Mathematical Model Analysis --The Relationship between Age at first Marriage and Marital Stability

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Abstract: Data for this thesis comes from the China Family Panel Studies in 2010, and the Discrete-time event history analysis are used in this study to explore the effect of age at first marriage and on marital stability by gender. Compared with men who get married at the marriageable age, men who get married at the age of 13-21 have a higher risk of divorce, early marriage is not conducive to men marriage stability, and the age at first marriage has no effect on women marital stability, and premarital cohabitation increases the adverse effects of early marriage on marriage for women and raises the risk of divorce for men who marry later in life.

Keywords: Discrete-time event history model, Age at first marriage, Marital stability

1 Introduction

In the middle of the 20th century, new changes in the demographic and family emerged in countries that had completed the first demographi transition, especially in Europe, including later marriage ages, higher divorce rates, and higher cohabitation rates. Based on this, Dirk van de kaa introduced the concept of "second demographic transition" in 1987. The second demographic transition is taking place in China, and the field of marriage and family has also undergone great changes [22], and the postponement of the age of first marriage and the increase in the cohabitation and divorce rates are regarded as important signs of the second demographic transition [12].

Since the reform and opening-up in the late 1970s, the divorce rate in China has been rising. The crude divorce rate in China was only 0.18‰ in 1978 at the beginning of the reform and opening up, and has risen to 3.20‰ in 2018. The popularization of education has led to changes in people's concept of marriage and childbirth, especially the emphasis on the development of individualism, which directly affects people's sense of family responsibility. While the divorce rate is rising, people's age of first marriage is also being postponed, and the average age of first marriage for men and women in 1990 was 23.57 years old and 22.02 years old respectively, Liang et al. concluded that the average age of first marriage for men and women in 2010-2014 has reached 27.9 years old and 25.9 years old based on data analysis. [13] At present, there are many trends in our society, one is the gradual postponement of the age of first marriage, and the other is the rising divorce rate. The study of the relationship between the age of first marriage

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and the risk of divorce will in turn provide a reference for the exploration of topics such as marital satisfaction, fertility and divorce rates.

2 Literature review

The relationship between the age of first marriage and marital stability, there mainly has three views.

First, early marriage is detrimental to marital stability, which means that marital instability decreases gradually as the age of marriage rises. Because early marriages are mentally immature, they do not spend enough time in the marriage search and may make wrong judgments about their spouses [7] [14]; they are unable to fulfill their marital roles [9] and have difficulty in accumulating sufficient marriage-specific capital; Adolescent marriages lack parental support [3]; there are more alternative partners to existing marriages [1], and therefore early marriage has a higher risk of divorce.Rotz (2011) suggests that an increase in the age of women at marriage explains 60% of the decline in divorce rates in the United States since 1980, and that the risk of divorce is at least 6% lower if women marry a year later. [15]

Second, age at marriage has a significant negative relationship with marital stability. The older the age at marriage, the more unstable the marriage.

Men and women will choose less desirable partners if they believe their chances of a happy marriage are decreasing. This effect applies to both men and women, but more so to women, and affects women more than men because for women, the decline in fertility begins when they are much younger. The effect of the biological clock leads women to be more likely to accept a mate who is far from ideal, resulting in a marriage with very low returns and a high likelihood of eventual dissolution [2] [10] [17].Marrying late is somewhat of an option for those who lack the characteristics that are conducive to success in the marriage market. Those who marry late may have unrealistically high standards for their spouses and, in turn, delay marriage until a relatively late age. If they marry, they must settle for an undesirable spouse, which may lead to a high propensity for divorce [2].

