Delay in First Marriage and First Childbearing in Korea- Trends in Educational Differentials

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Abstract

Stimulated by socioeconomic development, Korea has experienced rapid fertility decline since the 1960s. I study this social and demographic transformation by examining educational differentials in the timing of first marriage and first childbearing. To do this, I estimate multi-state life tables and Cox proportional hazard models using the Korean Labor and Income Panel Study (KLIPS). The analyses show that both educational expansion and growing educational differentials contribute to the delay of first marriage and first birth. Simulation and decomposition analysis shows that growing educational differentials are more important than compositional change in explaining delays in first marriage and childbearing. This implies that growing opportunity costs of marriage and childbearing, as well as lack of institutional adjustments to women's labor market participation are responsible for the delay in marriage and childbearing in Korea.

INTRODUCTION

This study examines trends in educational differentials in the timing of first marriage and first childbearing in Korea. Korea has experienced rapid fertility decline since the 1960s. The total fertility rate (TFR) in 1960 was 6.0 and decreased to below the replacement level (2.1) in 1983. The TFR continued declining, reaching 1.1 in 2006, much lower than in most Western countries. Fertility declined as a result of women's improved socioeconomic status, more permissive attitudes towards birth control, and more reliable means for contraception – the classic model of demographic transition (Notestein 1945; Coale 1973; Mason 1997). Among the socioeconomic developments, educational expansion was phenomenal. For example, while only 10 % of women received some high school education in 1960, 59% of women in 2005 did so (Korea Statistical Office 2008). Although socioeconomic development is associated with fertility decline in general, the Korean experience is notable because of extremely rapid pace of fertility decline and socioeconomic development. This simultaneous transformation in various aspects of social life is one of the most important features of "compressed modernization" in Korea (Chang 1999). I will study this rapid social and demographic change in Korea by examining educational differentials in the timing of first marriage and first childbearing. Given the importance of delayed marriage for rapid fertility decline (Kwon 1977; Eun 2001) and rapid educational expansion in Korea (Choe 2006), this examination is essential in understanding fertility decline in Korea.

EDUCATIONAL DIFFERENTIALS IN THE TIMING OF FIRST MARRIAGE AND FIRST CHILDBEARING

The negative association between education and fertility is commonly found and there are several reasons why highly educated women tend to marry and give birth later than their less educated peers (Bongaarts 2003; Jejeebhoy 1995). One explanation points to the difficulties in being married and having children. It is simply difficult to get married and to have children while attending school (Mare and Winship 1991). Marriage involves running independent household, which may be difficult economically. This behavioral constraint certainly contributes to later marriage of highly educated women. Second, more educated women enjoy more autonomy over their life than do their less educated peers, and are less likely to be subject to traditional norms (Mason 1985). For example, highly educated women are more likely to choose their own spouses rather than accepting arranged marriage, which increases the time spent to search for mates. Another explanation highlights the reduced economic gains to marriage among highly educated women (Becker 1974). Gender specialization of household work would not be beneficial to highly educated women, and the opportunity cost of marriage would also be greater for them. In addition, an extended spouse search is more affordable for highly educated women because of their economic independence (Oppenheimer 1988).

What about the timing of childbearing? Because non-marital births are unusual in Korea, delayed marriage would lead to delayed first childbearing. But net of educational differences in the timing of first marriage, would we still observe later childbearing among the better educated? The behavioral perspective would predict no association: if a college graduate woman marries later than a high school graduate does mainly because the former stays longer in school, there is no reason to expect that the former will also delay childbearing upon getting married. The autonomy hypothesis, however, would predict later childbearing of the better educated women even net of differences in marriage timing: the highly educated women may have better access to contraception or may be able to better negotiate with their husbands if they want to delay childbearing. The economic independence hypothesis would also predict later childbearing because the opportunity cost of childbearing is larger for the highly educated. In addition, economic theory also suggests the quality-quantity trade-off, which implies differentials in the direct cost of raising children and therefore delayed childbearing of highly educated women net of timing of marriage (Becker 1974).

TRENDS IN EDUCATIONAL DIFFERENTIALS

How are educational differentials expected to change over time, given the association between education and the timing of marriage and childbearing? The behavioral perspective and the autonomy perspective do not expect change in the association between education and the timing of marriage and childbearing over time. There is no reason to think that the effects of prolonged schooling and enhanced autonomy on the timing of marriage and childbearing differ across cohorts. Instead, these perspectives suggest that the increases in educational attainment would primarily explain the delay in marriage and childbearing. As women in later cohorts stay in school longer, they need to delay their marriage and childbearing more than earlier cohorts (*behavioral perspective*). Women in later cohorts received more schooling and therefore enjoyed more autonomy over their life, and this enhanced autonomy should yield the delays in marriage and childbearing (*autonomy perspective*). According to economic theories, educational differentials in the timing of marriage and childbearing should depend on cost and benefit of marriage and childbearing. For example, if educational differentials in opportunity cost increase over time, this theory should expect later marriage and childbearing. Then, what factors influence the educational differentials in opportunity cost of marriage and childbearing? Here, I consider three institutional arrangements associated with the education gap in the opportunity cost of marriage and childbearing: labor market participation, changing mate selection criteria in marriage market, and gendered division of household work.

Women's Economic Participation

<Figure 1> about here

First of all, women's economic participation increases opportunity cost because working women have more things to lose upon marriage and childbearing than non-working women do. In this sense, Figure 1 strongly suggests growing educational differentials in opportunity cost of marriage and childbearing in Korea. Overall, women's economic participation rate has been increasing since 1980, which suggests overall increase in opportunity of marriage and childbearing over time. More interestingly, we can also observe that educational differentials in women's economic participation have been also increasing. In particular, the economic participation rate of college graduates has increased much more rapidly than the other groups. This suggests that the difference in opportunity cost between women with bachelor's degree and the less educated women increased over time. The increasing differentials in opportunity cost lead us to expect growing educational differentials in the timing of marriage and childbearing.

Other institutional settings, however, would adjust growing educational differentials in labor market participation. In particular, spouse search process in marriage markets and gendered division of household labor should be sensitive to changing labor market circumstances and also affect educational differentials to some extent.

Marriage Market Search

Oppenheimer (1988) paid a close attention to changing structure of affordability of marriage. She expected delayed marriage in general because of the longer time required for young men to establish careers that are essential for economically stable marriage. Stagnation of young men's earnings makes women's economic potential a more important attribute in the marriage market, and rising cost of living would strengthen the importance of this. In this sense, growing educational differentials in women's labor market participation in Korea could contribute to decreasing educational differentials in the timing of marriage because the better educated women would contribute more to economically stable marriage. However, another aspect of Oppenheimer's theory would suggest increasing differentials. More educated women are better able to extend their spouse search because of their economic independence, which should yield later marriage of the better educated. Growing earnings differentials by educational attainment would widen the education differences in spouse search time. In an extreme case, this extended search may result in forgoing marriage altogether. For example, Raymo and Iwasasa (2005) found that women with a college education in Japan delay marriage and are more likely to never marry because they have a problem in finding marriageable men at later stage of their search. While the increasing importance of women's economic potential in the marriage market suggests decreasing educational differentials, prolonged spouse search of highly educated women suggests increasing educational differentials. Hence, a simple prediction based on marriage market theory is not possible.

