Trends in the Educational Differentials in Marriage Formation among Taiwanese Women

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ABSTRACT

In this paper, we document trends in educational differentials in marriage formation among Taiwanese women born between 1910 and 1991 using data pooled from 15 waves of the Women's Marriage, Fertility, and Employment Surveys. We analyze both rates and the eventual probabilities of first marriage to examine marriage delayed and marriage forgone. We find that (1) women born in more recent cohorts married later and fewer than those born in earlier cohorts, (2) more highly educated women tended to marry later and fewer than less educated women, and (3) the educational differentials were smaller in earlier birth cohorts than in later cohorts.

We then construct earnings potentials to test the human capital hypothesis by merging data pooled from the 1979-2005 waves of the Surveys of Family Income and Expenditure. The results show that the observed educational differentials in marriage formation cannot be fully attributed to differences in earnings potentials. Hence, we conclude that the effects of education on marriage formation may operate via noneconomic mechanisms above and beyond human capital mechanisms.

Introduction

Why Study Marriage Formation in Taiwan, with a Focus on Cultural Context

Taiwan has the lowest total fertility rates among all countries in the world.   We suspect that the lowest low fertility in Taiwan is likely related to changes in marriage formation in Taiwan.

While the vast body of empirical literature on marriage formation has examined educational differentials (e.g., Blossfeld 1995; Sweeney 2002; Thornton and Lin 1994), the theoretical literature has focused primarily on the human-capital mechanism through which educational attainment affects marriage formation (Becker 1981; Oppenheimer 1988).   However, findings from several countries (see, e.g., Italy, Spain, and Japan) that are incompatible with findings based on American data have prompted researchers to reconsider the role that cultural factors play in affecting the educational differentials in marriage formation (Raymo 2003).

In this paper, we document cohort trends in educational differentials in marriage formation among Taiwanese women, distinguishing between marriage delayed and marriage forgone—a key distinction Oppenheimer (1988) makes in her seminal critique of Becker's female economic independence hypothesis (Goldstein and Kenny 2001).   We also attempt to examine the mechanisms behind educational differentials in marriage formation with a focus on the human capital investment (e.g., Lichter et al.

1992; Mare and Winship 1991; Sweeney 2002). We follow Xie et al. (2003) to construct five measures of earnings potentials, and argue that these earnings potentials represent mechanisms of human capital investment via which educational attainment affects marriage formation. We find that these earnings potentials fail to explain the educational differentials in marriage formation. Hence, our results provide indirect empirical evidence for a cultural explanation.

We have completed all the analyses and included tables summarizing the main findings in this draft. An earlier version of the first analysis documenting trends in educational differentials focusing on the distinction between marriage rates and the eventual probabilities of marriage was presented in last year's PAA meeting. This current paper has updated and polished these cohort trend estimates, while adding the brand new second analysis which we think is interesting and potentially advances the theoretical literature on this topic. We hope that you will find our paper of merits.

Data and Variables

Women's Marriage, Fertility, and Employment Surveys

To document trends in marriage formation, we use data pooled from the 1979 to 2006 waves of Women's Marriage, Fertility, and Employment Surveys (WMFES). The WMFES is a series of repeated cross-sectional surveys conducted in Taiwan that

are similar to the June Supplement of the U.S. Current Population Survey. We use a total of 15 waves of the WMFES, conducted annually from 1979 to 1988, and in 1990, 1993, 2000, 2003, and 2006. Each WMFES includes a nationally representative sample of women aged 15 and above residing in Taiwan. These surveys include information on age at first marriage (measured in years), calendar year in which a respondent was born, and the highest degree a respondent completed, and thus are suitable for the purpose of our analysis.

Surveys of the Family Income and Expenditure

To test the human capital hypothesis, we use data pooled from the 1976 to 2005 waves of the Surveys of Family Income and Expenditure (SFIE). The SFIE includes a series of annually repeated cross-sectional surveys conducted in Taiwan that are similar to the U.S. Consumer Expenditure Survey. We use the SFIE data to estimate women's age-, education-, county-, and year-specific earnings profiles based on the so-called Mincer's equation. We then merge these estimated earnings profiles to construct earnings potentials for respondents in the WMFES, the dataset we use to document trends in educational differentials in marriage formation.

