Long-term effects of labor market conditions on family formation for Japanese youths*

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Abstract

This study aims to examine how each cohort's family formation is affected by labor market conditions experienced in youth in Japan. Although the deteriorated youth employment opportunities have been often blamed for the declining marriage and fertility rates, the effects of slack labor market conditions on marriage and fertility are theoretically unclear. We estimate the effects of regional labor market conditions on fertility and marriage formations, controlling for nation-wide year effects and prefecture fixed effects. We find that (1) the contemporaneous unemployment rate is not statistically significantly correlated with the fraction of ever married population or women with a child, (2) high school educated women who experienced a recession at entry to the labor market are less likely to have a child and tend to marry later, although the effect for men in the same cohort is subtle, (3) a recession might rather increase fertility for college educated women, (4) the overall impact of labor market conditions experienced in youth on family formation is relatively weak given the well-documented persistent loss in earnings and employment stability.

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1. Introduction

Like in many other countries, the average age at first marriage has been rising, and the fertility rate has been falling for decades in Japan. At the same time, unemployment and non-regular employment among youths have been on the rising trend. Because of this coincidence, the deteriorated youth employment is often blamed for the declining marriage and fertility rates. For example, Yamada (2007) argues that, under the custom that allows unmarried women to be economically dependent on their parents, the bleak economic prospects for young men relative to their fathers' generation have made marriage less attractive for young women. Based on a web survey about attitude toward family formation, Matsuda (2009) also claims that income risks due to a recession make young people reluctant to marry. Since out-of-wedlock childbirths are very rare in Japan, the decline in marriage is thought to lead to a lower fertility rate.

Economic theories, however, do not predict that the deterioration in youth employment prospects necessarily lead to lower marriage and fertility rates. A recession can have a positive substitution effect because worse employment opportunities for women lower the opportunity costs of marriage and childbearing. Indeed, empirical studies using data from the United States have established that worse opportunities for women in the local labor market increase marriage and fertility rates, and this effect tend to dominate the negative income effects from deteriorated male employment opportunities (Butz and Ward 1979, Schultz 1994, Blau, Kahn and Waldfogel 2000, Dehejia and Lleras-Muney, 2004).[1] At the same time, Kondo (2010) shows that this increase in marriage reflects an inter-temporal substitution and that the long run marriage rate is unaffected. Therefore, the counter-cyclical marriage and fertility rates may rely on the high labor turnover rate in the

[1] At the same time, earnings inequality among young men prolongs marital search process and delays marriage timing of women in the local labor market (Loughran 2002, Gould and Passerman 2003).

United States, which makes it easier to return to work after the child grows old enough. In countries with more rigid labor market structure, it may be harder to inter-temporarily substitute female labor with family activities. Incidentally, the fertility rate is falling rapidly in such countries including Japan and Southern European countries.[2]

Existing studies using Japanese data vary significantly in their conclusions, depending on data and methodology. On the one hand, cross-sectional analyses using Census 2000 (Ogawa 2003, Ohta 2007, Kitamura and Miyazaki 2009) report a positive correlation between employment opportunities for young men and contemporaneous marriage and fertility rates.[3] On the other hand, Ogura and Dekle (1992) find a negligible effect of earnings of men by applying the first-difference method to prefecture-level panel from Census 1970-85. These studies also report a modestly negative effect of female labor market opportunities on marriage and fertility; therefore, the overall effect of a recession on the demographic trend remains ambiguous. Studies on the effect of female labor market condition using the Japanese General Social Surveys also vary with their conclusion: Shimizu (2002) finds an decrease in women's earnings raises fertility, while Nozaki (2007) shows that a rise in the female unemployment rate delays marriage. Lastly, Higuchi, Matsuura and Sato (2007) find that prefecture-level active job opening to vacancy ratio (*yuko kyujin bairitsu*) does not affect the fertility of married women using the Japan Panel Study of Consumers.

The lack of consensus among the existing studies is attributable to the lack of an appropriate dataset that provides individual-level information on fertility and marriage history and has a sufficiently large sample size. We aim to overcome this limitation by constructing individual-level fertility history data from the Employment Status Survey (*Shugyo Kozo Kihon chosa*; ESS) and prefecture-level panel data from the Census and the Vital Statistics as

[2] As pointed by Yamada (2007), another similarity between Japan and Southern European countries is that unmarried youths are tend to be allowed to depend on their parents.
[3] Ermisch and Ogawa (1994) show similar results using time series data.

supplement. These datasets are augmented with the regional unemployment rate. By exploiting geographical variations in unemployment rates, we control for nation-wide time trends in a flexible way. Also, the large sample size of the ESS allows us to investigate the effect for subsamples divided by education.