Normative Adjustments in Gender Division of Labor

Opportunity cost of marriage and childbearing would depend on how normative or institutional arrangements adjust to the trend in women's educational attainment and labor force participation (Mason and Jensen 1995). Tsuya and Mason (1995) argued that gender differences in normative expectation about the division of labor increased between the 1970s and the 1990s, contributing to the delay of marriage in Japan. This implies that lack of institutional or normative adjustments in Japan caused extremely late marriage and childbearing when it is combined with increasing opportunity costs of marriage and childbearing. In other words, delayed transition to "symmetrical partnership" (Cherlin 2004) led to declines in nuptiality in Japan. By contrast, if the gendered division of labor becomes more egalitarian as women attain more schooling and participate more in the labor market, the opportunity cost of marriage and childbearing is reduced to some extent. Time use studies in the United States. shows this adjustment to some extent (Bianchi et al. 2000; Gershuny et al. 2005). These findings suggest that change in gender division of labor favorable for women may slow down the trend of delayed or forgone marriage caused by increasing opportunity costs of marriage and childbearing.

How do institutional adjustments affect the association between education and the timing of marriage and childbearing? Favorable institutional arrangements for highly educated women decrease educational differentials. Given strong educational assortative mating in Korea (Park and Smith 2005), and the presumably more egalitarian gender attitude of the better educated couples than the less educated (Goode 1970; Parsons 1964), we may expect institutional change would be favorable for the better educated women. However, the strong patriarchal culture prevalent in Korea leads us to expect no substantial difference in institutional arrangements by education. Because of the higher opportunity cost for highly educated women, this lack of institutional adjustments would contribute to growing educational differentials. Choe (2006) found much greater gender differences than educational differences in normative expectation about the gendered division of labor. This suggests delayed transition to "symmetrical partnership" (Cherlin 2004) even for highly educated couples in Korea, which would result in increasing educational differentials.[1]

In sum, educational differentials in the timing of first marriage and childbearing are dependent on the institutional changes that affect opportunity cost: women's economic participation, changing marriage market structure, and gender division of labor. Increasing educational differentials in women's economic participation should *increase* in the differentials in the timing of marriage and childbearing. However, this trend would be dependent on other related institutional adjustments. Educational differentials should *decrease* if gender division of household work adjusts to women's increased labor force participation and the importance of women's economic potential grew in marriage markets. Lack of adjustment or prolonged spouse search of highly educated women would *increase* educational differentials. Therefore, the trends in educational differentials in the timing of marriage and childbearing will be determined by how gender division of household work and marriage market dynamics adjust to change in women's educational attainment and labor force participation.

[1] There are other institutional arrangements that may influence educational gap in the cost and benefit of marriage and childbearing. For example, availability and prevalence of contraception and abortion should affect the timing of marriage and childbearing. In particular, if there are educational differentials in contraception and abortion, these should explain changing educational differentials in the timing. Although this study focuses on macro socioeconomic change, these micro changes should be considered for more complete description of fertility change in Korea.

Compositional Change and Associational Change

In two of the theories above – the behavioral constraints perspective and the autonomy perspective – compositional change in educational attainment is largely responsible for the delay in marriage and childbearing. This is because no change in *association* between education and the timing of marriage and childbearing is expected. In addition to the contribution of compositional change to the delayed marriage, economic theories and institutional perspectives expect the contribution of changing educational differentials to the delay in marriage and childbearing. Increasing educational differentials would delay marriage and childbearing further while decreasing differentials would exert the opposite influence. In this sense, if change in educational differentials is more influential than the compositional change, this implies that change in opportunity cost and related institutional arrangements are more crucial than behavioral constraints or enhanced women's autonomy in understanding the delay of marriage and childbearing.

RESEARCH QUESTIONS

To understand trends in educational differentials in the timing of marriage and childbearing and its implications for fertility decline, this study compares the timing of first marriage and first childbearing across birth cohorts. Using multi-state life table analysis and Cox proportional hazard models, I examine how the timing of marriage and childbearing changed over time and how the relationship between education and the timing of family formation in Korea has changed over time. Focusing on the timing of the first marriage and first birth only can be justified because fertility decline in Korea was driven by later marriage (Kwon 1977; Eun 2001).[2] I will examine the following research questions.

1. *What is the contribution of increases in women's schooling to delayed first marriage and first childbearing over time?*
2. *How do educational differentials in the timing of first marriage and first childbearing change over time?*
3. *What are the respective contributions of compositional and associational change to delays in first marriage and childbearing?*

DATA AND METHODS

Data

I use the first wave of the Korean Labor and Income Panel Study (KLIPS), an annual panel survey of a representative sample of urban Koreans age over 15 in 1998.[3] The KLIPS provides retrospective information on age at first marriage and first birth, school enrollment history, and other relevant socio-demographic measures. Unfortunately, the data provide only limited information on school enrollment history. Information is available for school enrollment history for post-secondary education, and the month and year when the respondents permanently left school (if applicable), regardless of their level of education. The reconstruction of schooling history necessarily induces some errors. Here, I assume that there is no enrollment disruption

[2] Studying women's complete birth history would be more informative for understanding fertility decline as a whole, but the data requirements are stringent for this kind of study. In addition, behaviors of the more recent birth cohorts may not be appropriately captured in this approach.
[3] The eighth wave is publicly available, but I only use the first wave because school enrollment history, which is important information in subsequent analyses, is available only in the first wave.

before high school graduation. For example, a person with high school diploma is assumed to have continued his or her schooling until high school graduation without any disruption. I checked the validity of this assumption by comparing the implied and reported school-leaving timing. For more than 80 percent of respondents, the difference between them is less than 2 years, which gives some confidence in my simplifying assumption. Because the KLIPS interviewed all individuals in household aged over 15, I can construct representative records using the retrospective information. Among 6,467 female respondents between age 15 and 70, 70 women are missing data for educational history. 390 respondents are missing in control variables: 359 missing in father's education and 31 missing in place of living at age 14. Data analysis is based on the 5,990 observations that are not missing in any variables.

<Table 1> about here

Descriptive statistics displayed in Table 1 show cohort differences in the educational distribution, control variables, percent never-married and percent never-childbearing. We can find that women's educational opportunity expanded rapidly and the timing of first marriage and first childbearing have been delayed substantially.

Multi-State Life Table Analysis

It is methodologically challenging to establish a causal relationship between education and the timing of marriage and childbearing. In event history analysis, we typically assume that education affects marriage and childbearing, but the causal direction is not straightforward in this context. For example, childbearing has a detrimental effect on educational outcomes among teenagers (Lee 2007). Hence, before making claims about causality, we need to examine the sequences of events in great detail. If we find marriage and childbearing occur after living school for most women, we would be in a safe position to build causal relationship between education and marriage and childbearing. [4] Otherwise, we should avoid making causal inference. Using multi-state life table analysis, I examine the sequences of events in detail.