In addition to the aforementioned sample selection criteria, we also restrict our analysis to a subsample of those WMFES respondents born after 1963 because we

only have earnings information from 1976 to 2005 in the SFIE data, and cannot

calculate earnings potentials for those born before 1963.

Analytic Samples

A total of 405,526 respondents were successfully interviewed in these 15 waves

of WMFES surveys.   We delete those respondents who were over 65 years old at the

time of interview (about 8.6%) because they might be relatively advantaged in terms

of socioeconomic status and health, and their marriage formation behaviors might

differ from those who died before age 65 and therefore not included in these surveys.

We also delete a handful of respondents whose self-reported gender is male or whose

age at first marriage was younger than 12 years old.   These sample selection criteria

lead to an analytic sample of 366,003 cases.   We use this analytic sample in the first

analysis to document cohort trends in marriage formation among Taiwanese women

born between 1910 and 1991.

In our second analysis that examines the human-capital hypothesis, we need to

combine the WMFES data with the SFIE data.   Because the SFIE data were only

available from 1976 and on, we further restrict our analytic sample to respondents

born in or after 1963 (which is the oldest cohort who were 13 years or older at the

time of the earliest, 1976, survey interview).   This restriction reduces the analytic

sample to a size of 112,053 cases in our second analysis.

Dependent Variables

We are interested in modeling the event of entry into first marriage.

Observations are left truncated at age 13 (which excluded a handful of respondents)

and right censored at the age when the respondent was interviewed if she reported that

she had never been married.   If the respondent reported having been married by the

survey interview, we code an event.   In the first analysis, we use a continuous

specification for the age at first marriage or the age at right-censoring.   In the second

analysis, we turn to a discrete-time hazard specification and rearrange the data into

person-year records ($N = 957,104$).

Independent Variables

We construct dummy variables to indicate the respondent's birth cohort.   In the

first analysis, we use the following categories: 1910-29 (reference category), 1930-49,

1950-69, and 1970-91.   In the second analysis, we use an alternative set of categories:

1963-1971 (reference category), 1972-1981, and 1982-1991, because we restrict the

sample to those respondents born in or after 1963.

The respondent's educational attainment is coded into four dummy variables,

according to their self-reported highest grade/diploma/degree completed: lower than

high school attainment, a high-school diploma (reference category), junior college

(which includes a few types of schools conferring a degree similar to the Associate

Degree in the United States), and a bachelor's degree or higher.   In the first analysis,

we consider educational attainment as a fixed attribute of the respondent, while in the

second analysis, we allow the respondent's educational attainment to vary with age.

In the second analysis, we also include enrollment status as a time-varying covariate.

Because there is no information about the actual enrollment status of respondents in

the WMFES, we infer their enrollment status using the normative ages of graduation

according to their highest degree completed.

Earnings Potentials

In the second analysis, we use earnings potentials to indicate the human-capital

effect of educational attainment on women's marriage formation behaviors.   We

follow the rationale of Xie et al. (2003) to construct five variables of earnings

potentials.   We use the SFIE data to estimate Mincer's (1974) earnings equation for

women, adding calendar year, birth cohort, and county to the original specification:

$$\ln E = b_0 + b_1 edu + b_2 workexp - b_3 workexp^2 + b_4 year + b_5 coh + b_6 cty, \quad (1)$$

where education (*edu*), cohort (*coh*), and county (*cty*) are dummy variables; and

working experience (*workexp*) and calendar year (*year*) are continuous variables.

Education, cohort, and county are coded into the same categories as in the WMFES.

Work experience is the inferred work experience, which equals the respondent's

current age subtracts her years of schooling and age at the beginning of schooling (i.e.,

6 years of age).   For those respondents with fewer than 6 years of schooling, their

work experience equals their current age subtracts 12.   The dependent variable is the

natural logarithm of the total annual earnings in the year before the survey year,

which is transformed into 2005 dollars using the Consumer Price Index.