Furthermore, we exploit the fact that labor market conditions in the year of graduation from schools have persistent effects on subsequent employment and earnings in Japan. That is, a recession at graduation permanently lowers the prospects for employment and earnings. It is important to distinguish the effect of temporary income fluctuations and that of permanent income changes because they have quite different implications for long-run demographic trends. On the one hand, a *temporary* decline in income may delay the timing of marriage and childbearing in order to smooth consumption inter-temporarily, without changing the total number of children the couple would eventually have. On the other hand, a decline in *permanent* income may reduce the total number of desired children and increase the number of people who will never have a child.

Our estimates suggest that the contemporaneous male employment rate is positively correlated with the fraction of married women only for high school graduates. The correlation with the fraction of woman who has a child is subtler. Further, high school educated women who experienced a recession at entry to the labor market are less likely to have a child and tend to marry later, although the effect for men in the same cohort is subtle. Surprisingly, a recession might rather increase fertility for college educated women. This weak income effect for more educated women is consistent with the existing evidence that the income loss due to a recession at entry is smaller for more educated (Genda, Kondo and Ohta, 2010). Nonetheless, the overall impact of labor market conditions experienced in youth on family formation is relatively weak given the persistent loss in earnings and employment stability.

We are not the first study that tries to examine the effects of labor market conditions at entry to the labor market on marriage and fertility: Abe (1999), Higuchi and Abe (1999), and Higuchi (2001) investigate such the effects using individual-level panel data and national-level labor market indices. They find women who graduate from school in the year when labor demand is slack tend to marry and bear children earlier, while the contemporaneous unemployment rate delay marriage and childbearing. Yet, the use of the national level labor market indices does not allow them to control for time trends in a flexible form. With controls for nation-wide year effects and region fixed effects, we aim to offer more robust estimates.[4] Another value added of this paper is that we investigate effects not only for women but also for men, and for subsamples divided by education.

The rest of this paper is organized as follows. The next section reviews the background statistics of Japanese youth labor market and demographic trends. Then, the third section describes our data. The fourth section reports our empirical findings, and the final section gives concluding remarks.

2. Japanese youth labor market and demographic trends

Japanese economy experienced a prolonged stagnation in the 1990s and the early 2000s. Since Japanese firms prefer to cut hiring of new school graduates rather than firing incumbent workers, the cost of this economic stagnation was borne disproportionately by young people who were on the course of transition from school to full-time work. As a consequence, a macroeconomic condition in the year of graduation has very persistent effects on subsequent employment and earnings in Japan. Genda, Kondo and Ohta (2010) show that a 1%-point rise in the regional unemployment rate at graduation lowers earnings in the subsequent 12

[4] To our knowledge, Ogura and Dekle (1992) is the only existing study that has employed the same strategy, and their analysis was limited to the contemporaneous relationship between labor market conditions and marriage and fertility behaviors.

years by 7% for high school educated men and 3% for college educated men. For high school graduates, a 1%-point rise in the unemployment rate at graduation also lowers the employment rate by 3%-point for over a decade. This implies that the cohorts that entered the labor force in the 1990s and the early 2000s suffer substantial loss in their permanent income.

At the same time, Japan has experienced a rapid fall in the fertility rate. The total fertility rate fell from around 1.8 in the early 1980s to below 1.3 in the mid 2000s, and Japan has become one of the countries with the lowest fertility rate in the world. This fall in the fertility rate is attributable to the increase in the number of women who never marry: the average number of children that a married couple has has stayed around 2 since the 1970s, while the fraction of women aged 25-39 who are not married increased from 18% in 1985 to 36% in 2005, according to the Census. Also, according to Vital Statistics Annual Report 2003, less than 2% of all births are out of wedlock. Thus, it is believed that a decline in marriage always leads to a decline in fertility.

This coincidence of the timing leads to an argument that the deteriorated employment prospects for young men accelerate population aging in Japan. That is, the economic stagnation has increased the number of young men who can not earn enough to support their families, thus it has suppressed marriage and fertility rates.[5] Indeed, as shown in Figure 1a, the total fertility rate looks as if picking up the fluctuations in the unemployment rate with a few years' lag. Also, at the individual level, an experience of non-regular employment and unemployment in youths delay marriage for Japanese women (Nagase 2002, Sakai and Higuchi 2005, Kitamura and Sakamoto 2009).