Third, there is a non-linear relationship between age at marriage and marital stability, both a U-shaped relationship between age at marriage and marital stability. Early marriage is detrimental to marital stability, and the postponement of the age of first marriage is beneficial to marital stability, but after postponement to a certain peak, this effect is reversed if the age of marriage continues to be postponed, and late marriage is also detrimental to marital stability. Wolfinger (2015) studied how to avoid divorce and concluded that for every 1-year increase in age at marriage until about age 32, the odds of divorce decreased by 11%. However, after the age of 32, the odds of divorce increase by 5% per year. [19]

Since the reform and opening-up, the popularization of nine-year compulsory education and the expansion of higher education in China have greatly increased the education level of women and delayed the age of first marriage for women. The increase in education level makes it easier for women to dissolve unsatisfactory marriages. Finally, access to economy requires devoting more time and energy to work, which is contrary to women's family-oriented gender role division and is not conducive to marital stability.

In China, especially in less developed and rural areas, men bear the major costs of new family construction, which usually includes bride price, wedding, and wedding house [6] [18]. In recent years, the continuous soaring of housing prices makes men need more time to accumulate marriage costs, thus delaying the age of marriage; higher education is also a symbol of economic potential, and receiving education also delays men's age of first marriage, i.e., men who marry at an older age have economic potential and also accumulate more marital capital, which is conducive to marital stability. Conversely, men who marry earlier are considered to have insufficient marriage-specific capital, no higher education, and no higher economic potential, which is contrary to the male gender role of "breadwinner" and is not conducive to marital stability.

In conclusion, the relationship between age at first marriage and marital stability in China is more consistent with the view that late marriage is detrimental to marital stability for women, while early marriage is detrimental to marital stability for men. Based on the above, the following research hypotheses are proposed.

Hypothesis 1: Later marriage is not conducive to marital stability for women, and early marriage is not conducive to marital stability for men.

3 Data and method

3.1 Data

The data for this paper were obtained from the 2010 China Family Panel Studies (CFPS), a nationwide, comprehensive social tracking survey project implemented by the China Social Science Research Center of Peking University, which aims to reflect the social, economic, demographic, educational, and health changes in China by tracking and collecting data at the individual, household, and community levels [20].

In accordance with the research objectives, the risk of divorce measurement in this paper is limited to first marriages to avoid the interference of complex factors related to non-first marriages. This paper retains the sample of first marriages still married or previously married and excludes the sample of first marriages separated by widowhood . After excluding the samples with missing key variables, we obtained a male study sample of 8755, including 280 divorced at first marriage, and a female study sample of 9365, including 231 divorced at first marriage.

3.2 Variables

Dependent variable: Individuals entered the risk set when they were first married and exited the risk set if they were divorced at first marriage. In the first marriage divorce sample, the data are reconstructed into the format of person-year data from the year of first marriage to the year of first marriage divorce; in the first marriage at marriage sample, the data are reconstructed into the format of person-year data from the year of first marriage to the year of survey (2010), such that the data structure constitutes a time axis, and the survival time of first marriage becomes a year-by-year The time-varying variables in this paper are The dependent variable in this paper is constructed as whether or not a person is divorced in a particular year, and is coded as 0 starting from the year of marriage, and the variable is coded as 1 when the timeline rolls over to

the year of divorce, and is always coded as 0 if no divorce has occurred by the time of the survey (2010).

Independent variable: The independent variable in this study is age at first marriage. Age at first marriage = year of first marriage - year of birth. Due to the different policies on population marriage and childbirth in different periods, as well as the cultural differences in marriage and childbirth in different regions (especially in minority gathering areas), there are corresponding fluctuations in the age of first marriage, and the starting age of the age of first marriage is set to 13 years in this paper. The age of first marriage is divided into categorical variables, and the Marriage Law stipulates that the age of first marriage for men and women is 22 and 20 years old respectively, so men getting married at 13-21 years old is considered as early marriage, women getting married at 13-19 years old is considered as early marriage, 22/20-25 years old is considered as marriageable age as a reference group, and 26-30 years old as well as 31 years old and above is considered as late marriage.