We obtain estimates of *b*'s in Eq. (1) on the SFIE data and use these estimates to

compute the predicted current earnings potential of each person-year record of the

WMFES data: E_{ik} for person *i* in year *k*.   The predicted earnings over the next five

years , E_{ik}^5 , for the person-year record of respondent *i* in year *k* are calculated as the

sum of predicted earnings observed from year *k* to *k+4*:

$$E_{ik}^5 = \sum_{x=k}^{k+4} E_{ix} \ . \tag{2}$$

Assuming that everyone, regardless of educational attainment, exits the labor market

at age 60, we calculate the predicted future earnings, E_{ik}^F , for the person-year record

of respondent *i* in year *k* as follows:

$$E_{ik}^F = \sum_{x=k}^{\rho+60} E_{ix} \ . \tag{3}$$

where ρ denotes the year in which the respondent was born.   The predicted total

past earnings, E_{ik}^P, are calculated as follows:

$$E_{ik}^P = \sum_{x=\rho+13}^{k} E_{ix} \ . \tag{4}$$

The predicted lifetime earnings, E_i^L, for individual *i* that is constant across all

person-year records, are calculated as the sum of earnings from age 13 when she

began to be exposed to the risks of first marriage to age 60 when she is assumed to

exit the labor market:

$$E_i^L = \sum_{x=\rho+13}^{\rho+60} E_{ix} = E_{ik}^P + E_{ik}^F - E_{ik} \ . \tag{5}$$

Methods

Documenting Cohort Trends in Educational Differentials in Eventual Probabilities

and Rates of First Marriage Using the Kaplan-Meier Method and Cox Models

We use the maximum-likelihood method proposed by Kaplan and Meier (1958)

to estimate the proportions of women who had never been married by age *t*:

$$\hat{S(t)} = \prod^{(t)} \left(1 - \frac{d_j}{r_j} \right), \tag{6}$$

where r_j is the number of respondents who had never entered a first marriage by age

t; d_j is the number of respondents who entered a first marriage at age *t*. We apply

this estimator to women grouped by birth cohort and educational attainment. When *t*

is some advanced age (e.g., 40 or 50) after which the age-specific marriage rates are

negligible, we consider $1\text{-}\hat{S(t)}$ as the eventual probability of ever being married for

that group of women.

We then estimate Cox proportional hazard models for the rates of first marriage.

The Cox proportional hazard models assume that the differentials in marriage rates $h(t)$

are multiplicative across respondents in different birth cohorts and with different

levels of educational attainment:

$$h(t) = h_0(t) \cdot \exp(b_1 \cdot coh + b_2 \cdot edu), \tag{7}$$

where $h_0(t)$ is the baseline hazard and age, t, is assumed to be a continuous variable.

Under the Cox model specification, we also examine whether educational differentials

in marriage rates have changed across successive birth cohorts of women in Taiwan:

$$h(t) = h_0(t) \cdot \exp(b_1 \cdot coh + b_2 \cdot edu + b_3 \cdot edu \times coh). \tag{8}$$

If b_3 differs significantly from zero, the statistical assumption of proportional hazard

in Eq. (7) does not hold.   Substantively, we conclude that educational differentials in

marriage rates vary across birth cohorts.

Examining the Human-Capital Role of Education in Marriage Formation Using

Discrete-Time Hazard Models

On a subsample restricted to women born in or after 1963, we estimate a series

of discrete-time hazard models to compare the effects of different operationalizations

of economic potentials on rates of first marriage.   This series of models examine the

human-capital role that educational attainment plays in marriage formation.   We

transform the data into a total of 957,104 person-year records, and specify the

discrete-time hazard model using a logistic regression functional form:

$$\log\left(\frac{q(t)}{1-q(t)}\right) = \sum_k b_{0 \cdot k} \cdot age_k(t) + b_1 \cdot coh(t) + b_2 \cdot edu(t) + b_4 \cdot enroll(t), \quad (9)$$

where age is divided into K groups from 13-19, 20-24, 25-29, 30-34, 35-43 years old,

with the 25-29 age group being the reference category, and all covariates (including

cohort, education, and enrollment status) are allowed to vary over time.   We then add

those five earnings potentials to Eq. (9) and see how the coefficient of educational

attainment, b_2, changes with their inclusion:

$$\log\left(\frac{q(t)}{1-q(t)}\right) = \sum_k b_{0 \cdot k} \cdot age_k(t) + b_1 \cdot coh(t) + b_2 \cdot edu(t) + b_4 \cdot enroll(t)$$
$$+ b_m \cdot EP_m(t) \ . \quad (10)$$

