3	-0.182*	0.083	0.834	-0.095	0.085	0.910	-0.189*	0.082	0.828
SEDUC4	-0.326*	0.063	0.722	-0.187**	0.071	0.830	-0.333*	0.063	0.717
SEDMISS	-0.042	0.046	0.958	-0.020	0.047	0.980	0.010	0.048	1.010
DSNAGM	-0.060*	0.029	0.942	-0.060	0.029	0.942	-0.061*	0.028	0.941
RURAL	0.004	0.028	1.004	-0.024	0.029	0.977	-0.246*	0.084	0.782
SINDH	0.048	0.031	1.049	0.062*	0.032	1.064	-0.291*	0.070	0.747
NWFP	0.137*	0.040	1.146	0.134*	0.040	1.144	-0.151*	0.060	0.860
BALUCH	0.294*	0.055	1.342	0.284*	0.055	1.328	0.059	0.079	1.060
κ	0.713	0.021		0.710	0.020		0.709	0.021	
σ	0.124	0.084		0.119	0.083		0.117	0.084	
W(1)	186.778*			210.25*			192.020*		
W(0)	1152.764*			1260.25*			1139.866*		

Notes:

Acceleration Factor given by e^{γ}, where γ is the estimated Coefficient

*: Significant using the 95% confidence interval

**: Significant using the 90% confidence interval

MODEL 1: No Education or Age at Marriage included

MODEL 2: Education and Age at Marriage assumed to be Exogenous

MODEL 3: Education and Age at Marriage assumed to be Endogenous (Complete Structural Model)

Test: $\kappa = 0$: $W(0) \sim \chi^2(1)$

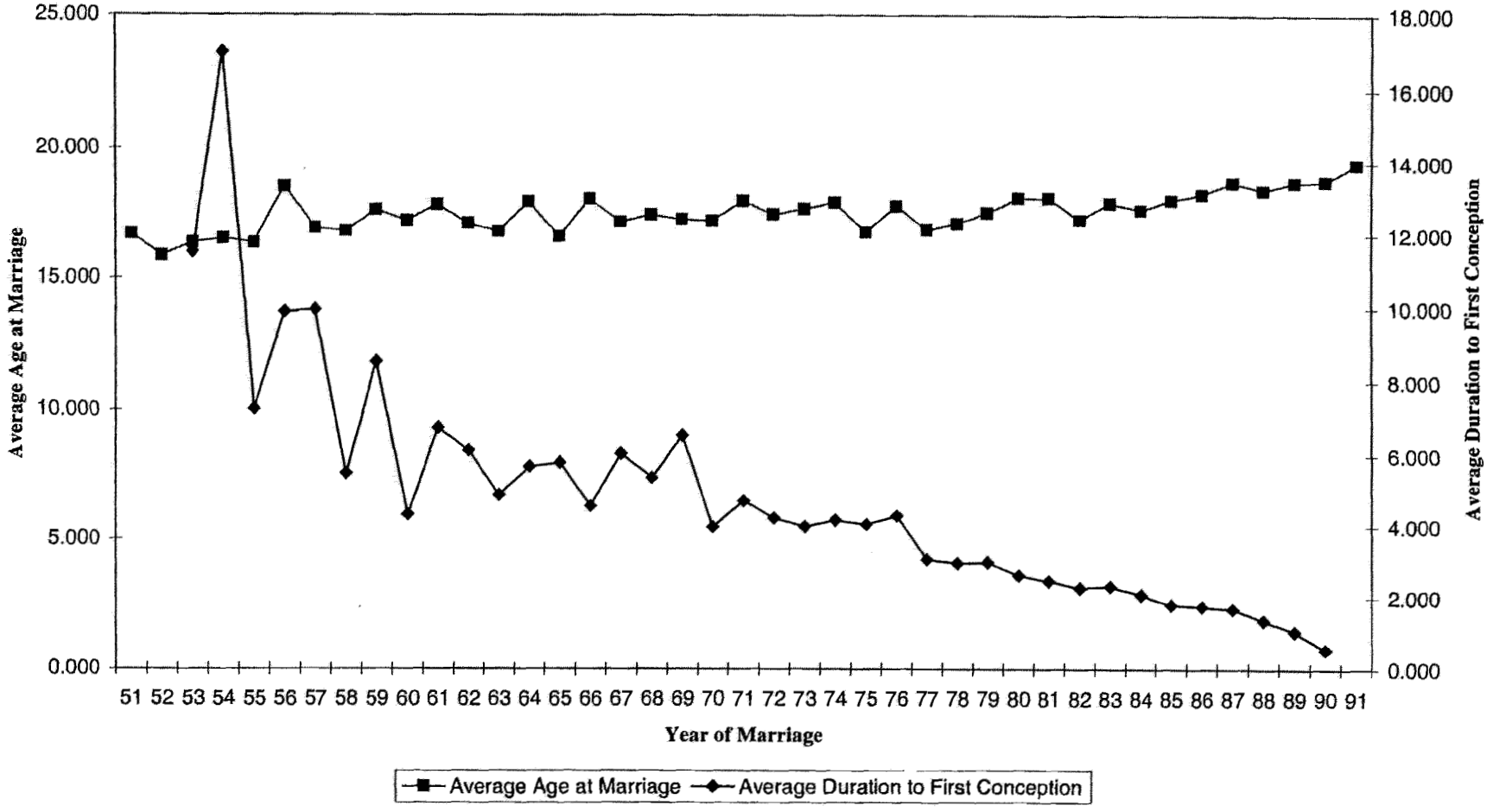
Test: $\kappa = 1$: $W(1) \sim \chi^2(1)$

Table 5:
Robustness of Results
Effect of Parental Education on Duration between Marriage and First Conception

	MODEL 1		MODEL 2		MODEL 3	
	COEFF	STD. ERROR	COEFF	STD. ERROR	COEFF	STD. ERROR
FEDUC1	0.129	0.262	0.086	0.260	1.432*	0.282
FEDUC2	-0.048	0.233	-0.017	0.232	3.380*	0.447
FEDMISS	0.052	0.143	0.063	0.143	2.466*	0.365
MEDUC1	-0.138	0.382	-0.065	0.380	3.508*	0.576
MEDUC2	0.541	0.503	0.690	0.497	5.784*	0.847
MEDMISS	0.079	0.114	0.050	0.114	-0.324*	0.155

Notes:
*: Significant using the 95% confidence interval
**: Significant using the 90% confidence interval
MODEL 1: No Education or Age at Marriage included
MODEL 2: Education and Age at Marriage assumed to be Exogenous
MODEL 3: Education and Age at Marriage assumed to be Endogenous (Complete Structural Model)

Figure 1:
Average Age at Marriage and Average Duration to First Conception



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