Control variables: The main control variables in this paper are premarital cohabitation, Ethnicity, Household, Region, Respondents' education, Occupational class, Annual income, First marriage acquaintance mode, The time of first marriage adventure, Number of children, Father's education, Mather's education, Household at age 12 and Concept of family well-being. The time of first marriage adventure is treated as a time-varying variable, and couples may go through multiple historical periods as the marriage continues. The number of children is also treated as a time-varying variable, with the number of children changing as the marriage continues.

Those who have an accepting attitude toward divorce are more likely to divorce. Acceptance of divorce is measured in this paper by the concept of family well-being. A principal component factor analysis was conducted on the variables "importance of close relationship with spouse" and "importance of family happiness and harmony" in CFPS2010, and the resulting common factor was the perception of family happiness variable (KMO statistics for each original variable were The KMO statistic of each original variable was greater than 0.7, and the Bartlett's test was significant). The descriptive statistics of the main variables are shown in Table 1.

Table1: Descriptive statistics for each variable (%).

Variable	Variable classification	Male	Female
Divorce	Yes	3.20	2.50
	No	96.80	97.50
Age at first Marriage	13~21	21.79	-
	13~19(Female)	-	16.19
	22~25	49.21	-
	20~25 (Female)	-	71.78
	26~30	23.88	10.53
	31 plus	5.12	1.51
Cohabitation	Yes	10.27	9.98
	No	89.73	90.02
Ethnicity	Han	92.59	92.38
	Minority	7.41	7.62
Household	Agricultural	68.56	70.51
	Urban	31.44	29.49

Region	East	31.81	31.21
	Central	26.07	26.43
	West	27.73	26.86
	Northeast	14.39	15.50
Respondents' education	Illiterate / semi-literate	16.94	29.61
	Primary School	21.66	21.41
	Junior High School	36.71	30.22
	High School	16.04	11.81
	College	5.29	4.19
	Bachelor and above	3.37	2.77
Occupational class	No job	37.76	52.90
	Controller	9.03	6.12
	Non-manual workers	12.06	8.21
	Manual workers	41.14	32.77
Annual income (CNY)	0~1000	14.70	41.40
	1000~5000	18.95	22.51
	5000~10000	20.06	14.40
	10000~30000	36.61	17.74
	30000~50000	6.19	2.56
	50000~100000	2.68	-
	100000 and above	0.81	-
	50000 and above (Female)	-	1.39
First marriage acquaintance mode	Know oneself	23.00	22.10
	Introduced by others	71.98	72.75
	Arranged by parents	3.24	3.17
	Online acquaintance and others	1.77	1.98
The time of first marriage adventure	Before 1980	26.27	23.41
	1981~1990	29.24	29.32
	1991~2000	24.48	25.94
	2001~2010	20.01	21.33
Number of children	Childless	5.61	5.09
	One child	40.45	41.99
	Two children and above	53.95	52.92
Father's education	Illiterate / semi-literate	49.56	46.05
	Primary School	28.52	29.03
	Junior High School	13.14	15.71
	High School	6.58	7.16
	College and above	2.20	2.04
Mather's education	Illiterate / semi-literate	73.57	66.97
	Primary School	17.10	20.96
	Junior High School	6.38	8.34
	High School	2.51	3.15
	College and above	0.43	0.58
Household at age 12	Agricultural	83.89	83.98
	Urban	16.11	16.02
Concept of family well-being	mean	1.03e-08	-6.66e-09
	standard deviation	1	1
Totals		8755	9365

3.3 Model

This paper examines the risk of divorce in first marriages at different times, referring to the probability of a divorce event at a point in time. Since most of the respondents were in marriage during the observation period, we could not observe the actual duration of marriage for these respondents, and the dependent variable suffers from data censoring problems, thus it is more suitable to use event history analysis. The reasons for choosing the discrete model in this paper are: i) to retain more samples, the divorce times used in this paper are calculated in years; ii) compared to continuous-time event history analysis, the discrete model can incorporate time-varying and non-time-varying variables. Often discrete event history models are combined with the commonly used logit models.