<Figure 2> about here

The process of schooling, first marriage and first childbearing is displayed in Figure 1. Transitions to first marriage and first childbearing are non-reversible events whereas transitions involved in school are repeated events. In other words, a woman can leave and return to school any time, but she cannot become never-married or childless once she transited to being married or giving birth. This yields 8 distinct states and 16 possible transitions between them.

From the observed transition rates between distinct states (${}_nM^{ij}_x$), we can estimate the life table quantities such as the number of people in state i at age x ($l^i(x)$), the number of transitions from the state i to the state j between age x and $x+1$ (${}_nd^{ij}_x$), and probability of leaving state i between age x and $x+1$ (q^i_x), and the number of person-years lived in state i between age x and $x+1$ (${}_nL^i_x$). The mathematical relationships between these measures are as follows (Palloni 2001: 263);

[4] However, this may not fully justify making a causal inference because education and family building behaviors may be jointly determined by other 'unobserved' factors. For example, a recent study shows that risk-taking tendency, which is not typically observed in survey data, explains variations in education and the timing of first marriage and childbearing (Schmidt 2008). This suggests that the effect of education on the timing of marriage and childbearing would be biased without controlling for this factor. Unfortunately, this study cannot control for these factors, so we need to be cautious in interpreting the results based on event history analysis.

$$l^i(x+n) = l^i(x) + \sum {}_n d^{ji}{}_x - \sum {}_n d^{ij}{}_x \qquad (1)$$
$${}_n d^{ij}{}_x = {}_n M^{ij}{}_x * {}_n L^i{}_x \qquad (2)$$
$${}_n L^i{}_x = .5*[\, l^i(x) + l^i(x+n)] \qquad (3)$$
$$q^i{}_x = 1 - \; (l^i(x) - l^i(x+n))/\, l^i(x) \qquad (4)$$

Using person-month data from the KLIPS, I estimate a multi-state life table for all women in the sample and separate life tables by birth cohorts to see changing patterns across cohorts. The risk of transitioning among states starts at age 15 and the cases are censored at age 45. I characterize the following states as "conventional:" State 1 (in-school, never-married and childless), State 5 (out-of-school, never-married and childless), State 6 (out-of-school, ever-married and childless) and State 8 (out-of-school, ever-married and ever-giving birth). The other states are characterized as "unconventional". By examining the rates of the transitions to the "unconventional" states and how much time is spent in these "unconventional" states, I can check the validity of causal assumptions in the hazard model. In addition, multi-state life tables allow me to examine the contribution of increasing schooling to delays in marriage and childbearing by comparing *L* measures across cohorts. For example, if increases in time spent in school (State 1) are largely responsible for later marriage and childbearing of recent cohorts, this implies that the behavioral constraint of schooling for marriage and childbearing is a crucial part of the story.

Event History Analysis

I use Cox proportional hazard models to estimate the effect of education on the timing of first marriage and first childbearing. The log of hazard of getting married and give first birth is modeled as a linear function of years of schooling, school enrollment, and control variables.

Control variables include father's years of schooling and whether the respondents lived in metropolitan areas at age 14. Control variables are time-invariant, and education variables are used as time-varying covariates. Cox proportional hazard models are appropriate for this study because incorporation of time-varying covariates is easy and it is difficult to make a parametric assumption about the baseline hazard of first marriage and first childbearing (Allison 1995; Singer and Willet 2003). The following features are worth mentioning with regard to model specifications. First, the risk of first marriage and first childbearing begins at age 15 and the cases are censored at age 45 as in the multi-state life tables. The non-marital birth rate is very low in Korea, so I might limit my analysis to marital births and set the risk of childbearing to start after marriage. However, to see the effects of the covariates on the timing of first birth after controlling for the timing of first marriage, I estimate hazard models of first birth using marital status (never-married vs. ever-married) as a time-varying covariate. Second, as I noted above, failing to control for school enrollment would yield overestimation of the negative effects of education on the timing of first marriage and birth. I include school enrollment (in school vs. out-of-school) as a time-varying covariate in the model to address this problem. I include years of schooling as a time-varying covariate because many of youngest cohort members (1974 – 83) do not finish their schooling. In addition, using years of schooling as a time-varying covariate facilitates testing of non-proportional effects of education on the rate of marriage and childbearing. For example, the negative association between education and risk of marriage and childbearing would be greater earlier in life. Third, I include cohort and its interaction with education as covariates in the model to test for cohort differences in educational differentials. I also test the non-proportionality of cohort differences in the effect of years of schooling on hazard by including three-way interaction of years of schooling, cohort and age. Finally, I use

Efron approximation to handle tied cases because exact method of tie-handling does not allow for computing Schoenfeld residuals needed to test non-proportionality. The following Cox hazard models are estimated:

First marriage

$$\log[h(t)] = a(t) + \beta_1 FE + \beta_2 Metro + \beta_3 E(t) + \beta_4 S(t) + \sum \beta_j C + \sum \beta_k E \times C + \beta_5 E(t) \times Age + \beta_6 S(t) \times Age + \sum \beta_1 E \times C \times Age \quad -(1)$$

First birth

$$\log[h(t)] = a(t) + \beta_1 FE + \beta_2 Metro + \beta_3 E(t) + \beta_4 S(t) + \sum \beta_j C + \beta_5 MS(t) + \sum \beta_k E \times C + \beta_6 E(t) \times Age + \beta_7 S(t) \times Age + \sum \beta_1 E \times C \times Age \quad -(2)$$

h(t): hazard, a(t): log of baseline hazard
FE: Father's years of schooling, Metro: place of living at age 14
E(t): Years of schooling, S(t): School enrollment
C: Cohort, MS(t): Marital status

To understand the importance of compositional change and associational change, I conduct a simulation and decompose the proportional change in cumulative hazard into proportional change in educational composition and association across birth cohorts. To facilitate the cohort comparison, simulation and decomposition model use only time-constant covariates. First, I will do a simulation using the parameter estimates from the hazard models and observed distribution of education and other controls. This simulation will show what the proportion never-married and childless at different ages would look like if either compositional change or associational change occurred. This will illustrate the size of the effects of compositional change and associational change on the timing of marriage and childbearing. Second, decomposition method will allow for quantifying the contribution of compositional and associational change to the proportional change in cumulative hazard.

RESULTS

Multi-State Life Tables

<Table 2>, <Figure 3> and <Figure 4> about here

Table 2 shows the person-years lived between age 15 and 34 in each state. First of all, it shows that person-years spent in "unconventional" states are minimal. On average, less than 1 year out of 20 years is spent in these "unconventional" states. This implies that transition to marriage and motherhood in Korea are quite ordered. One interesting exception is that relatively long years (1.2 years) are spent in single motherhood for the earliest cohort (born between 1928 and 1943). This implies that the lack of contraceptive means for this cohort would yield more non-marital birth than the later cohorts. Figure 3 also shows that transition probability of going back to school is virtually zero. Actually, the estimated transition probabilities in multi-state life tables fluctuate quite a lot. I smoothed the transition probability in this graph, using a local polynomial smoothing method available in STATA 10 (Cox 2005).