If the inclusion of earnings potential fully account for the effect of educational

attainment on marriage rates, we will conclude that human capital is the primary

mechanism behind educational differentials in marriage formation in Taiwan.

Otherwise, we will interpret the results as consistent with cultural explanations for the

educational differentials.

Results

Descriptive Statistics

Table 1 presents the descriptive statistics of the sample used in the first analysis. About two-thirds of women had ever been married when they were surveyed, and their average age at first marriage is about 21.8 years.   Because the majority of respondents were born before 1969, the proportion of women with less than 12 years of schooling in the sample is over 60%.   Respondents with more than 13 years of schooling consist of 12% of the analytic sample.

[Table 1 about here]

Table 2 presents the descriptive statistics of the person-year data used in the second analysis.   The mean current earnings potential is NT$167,711 (= exp[12.03]). The mean earnings potentials are NT$984,609 (= exp[13.80]) over the next five years, and NT$634,124 (= exp[13.36]) cumulated in the past.   The means for future earnings potential and lifetime earnings potential are, respectively, NT$16,852,339 (= exp[16.64]) and 17,716,377 (= exp[16.69]).

[Table 2 about here]

In the first analysis, we estimate marriage rates and the eventual probabilities of marriage among successive cohorts of Taiwanese women.   The results suggest a trend toward later and fewer marriages across birth cohorts.   Marriage formation among Taiwanese women has shifted from early and universal marriages (Thornton and Lin 1994) into later and fewer marriages.

The most striking finding is that one in every four college-educated women born

between 1960 and 1969 had never been married by age 40 (Table 3).   We believe

that this, along with rapid educational expansion and the extremely low nonmarital

fertility ratio in recent decades, might help us understand why the total fertility rate in

Taiwan has dropped below 1.0 (and is the lowest among all countries in the world).

[Table 3 and Table 4 about here]

In the second analysis, we include both years of schooling and earnings

potentials in our models to test the hypothesis that education influences women's

marriage rates through earnings potentials.   Enrollment is negatively associated with

the risks of being married, which we interpret as reflect the role conflicts between a

student and a wife.   In addition, we find that more highly educated Taiwanese

women are less likely to be married than less educated women even after we control

for earnings potentials.   This finding suggests that there are mechanisms other than

human capital investment in explaining how education influences Taiwanese women's

marriage formation behaviors.

[Table 5 about here]

Discussion

In this paper, we address the debate over marriage decline by distinguishing

between marriage delayed and marriage forgone in the Taiwanese context.

Specifically, we document trends in marriage formation, and then examine the role of

education as a proxy for women's earnings potential in explaining the documented

trends. The results show that more highly educated Taiwanese women marry later

and fewer than less educated women. The results also show that educational

attainment influences Taiwanese women's risks of first marriage through mechanisms

other than human capital investment. Hence, educational attainment should not be

treated merely as an indicator of human capital investment while studying marriage

formation in Taiwan. This finding is neither consistent with Becker's nor with

Oppenheimer's theory, and suggests that we should be cautious about how to explain

educational differentials in marriage formation.

Taiwanese women's marriage rates may be negatively associated with such

unobserved factors. Educational attainment may serve as a signal to potential mates,

indicate one's tastes and lifestyle, or shape the marriage market for the spouse-search

process (Arum et al. 2008; Stevens et al. 2008). To clarify what these unobserved

factors, we need more studies in the future. Neither Becker's (1981) nor

Oppenheimer's (1988) theory has considered these other unobserved factors.

Researchers should be more cautious in explaining the effect of educational

attainment on marriage formation.