In a discrete event history analysis model, the probability of risk is the probability that an event will occur at a certain point in time for an individual The probability of an event at a certain point in time. In the case of divorce events in this paper, it refers to the probability of divorce in a particular year, which can be expressed as the following model:

$$P_{it} = P(T_i = t | T_i \geq t, x_i, x_{it}) = F(x, \beta) \tag{1}$$

Let $F(x, \beta)$ be the cumulative distribution function of the "logistic distribution", and further obtain the following model:

$$P_{it} = F(x, \beta) = \Lambda(x'\beta) \equiv \frac{exp(x'\beta)}{1+exp(x'\beta)} \tag{2}$$

In the above equation, T_i as a discrete-time variable denotes marriage duration; x_i denotes non-time-varying variables, i.e., characteristic variables that are not stable over time, such as age at first marriage, education level, and cohabitation before marriage; x_{it} denotes time-varying variables, i.e., unstable characteristic variables that change over time for individuals, include age of marital adventure and number of children. To explore what association exists between the probability of occurrence of divorce events (T_i=t) in the risk set ($T_i \geq$t) and the independent variables, the logit model is usually used for modeling, and the logit model is estimated using the maximum likelihood method (MLE), so that the undivorced sample can be brought into the estimation of divorce risk equally with the divorced sample.

The discrete event history analysis model combined with the Logit model is expressed as follows:

$$\frac{P_{it}}{1-P_{it}} = \exp\left(\beta_0 + \beta_1 x_i + \beta_2 x_{it}\right) \tag{3}$$

$$Log\frac{P_{it}}{1-P_{it}} = logitP_{it} = \beta_0 + \beta_1 x_i + \beta_2 x_{it} \tag{4}$$

In the above equation, $\frac{P_{it}}{1-P_{it}}$ is the ratio of the probability of the event occurring to the probability of the event not occurring, β_1 and β_2 represent the effect of non-time-varying

versus time-varying variables on the change in divorce risk, and the intercept term β_0 represents the baseline risk of the model.

4 Findings

This paper focuses on the effect of age at first marriage on marital stability, and the model constructed is as follows:

$$stability = \beta_0 + \beta_1 age + \beta_2 cohabitation + \beta_i controls + \varepsilon_i \quad (5)$$

The dependent variable $stability$ indicates marital stability, age indicates age at first marriage, $cohabitation$ is a binary variable of whether to cohabit, $controls$ are other control variables, $\varepsilon_i$is a disturbance term.

In order to further explore whether the effect of age at first marriage on marital stability is moderated by pre-marital cohabitation, the interaction term of age at first marriage and pre-marital cohabitation is added to the model in this paper, and the following empirical model is constructed:

$$stability = \beta_0 + \beta_1 age + \beta_2 cohabitation + \beta_3 age \times cohabitation + \beta_i controls + \varepsilon_i \quad (6)$$

The $age \times cohabitation$ is the interaction term for age at first marriage and cohabitation, and the other variables are set consistent with Equation 5.

4.1 Hazard Function

Figure 1 and Figure 2 show the hazard function of the male and female samples, respectively. From the Figure 1 , the divorce risk rate experienced a short rise and then declined rapidly, and the peak of divorce risk was around 7~8 years of marriage duration, the divorce risk of men reached the highest level around 7~8 years of marriage, indicating that there might be a "seven-year itch" in marriage, and the divorce risk declined rapidly afterwards.

As with the male sample, the risk of divorce for the female sample continued to decline after a brief increase over time, with a slower decline than the male sample, and the possibility of a "seven-year itch" also existed.