Second, we can see that delays in marriage and childbearing are largely explained by the increase in schooling. Figure 4 illustrates this point. On average, Korean women spent about 6 years after leaving school and before getting married, and spent about 1 year before being a mother upon marriage. There is virtually no change in the time spent in these two states across cohorts. This suggests the strong influence of educational expansion on the delay in marriage and childbearing.. This finding is also consistent with previous research; nuptiality drove fertility decline in Korea (Kwon 1977; Eun 2001). Upon marriage, women tend to have children quite quickly. In addition, Figure 2 also shows that transition probability from 6 and 8 is quite high, which also implies quick childbearing upon marriage.

Educational Differentials, Hazard Models

<Table 3> about here

Parameter estimates of survival analysis are given in Table 3. The effects of years of schooling on the hazard of first marriage and first childbearing differ by cohorts. These differences are statistically significant, and we can see growing negative educational differentials in the timing of marriage and childbearing. We can also see the statistically significant three-way interaction, which suggests cohort differences in the educational differentials. Except for one interaction, the positive three-way interactions are observed, indicating that the cohort differences in the educational differentials are smaller in later life. Figure 5 shows how the effects of education on the hazard of first marriage and first birth differ by cohort and age.

<Figure 5> about here

When the value in this graph is smaller than 1, this means that one-year increase in schooling decreases the hazard of getting married and giving birth. We can see that the negative effect of education on hazard is strong earlier in life, but this effect is getting smaller and after certain age, there appears a positive association between education and hazard of getting married and having a child. Non-proportional effect of education on marriage implies that highly educated women marry and give birth later and instead of forgoing marriage and childbearing. For cohort difference, we can see the effect of education on marriage and childbearing becomes greater over cohorts, except for the smaller effect of education for the second cohort (born 1944 – 53) on the hazard of getting married than for the first cohort (born in 1928 – 43). The growing educational differentials support the claims that growing opportunity cost and the lack of institutional adjustments explain delays in marriage and childbearing. However, the cohort differences in educational differentials are smaller later in life, say after age 30. This implies that highly educated women in the recent birth cohorts are more likely to marry and have a child eventually than their less educated peers or highly educated women in the earlier cohorts, upon remaining single and childless until around age 30. Altogether, highly educated women are likely to marry later and give birth later, and educational differentials in the timing of marriage and childbearing are growing over time. However, the cohort differences in the educational differentials become smaller in later life.

Simulation and Decomposition

<Figure 6> about here

Whereas multi-state life table analysis suggests the importance of compositional change in the delay of first marriage and first childbearing, survival analysis shows that growing educational differentials account for delays in first marriage and childbearing. To see the importance of compositional and associational change for the delay in the timing of first marriage and first childbearing, I conducted a simulation using the observed distribution of education and control variables for each cohort and association predicted from Cox proportional hazard models. For the simulation, I only include time-constant covariates (completed years of schooling, father's years of schooling, place of living at age 14 and cohort) to facilitate cohort comparison. Parameter estimates are shown in Table A1. Cohort means of education and father's education given in Table 1 are used in the simulation. Panel A in Figure 6 shows that the expected percent of women who are never married for four hypothetical conditions. A thin solid line shows the expected percent never married for first cohort women, with their own education and father's education fixed at cohort mean, and having lived in metropolitan areas at age 14. A thick solid line is the equivalent survival curve for women in cohort 4. Comparing these two lines clearly demonstrates the later marriage of the younger cohort compared to the older cohort. The dashed line shows a hypothetical survival curve when holding everything else the same as the cohort 1 except for mean years of schooling, which is set to be the same as mean of the cohort 4. The dotted line shows the effect of the associational change on proportion never-married, holding the mean years of schooling the same as cohort 1. Panel B is an equivalent graph for percent childless. These simple simulations suggest a slightly stronger effect of associational change on the timing of marriage, and a much stronger effect on the timing of childbearing than compositional change. This suggests that increasing educational differentials in the timing of marriage and childbearing is more responsible for delayed marriage and childbearing than compositional change. This implies that growing opportunity cost, lack of institutional adjustments, and changing spouse search process in marriage markets explain the delay of marriage and childbearing. Although this graphical approach provides us with intuitive sense about the relative importance of compositional and associational change for delay of marriage and childbearing, this representation is incomplete because this does not take into account the change in the baseline hazard and control variables. The following decomposition complements this weakness.

$$\frac{H_{2t}}{H_{1t}} = \frac{\int_0^t h_{0u} e^{(C_2+\beta_2 \overline{X_2})} du}{\int_0^t h_{0u} e^{(C_1+\beta_1 \overline{X_1})} du} = \frac{e^{(C_2+\beta_2 \overline{X_2})} \int_0^t h_{0u} du}{e^{(C_1+\beta_1 \overline{X_1})} \int_0^t h_{0u} du} = e^{(C_2-C_1)} \times e^{(\overline{X_2}-\overline{X_1})(\frac{\beta_1+\beta_2}{2})} \times e^{(\beta_1-\beta_2)(\frac{\overline{X_2}+\overline{X_1}}{2})}$$

= (Baseline change) × (Compositional change) × (Associational change) – (3)

C: cohort, H_{1t}: cumulative hazard of cohort 1, h_{ou}: baseline hazard, $\overline{X}$: means of covariate, β: coefficient.

Equation (3) shows a multiplicative decomposition of the ratio of two cumulative hazards. Here, I use average of coefficients and means for two groups as a standard. [5] The ratio of two cohorts' cumulative hazards can be decomposed into three parts; proportional change in baseline hazard, composition and association. I can do this simple multiplicative decomposition because baseline hazard difference between cohorts and the effect of each covariate on hazard are assumed to be proportional in Cox hazard model. For example, if the ratio of two cumulative hazards is .9, this means that the cumulative hazard decreases by 10 percent, which implies the delay of marriage or childbearing. If the second part, $e^{(\overline{X_2}-\overline{X_1})(\frac{\beta_1+\beta_2}{2})}$, is close to zero, this means that cumulative hazard decreases a lot due to the compositional change. The same interpretation applies to associational change. Unlike decomposition of linear equation, this decomposition has a few

[5] There are alternative ways of decomposition. Some widely-used decomposition includes interaction term between compositional and associational change. I conducted these two decompositions, one with the interaction term and one without; there is no substantive difference between the two decompositions.

limitations. First, the decomposition is not additive but multiplicative, making interpretation more difficult. More importantly, instead of decomposing the mean cumulative hazards, I decompose the cumulative hazards when the covariates are fixed at group means because it is more manageable mathematically. These two are identical in decomposition of linear equation, but this does not hold because of non-linear relationship between covariates and cumulative hazard. However, because of monotonic relationship between covariates and cumulative hazard, this decomposition still provides us with a tool to assess the importance of compositional change and associational change.