The relationship between Taiwanese women's earnings potentials and marriage rates is more complicated than suggested in prior research. Potential earnings in the past and in the near future are positively associated with Taiwanese women's marriage rates. But potential earnings in the future and for the lifetime are negatively associated with Taiwanese women's marriage rates. There may be an omitted variable indicating the strength of women's long-term career commitment that is associated with their economic potentials. These results seem to imply that the relationship between women's economic potential and marriage formation is more complicated than the theories proposed by Becker and Oppenheimer.

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Table 1. Descriptive Statistics (Means with Standard Deviations in Parentheses) for the First Analysis Documenting Trends in Educational Differentials in the Eventual Probabilities and Rates of First Marriage

Variable	Mean
Event (First marriage)	.68
Age at first marriage	21.79
(for ever-married women)	(3.41)
Birth cohort	
1910-1929	.08
1930-1949	.27
1950-1969	.52
1970-1991	.13
Years of schooling	
Fewer than 12 years	.61
12 years	.27
13-15 years	.06
16 or more years	.06
Number of cases	366,003

Source: Women's Marriage, Fertility and Employment Surveys: 1979 – 2006.

Table 2. Descriptive Statistics (Means with Standard Deviations in Parentheses, and Person-Year Data) for the Second Analysis Examining the Human-Capital Role of Educational Attainment in Marriage Formation

Variable	Mean	
Event	.03	
Age at first marriage (for ever-married women)	22.56	(3.82)
Age Group		
13 to 19	.71	
20 to 24	.21	
25 to 29	.06	
30 to 34	.02	
35 to 43	.01	
Birth cohort		
1963 to 1971	.67	
1972 to 1981	.26	
1982 to 1991	.07	
Educational attainment (time varying)		
Less than 12 years	.70	
12 years	.21	
13 to 15 years	.05	
16 or more years	.04	
Enrollment status	.61	
Logged earnings potential (in 2005 dollars)		
Current earnings	12.03	(.38)
Earnings over the next five years	13.80	(.40)
Past earnings	13.36	(.95)
Future earnings	16.64	(.31)
Lifetime earnings	16.69	(.30)
Number of person-year records	957,104	

Source: Women's Marriage, Fertility and Employment Surveys: 1979 – 2006.

Table 3. Kaplan-Meier Estimates of Age-Specific Proportions of Women Never Married by Birth Cohort and Years of Schooling (*N*=366,003)

Age	Education	Birth Cohort						
		1910-19	1920-29	1930-39	1940-49	1950-59	1960-69	1970-79
	Fewer than 12	.03	.02	.02	.02	.04	.08	.17
	12 years	.04	.05	.05	.10	.14	.18	.26
30	13-15 years	.07	.05	.04	.14	.20	.27	.43
	16 or more years	.04	.10	.09	.13	.25	.38	.56
	Fewer than 12	.01	.01	.01	.01	.02	.05	---
	12 years	.03	.02	.02	.06	.08	.11	---
40	13-15 years	.00	.01	.02	.08	.13	.17	---
	16 or more years	.04	.02	.06	.10	.16	.25	---
	Fewer than 12	.01	.01	.01	.01	.02	---	---
	12 years	.03	.01	.02	.06	.08	---	---
50	13-15 years	.00	.01	.02	.08	.12	---	---
	16 or more years	.04	.01	.05	.09	.15	---	---
	Fewer than 12	.01	.01	.01	.01	---	---	---
	12 years	.03	.01	.02	.05	---	---	---
60	13-15 years	.00	.01	.02	.08	---	---	---
	16 or more years	.04	.01	.05	.09	---	---	---

Source: Women's Marriage, Fertility and Employment Surveys: 1979 – 2006.