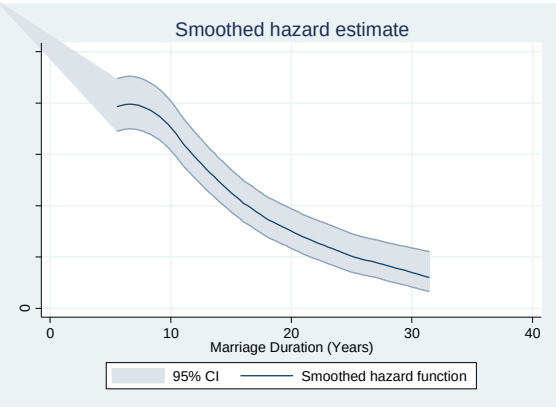

Figure1: Hazard Function for Male.

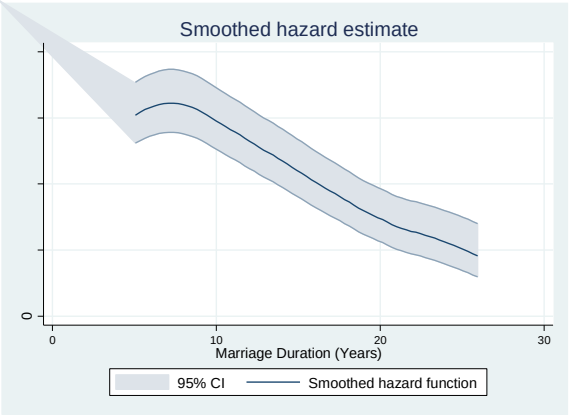

Figure2: Hazard Function for Female.

4.2 The Effect of Age at first Marriage on Marital Stability

The regression results of the effect of age at first marriage on marital stability by gender are given in Table 2. Where model 1 is the regression result without the interaction term of age at first marriage and cohabitation, and model 2 is the regression result with the interaction term of age at first marriage and cohabitation.

Model 1 for the male sample shows that marrying at the age of 13-21 significantly increased the risk of divorce compared to men who married at the marriageable age of 22-25. Relative to the reference group, the risk of divorce is increased by 39.8% (e^0.335-1), proving that early marriage is detrimental to the stability of men's marriage. The reason may be that, on the one hand, early marriage is mentally immature, does not make a correct prediction of the marriage partner, lacks correct knowledge of marriage itself, and does not have a strong sense of responsibility for marriage and family, which makes it difficult to get through marriage; on the other hand, when meeting a marriage partner who is more compatible with them in the marriage market, the advantage of age will make it easier for them to enter the next marriage due to the

lower age of the early married. And men have the advantage of remarrying more than women [11]. Finally, men need to provide financial support for their families more than women, and those who marry early tend to be less educated and do not have regular jobs and financial resources to cover the various expenses in marriage, which can be very damaging to marital stability. Compared to the reference group, there was no significant effect on the risk of divorce between the ages of 26-30 and 31 and above.

Looking at the female sample, neither age at first marriage nor cohabitation had a significant effect on the risk of divorce. Compared to men, women's role in the family changed after marriage and as the age at marriage increased, women have a marginal increase in the cost of divorce, a marginal decrease in the competitiveness of remarriage, and an increased emphasis on marriage, making women's divorce decisions different from men's [23]. At the same time, the influence of women's education, economic ability, social status, mobility, and view of marriage on marital stability gradually increases, and the age of first marriage does not have a significant effect on marital stability.

Hypothesis 1 is partially tested, early marriage for men is not conducive to marital stability.

Table2: Regression results of age at first marriage on marital stability by gender