<Table 4> about here

Table 4 shows the proportional change in cumulative hazard of first marriage and first childbearing for each successive cohort and its decomposition. I present the contribution of change in baseline hazard and controls together because the main interest is in the effect of education. The ratios of cumulative hazards of both marriage and birth decrease at an accelerating pace. The proportional change is greater for the comparison between later cohorts than earlier cohorts; while cumulative hazard of first marriage decreases by 8 percent between cohort 1 and cohort 2, 31 percent decrease is expected between cohort 3 and cohort 4 according to the decomposition. This implies that the pace of delays in first marriage and first childbearing become faster over time. Second, we can see that the contribution of associational change is much greater than compositional change. For example, whereas the reduction of cumulative hazard of marriage between cohort 3 and 4 due to compositional change is 16 percent, the contribution of associational change to the reduction of cumulative hazard between cohort 3 and

4 is 58 percent. Even more, the contribution of associational change is getting larger. This strongly implies that the accelerating delay of first marriage and first childbearing in Korea is largely due to the change in association between education and the timing of the two family building behaviors. This result strongly suggests that highly educated women face more opportunity costs of marriage and childbearing and there are not enough institutional adjustments to compensate for these changes. Alternatively, this suggests prolonged spouse search for highly educated women.

SUMMARY AND DISCUSSION

Using multi-state life table analysis and Cox proportional hazard models, I studied trends in the educational differences in transitions to first marriage and childbearing. First, transitions to marriage and motherhood in Korea follow an orderly pattern. The transition probability to "unconventional" states is very low, and most person-years are spent in conventional states. Second, in terms of sequences of events in life course, the increasing schooling is primarily responsible for the delay in marriage and childbearing. There is no change in time spent single after leaving school or being married without a child over time. Third, educational differentials in the timing of first marriage and first birth have grown over time. This implies that institutional adjustments do not compensate for the growing opportunity cost of highly educated women or for the prolonged spousal search process for highly educated women. Finally, simulation and decomposition analysis show the growing negative association between education and the timing of marriage and childbearing is more responsible for the delay of marriage and childbearing than the compositional change in Korea. Altogether, the findings in this study strongly imply that changing opportunity cost structure and prolonged spouse search of the highly educated women explain the trends in the timing of first marriage and childbearing.

This study, however, is not able to show the mechanisms through which Korean women delayed marriage and childbearing over time and educational differentials in the timing of marriage and childbearing grew over time. Among several mechanisms, the timing of sexual debuts, and the adoption of contraception and abortion would be helpful to explain cohort and educational differences. Because the information on this micro behavior is not available in the KLIPS and primary interest of this study is given to macro socioeconomic change, I did not fully account for this mechanism. Future study should incorporate this element for better understanding of fertility decline in Korea. Given these limitations, this paper contributes to our understanding of trends in the timing of marriage and childbearing and educational differentials in these timings.

Appendix

Table A1 Parameter Estimates for Simulation and Decomposition

	First Marriage		First Birth	
Variable	b (s.e)	exp(b)	b (s.e)	exp(b)
Main effects				
Cohort (ref: cohort 1, 1928 - 43)				
Cohort 2 (1944 – 53)	-.108 (.099)	.897	.078	1.081
Cohort 3 (1954 – 63)	.167 (.111)	1.181	.451	1.570
Cohort 4 (1964 – 73)	.859 (.192)	2.361	1.205	3.337
Cohort 5 (1974 – 83)	1.043 (.454)	2.837	1.361	3.900
Years of schooling	-.044 (.008)	.957	-.022	.978
Father's years of schooling	-.010 (.004)	.990	-.016	.984
Metropolitan (ref: non-metro)	-.242 (.037)	.785	-.261	.771
Interaction				
C2*Years of schooling	.025 (.012)	1.025	-.011	.989
C3*Years of schooling	-.009 (.012)	.991	-.054	.948
C4*Years of schooling	-.082 (.017)	.921	-.134	.875
C5*Years of schooling	-.177 (.037)	.838	-.205	.815

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Table 1 Descriptive Statistics

	Birth Cohort					
Variables	1928 – 43	1944 – 53	1954 – 63	1964 – 73	1974 – 83	Total
% never-married by age 25*	30.1	31.6	38.5	57.9	-	41.3
% childless by age 25*	31.1	40.4	50.6	70.9	-	50.8
Years of schooling	4.96 (4.26)	8.85 (3.67)	10.95 (2.94)	12.90 (2.11)	12.47 (1.92)	10.51 (4.02)
% HS degree +*	11.3	35.1	62.5	92.6	-	55.9
% Some college +*	3.0	8.0	15.5	35.5	-	17.6
Father's years of schooling	2.29 (4.00)	4.64 (4.63)	6.05 (4.65)	8.21 (4.42)	10.60 (3.84)	6.80 (5.14)
% living in metropolitan area at age 14	17.2	23.9	30.1	41.4	57.6	29.7
N	934	895	1,391	1,384	1,386	5,990

Sources: Korean Labor and Income Panel Study (1998)
Standard deviations are in parentheses
* Not computed for the youngest cohort (1974 – 83)

Table 2 Person-years Lived between Age 15 and 34, by Cohort

	In school				Out of school			
	w/o child		with child		w/o child		with child	
Birth cohort	single	married	single	married	single	married	single	married
All	3.179	0.032	0.006	0.026	6.204	1.443	0.517	8.593
1928 - 43	0.569	0.016	0.007	0.015	6.175	2.021	1.223	9.974
1944 - 53	1.682	0.011	0.003	0.014	6.569	1.439	0.670	9.612
1954 - 63	2.853	0.036	0.007	0.024	6.414	1.246	0.378	9.042
1964 - 73	4.724	0.051	0.008	0.023	6.650	1.230	0.119	7.194

* Shaded cells: unconventional states

Table 3 Parameter Estimates of Cox Hazard Model for First Marriage and First Birth