Table 4. Percentage Change in Women's Rates of First Marriage, Cox Models (N=366,003)

Variable	Model 1		Model 2	
Birth cohort				
1910-1929	0		0	
1930-1949	-13.28 (.01)	***	-27.04 (.02)	***
1950-1969	-30.45 (.01)	***	-45.07 (.02)	***
1970-1991	-55.39 (.01)	***	-56.90 (.01)	***
Years of schooling				
Fewer than 12 years	108.37 (.01)	***	68.23 (.05)	**
12 years	0		0	
13 – 15 years	-33.29 (.01)	***	-14.68 (.05)	***
16 or more years	-51.46 (.01)	***	-30.29 (.04)	***
Interaction term				
Fewer than 12 years x 1910-1929			0	
Fewer than 12 years x 1930-1949			18.96 (.04)	***
Fewer than 12 years x 1950-1969			30.54 (.04)	***
Fewer than 12 years x 1970-1991			19.52 (.05)	***
13 – 15 years x 1910-1929			0	
13 – 15 years x 1930-1949			-1.85 (.06)	
13 – 15 years x 1950-1969			-20.25 (.05)	***
13 – 15 years x 1970-1991			-43.66 (.04)	***
16 or more years x 1910-1929			0	
16 or more years x 1930-1949			.82 (.06)	
16 or more years x 1950-1969			-23.77 (.05)	***
16 or more years x 1970-1991			-65.07 (.02)	***
Log likelihood	-2,935,609.10		-2,934,968.40	
BIC	5,871,295		5,870,129	

* $p < .05$ ** $p < .01$ *** $p < .001$

Source: Women's Marriage, Fertility and Employment Surveys: 1979 – 2006

Table 5. Percentage Change in Women's Rates of First Marriage, Discrete-time Hazard Models, (N= 957,104)

Variable	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
Age												
13 to 19	-69	(.02) ***	-56	(.03) ***	-54	(.03) ***	-29	(.03) ***	-67	(.02) ***	-70	(.02) ***
20 to 24	0		0		0		0		0		0	
25 to 29	93	(.02) ***	31	(.02) ***	27	(.02) ***	0	(.02)	77	(.02) ***	95	(.02) ***
30 to 34	25	(.04) ***	-38	(.05) ***	-41	(.05) ***	-64	(.05) ***	-2	(.04)	27	(.04) ***
35 to 39	-67	(.12) ***	-86	(.12) ***	-86	(.12) ***	-94	(.13) ***	-79	(.13) ***	-66	(.12) ***
40 to 43	-80	(.52) **	-91	(.52) ***	-91	(.52) ***	-97	(.52) ***	-91	(.53) ***	-80	(.52) **
Birth cohort												
1963 to 1970	0		0		0		0		0		0	
1971 to 1980	-16	(.02) ***	-25	(.02) ***	-27	(.02) ***	-25	(.02) ***	-6	(.02) ***	-6	(.02) ***
1981 to 1991	-44	(.05) ***	-54	(.05) ***	-56	(.05) ***	-53	(.05) ***	-30	(.06) ***	-31	(.06) ***
Educational attainment												
(time-varying)												
Less than 12 years	61	(.02) ***	76	(.02) ***	91	(.02) ***	75	(.02) ***	13	(.03) ***	20	(.03) ***
12 years	0		0		0		0		0		0	
13 to 15 years	-37	(.02) ***	-47	(.03) ***	-51	(.03) ***	-42	(.02) ***	-16	(.03) ***	-20	(.03) ***
16 or more years	-51	(.03) ***	-65	(.03) ***	-70	(.03) ***	-58	(.03) ***	-13	(.04) ***	-21	(.04) ***

Table 5. (*continued*)

Variable	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Enrollment status	-95 (.04) ***	-94 (.04) ***	-94 (.04) ***	-92 (.04) ***	-93 (.04) ***	-93 (.04) ***
Earnings potential (in 2005 dollars)						
Current earnings		211 (.05) ***				
Earnings over the next five years			328 (.05) ***			
Past earnings				191 (.02) ***		
Future earnings					-65 (.06) ***	
Lifetime earnings						-63 (.06) ***
Loglikelihood	-32216558	-32106021	-32051737	-31848661	-32160457	-32171428
BIC	64400000	64200000	64100000	63700000	64300000	64300000

* p < .05   ** p < .01   *** p< .001

Source: Women's Marriage, Fertility and Employment Surveys: 1979 – 20