	Male			Female	
	Model1	Model2		Model1	Model 2
Age at first marriage (Reference group:22~25)			Age at first marriage (Reference group:20~25)		
13~21	0.335**	0.304*	13~19	0.067	-0.075
	(0.167)	(0.178)		(0.233)	(0.249)
26~30	0.159	0.113	26~30	-0.099	-0.094
	(0.156)	(0.169)		(0.195)	(0.205)
31 plus	0.146	-0.070	31 plus	-0.012	0.075
	(0.256)	(0.297)		(0.432)	(0.432)
Cohabitation (Yes=1)	0.712***	0.497*	Cohabitation (Yes=1)	-0.065	-0.195
	(0.182)	(0.274)		(0.246)	(0.302)
Interactive term (Reference group:22~25*Cohabitation)			Interactive term (Reference group:20~25*Cohabitation)		
13~21*Cohabitation	-	0.193	13~19*Cohabitation	-	1.453**
		(0.492)			(0.628)
26~30*Cohabitation	-	0.276	26~30*Cohabitation	-	-0.039
		(0.408)			(0.621)
31 plus*Cohabitation	-	1.082*	31plus*Cohabitation	-	0.000
		(0.585)			(0.000)
Constant	-3.514***	-3.507***	Constant	-4.964***	-4.929***
	(0.397)	(0.399)		(0.554)	(0.553)
Observations	194,306	194,306	Observations	201,163	201,071
$\bar{R}^2$	0.183	0.184	$\bar{R}^2$	0.149	0.150

Note: (1) Standard errors in parentheses; (2) *** p<0.01, ** p<0.05, * p<0.1;(3) Ethnicity, Household, Region, Respondents' education, Occupational class, Annual income, first marriage acquaintance mode, The time of first marriage adventure, Number of children, Father's

education, Mather's education, Household at age 12 and Concept of family well-being were also controlled in analysis.

4.3 The Moderating Effect of Premarital Cohabitation

In Model 2 with the inclusion of the interaction term, it can be seen that the interaction effect of pre-marital cohabitation for men with age at first marriage of 31 and above is positive and significant, pre-marital cohabitation raises the risk of divorce for men who marry later compared to the group of men who marry later without cohabitation before marriage.

In China, pre-marital cohabitation belongs to transitional cohabitation [21]. For men, when pre-marital cohabitation delays the age of first marriage, on the one hand, they may not have accumulated enough marriage-specific capital and cannot afford the cost of entering marriage. On the other hand, they may be dissatisfied with the cohabitant, but they are forced to enter into marriage due to their sense of responsibility to the cohabitant and the pressure from both parents, which results in high instability of the marriage afterwards. In order to protect the rights of their unmarried children, parents of cohabitants also urge them to get married as soon as possible [8].

And from the results of Model 2 of the female sample, the interaction effect between premarital cohabitation and age at first marriage of 13-19 years is positive and significant, premarital cohabitation increases the risk of divorce for women who marry early.

Possible reasons why the experience of cohabitation increases the negative impact of early marriage on marriage among women are that women who cohabit at an early age are often associated with low education, unstable family backgrounds, lack of parental discipline and love, and are more rebellious and immature in their peer group, and do not have a proper understanding of the act of cohabitation and make arbitrary decisions. Cohabitation is more prevalent among those with lower education, lower income, and greater reliance on public assistance [4] [5]. Most cohabiting partners have similar characteristics and are younger and more likely to be "married to a child". The low educational level leads to low financial ability to cover the expenses of family life, and it is often difficult for such individuals to keep their marital commitment.

5 Conclusion

The risk of divorce for both men and women reaches a peak between 7 and 8 years, indicating that there is a possibility of the "seven-year itch" in marriage. The peak of the hazard function is lower than that of men, which means that men have a higher risk of divorce than women, probably because Chinese women have traditionally made their families the focus of their lives and are more likely to endure even if they encounter an unsatisfactory marriage.

Early marriage is detrimental to male marital stability, and premarital cohabitation increases the adverse effects of early marriage on marriage for women and raises the risk of divorce for men who marry later in life. Meanwhile, the influence of women's economic ability, education, social status, and marital outlook on marital stability gradually increases, and age at first marriage does not have a significant effect on marital stability. This is also evidenced by the effect of other control variables on women's marital stability, with location, education, and number of children being the most significant variables affecting women's marital stability. In addition, the financial

costs of divorce fall more heavily on women. After divorce, women's household income drops sharply and the risk of poverty is greater [16], which also leads to women's cautious decision making about divorce.

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