	First Marriage		First Birth	
Variable	b (s.e)	exp(b)	b (s.e)	exp(b)
Main effects				
Cohort (ref: cohort 1, 1928 - 43)				
Cohort 2 (1944 – 53)	-.105 (.103)	.900	.356 (.105)	1.427
Cohort 3 (1954 – 63)	.195 (.119)	1.215	.698 (.120)	2.011
Cohort 4 (1964 – 73)	.832 (.204)	2.298	1.608 (.220)	4.994
Cohort 5 (1974 – 83)	.392 (.541)	1.480	1.884 (.755)	6.580
Years of schooling	-.247 (.045)	.780	-.161 (.046)	.852
School enrollment	-3.660 (.547)	.026	-2.333 (.741)	.097
Father's years of schooling	-.101 (.004)	.990	-.012 (.004)	.988
Metropolitan (ref: non-metro)	-.250 (.037)	.779	-.142 (.038)	.867
Ever-married (ref: never-married)	-	-	3.106 (.050)	22.333
Interaction				
C2*Years of schooling	-.034 (.042)	.967	-.011 (.045)	.989
C3*Years of schooling	-.050 (.039)	.951	-.080 (.043)	.923
C4*Years of schooling	-.272 (.046)	.762	-.271 (.050)	.763
C5*Years of schooling	-.220 (.138)	.802	-.439 (.173)	.645
Wald test for interaction	χ^2 (4) = 49.26	p = .000	χ^2 (4) = 42.35	p = .000
Non-proportionality				
Age*Yrs of schooling	.001 (.000)	1.001	.001 (.000)	1.001
Age*school enrollment	.009 (.002)	1.009	.005 (.003)	1.005
Age*C2*Years of schooling	.0002 (.0001)	1.0001	-.0001 (.0001)	.9999
Age*C3*Years of schooling	.0001 (.0001)	1.0001	.0001 (.0001)	1.0001
Age*C4*Years of schooling	.0007 (.0001)	1.0007	.0004 (.0001)	1.0004
Age*C5*Years of schooling	.0005 (.0005)	1.0005	.0010 (.0006)	1.0010
Wald test for three-way interaction	χ^2 (4) = 36.60	p = .000	χ^2 (4) = 21.46	p = .000
Person-months	604,025		654,881	
Log likelihood	-31,727.23		-27,517.60	
BIC	-1,144.22		-7,483.38	

N=5,990

* Age measured as month.

Table 4 Decomposition of Ratios of Cumulative Hazards, First Marriage and First Birth

Cohorts Compared	Cumulative hazard ratio	Baseline + Control	Compositional Change	Associational Change
		First Marriage		
2 to 1	.920	.877	.884	1.186
3 to 2	.862	1.299	.927	.716
4 to 3	.690	1.957	.840	.420
		First Birth		
2 to 1	.866	1.041	.898	.927
3 to 2	.830	1.420	.892	.656
4 to 3	.628	2.053	.798	.383

Figure 1 Women's Economic Participation by Education, 1980 - 2007

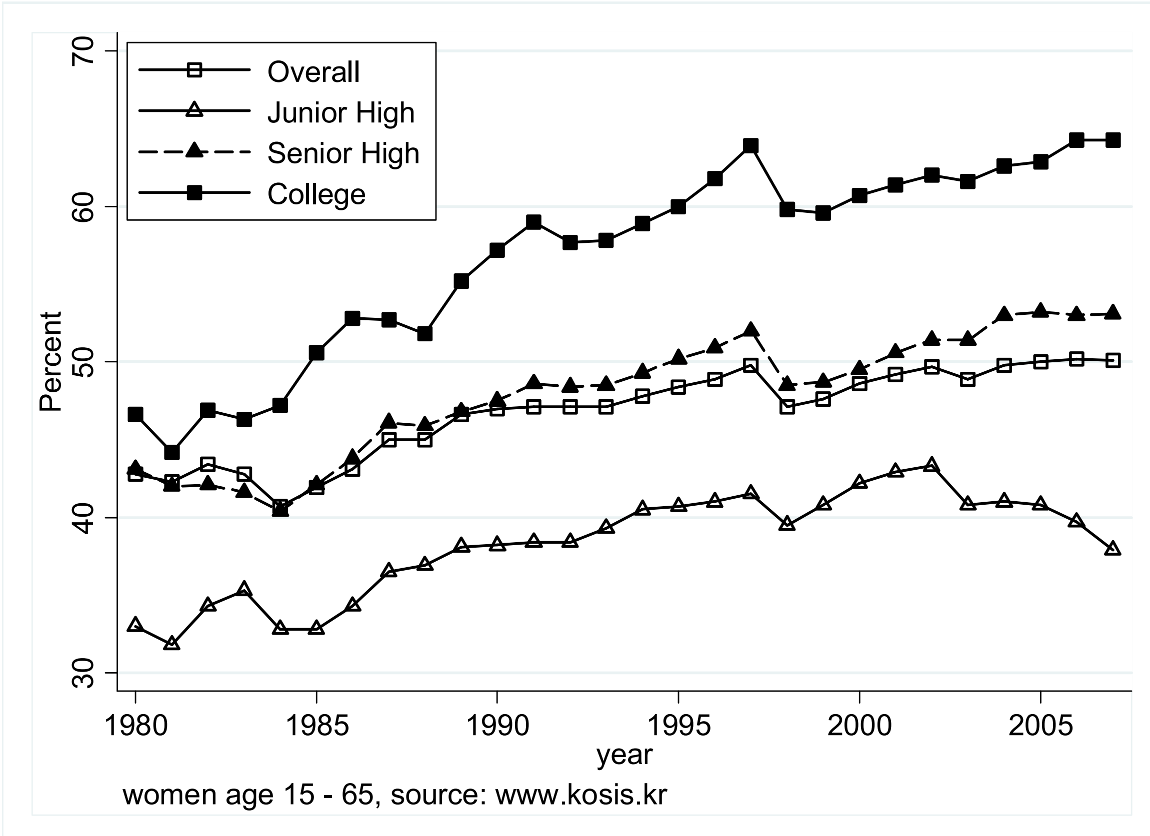


Figure 2 Multi-state Representation of Schooling, First Marriage and Childbearing

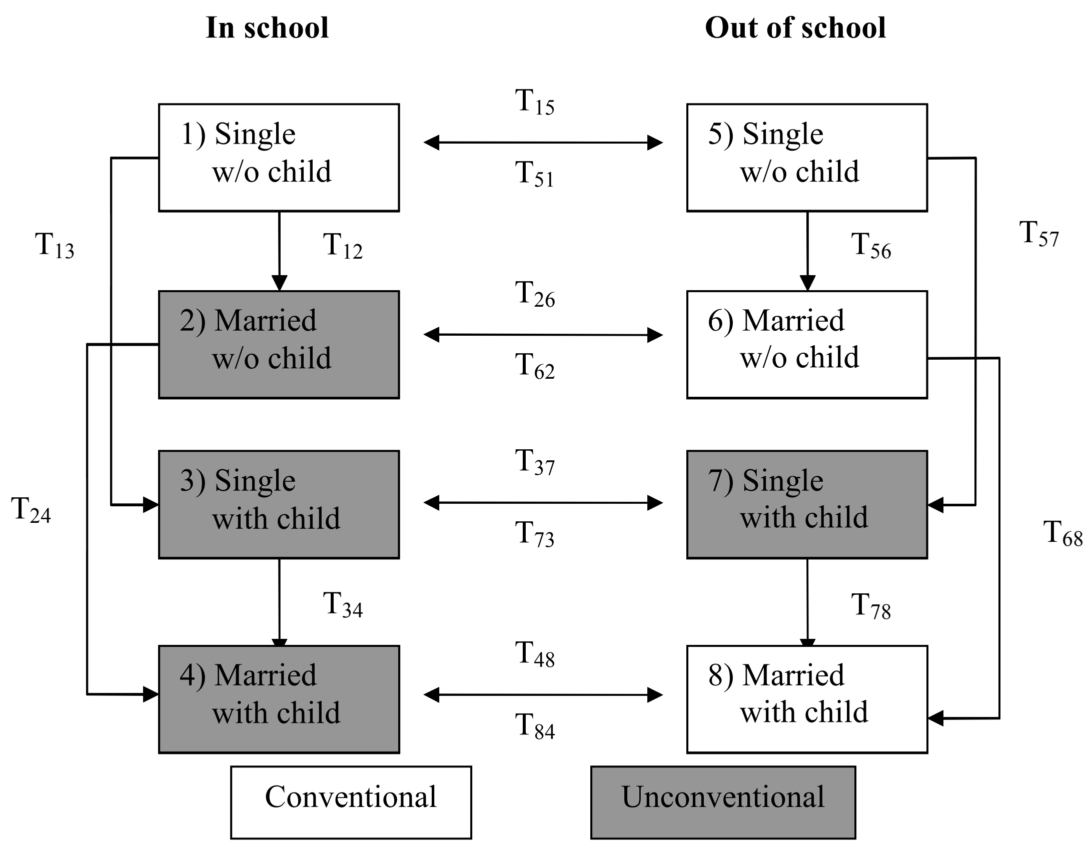


Figure 3 Annual Transition Probability, Entire Sample

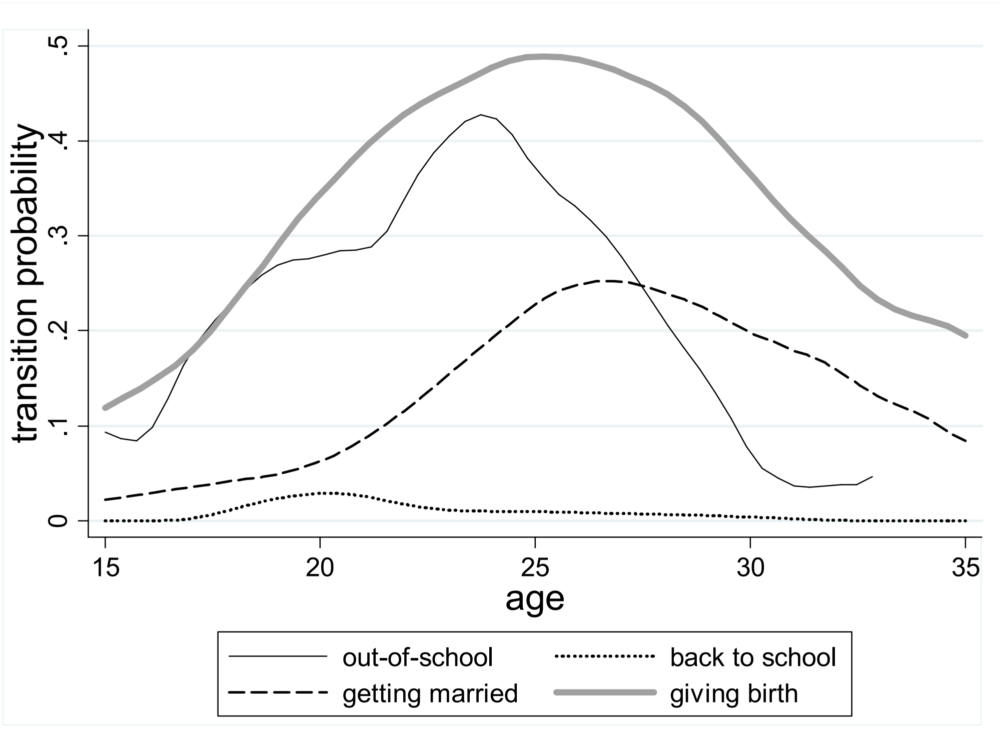


Figure 4 Person-years Lived between Age 15 and 34, by Cohort

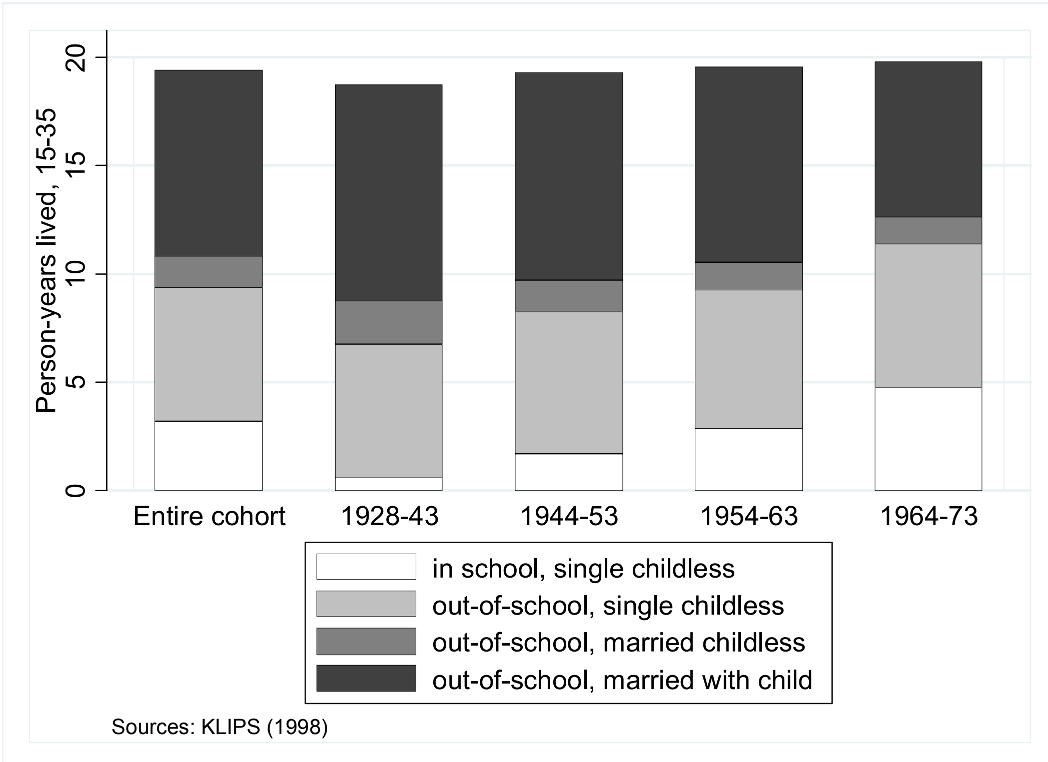
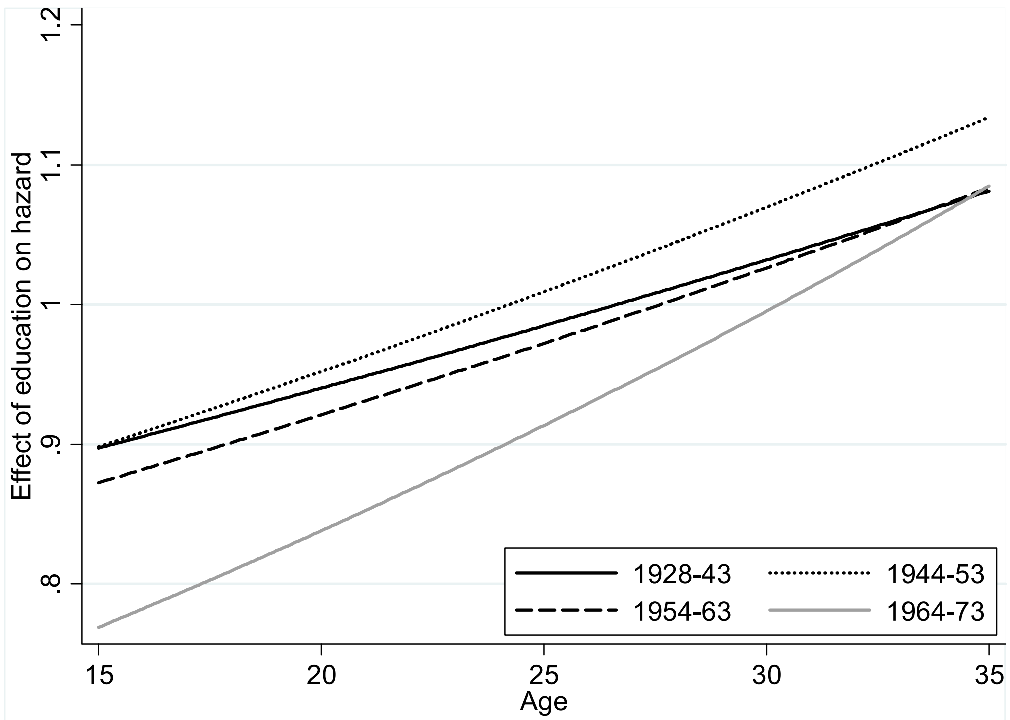


Figure 5 The Effect of Years of Schooling on the Hazard, by Age and Cohort

A. Hazard of First Marriage



B. Hazard of First Birth

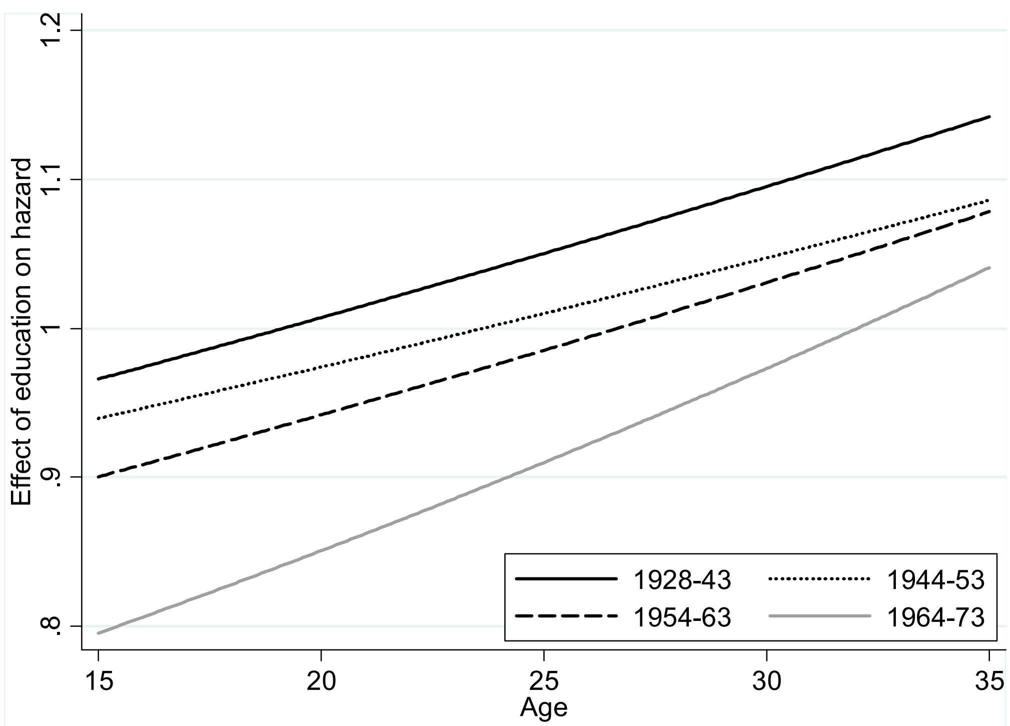
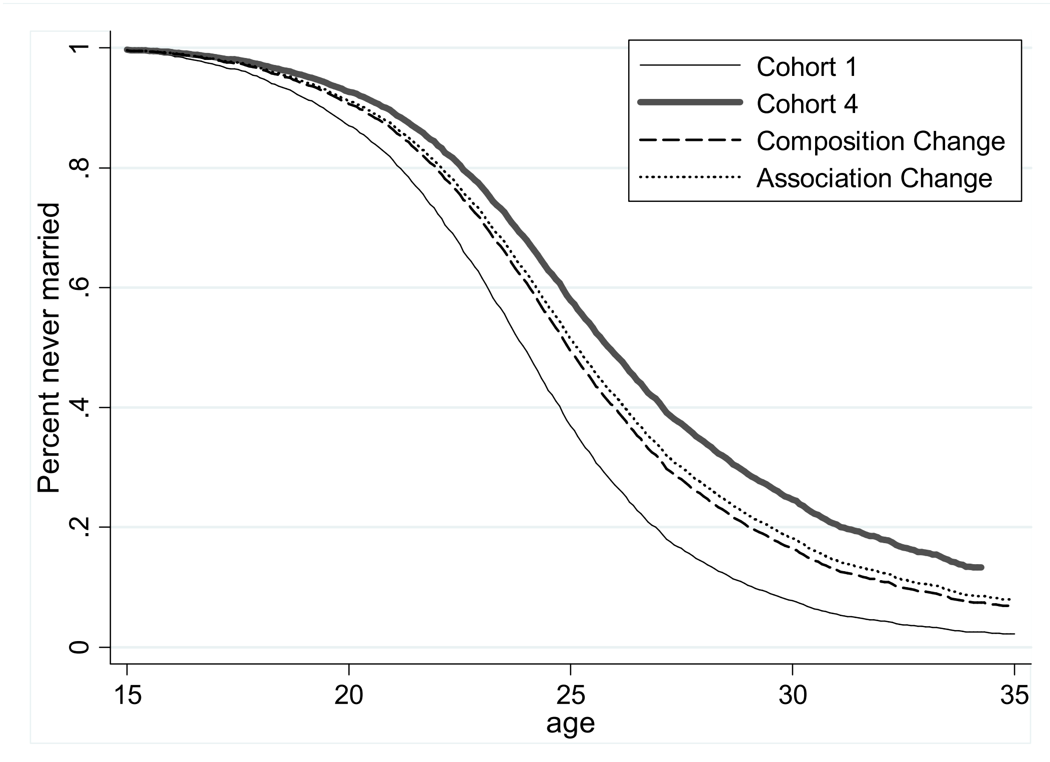


Figure 6 Simulation, Compositional Change and Associational Change

A. Percent Never Married by Cohort



B. Percent Childless by Cohort