However, the unemployment rate and the fertility rate are on the secular trend changes,

[5] It is often emphasized that the social norm in Japan expects men to support their spouse financially. According the Eleventh Japanese National Fertility Survey in 1997, women in Japan think earning capacity is one of the very important attributes for their prospective spouse.

thus the observed negative correlation might be a mere coincidence. Also, the individual-level correlation between family formation and past employment status does not necessarily mean an aggregate effect of macroeconomic shocks experienced in youth, especially if some unobservable factors affect both labor supply and family formation. Therefore, the causal link between the unemployment rate and the fertility rate might be much weaker than it appears in the aggregate time series. Hence, the rest of this paper explores the relationship between the unemployment rate and fertility with controls for nation-wide trends in as a flexible way as possible. Also, inspired by Genda et al (2010) – macroeconomic conditions at entry to the labor market have a persistent effect on the subsequent employment and earnings – we focus on the effect of the unemployment rate in the year of graduation from school and the probability of being married or having a child, as well as the effect of the contemporaneous unemployment rate.

3. Data

Since no single dataset provides fertility and marriage history of women in Japan with sufficiently large sample size, we construct separate datasets for fertility and marriage. First, we use the information on the household composition and children's age to retrieve the individual-level fertility history from the Employment Status Survey (*Shugyo Kozo Kihon Chosa*). The Employment Status Survey also provides information on the employment status and marital status at the time of survey; however, the Survey does not provide any information on when the respondent married. Therefore, in order to assess the effect on marriage timing, we construct an annual panel of total and married population by gender and single age for each prefecture from the Census and the Vital Statistics (*jinko dotai tokei*). Both fertility and marriage data are augmented with the regional unemployment rate taken from the annual reports of the Labour Force Survey.

The Employment Status Survey is conducted by the Statistics Bureau of Japan in every 5 year, and we use the surveys in 1992, 1997, 2002 and 2007. The survey asks basic demographic characteristics of all adult household members such as age, gender, and educational background. The Survey also asks employment status and, if employed, job characteristics and earnings. Furthermore, the Survey asks marital status and relationship to the head of each adult and ages of all children in the household. To retrieve fertility history of each adult woman, we assume that all children younger than 18 live with their mother and no woman younger than 18 or older than 45 can have a child. Then, if a woman was fertile when a child in the same household was born, the woman is assumed to be the child's mother. The Appendix describes the step-by-step process to deal with households with multiple adult women; at the end, fertility histories of more than 99% of the women in the relevant age are retrieved. For men, the best we could do is to assume that all children of their wives are their children, although this is admittedly a strong assumption.

For the main analyses, we use women and men who were 33-37 years old at the time of survey. This cut-off threshold is a result of the tradeoff between the accuracy and the length of period to cover. On the one hand, since we cannot follow childbirths 18 or more years prior to the survey, we can't capture teenage births by women who were 34 or older at the time of survey. On the other hand, given that the median age of mother at her first child's birth is 29, we should not ignore births by women in their early thirties. Since the teenage births make less than 2% of all births in Japan, we set 37 as the maximum age of women to include. The lower cutoff is set to 33 so that each survey can cover 5 cohorts.

The summary statistics is shown in Panel a of Table 1. We divide the sample by educational background because it affects the timings of fertility and marriage. One thing to note is that junior college (*tanki daigaku*) is a much more popular option for girls than for

boys in Japan.[6] In contrast, boys are much more likely to go to four-year colleges. Also, skipping and repeating grades are very rare in Japan. Thus, although the survey asks only the highest degree completed in the four categories, we can calculate the year of graduation fairly accurately as follows: 15 for junior high school, 18 for high school, 20 for junior college and 22 for college. The table also shows a cross tabulation of spouses' educational background. Not surprisingly, spouses' educational background is positively correlated.

The median age of mothers at their first child's birth is 29. Figure 2 plots the age-profile of the fraction of women who have a child. As expected, less educated women tend to have a child earlier. Also, a significant number of women have not had a child by their mid-thirties, especially for college graduates. The median age of men at their wife's first children's birth is 33.

A drawback of the ESS is the lack of marriage histories. Therefore, we construct prefecture-level panel of ever-married population as supplemental data from the Population Census and the Vital Statistics. Total and never married population by single age, sex and prefecture is available from the quinquennial Population Census for 1980, 85, 90, 95, 2000 and 2005. We impute the data for inter-Census years from the Census and the annual report of Vital Statistics.

The total population is interpolated solely based on the Census by taking weighted average of the previous and subsequent Census. The underlying assumption is that the age-specific migration rate does not jump at a certain age. This assumption is not very

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[6] Also, the category includes both regular junior colleges (*tandai*), which grants associate degrees, and technical college (*kosen*), which offers a 5-year program granting high school diploma and associate degree. In addition to them, some of respondents who went to 2-year vocational schools (*senmon gakko*) seem to classify themselves as "junior college" graduates, probably because the certificates issued by such vocational schools are taken as equivalent to the associate degree. Since most students of regular junior colleges are women, most men who are classified as "junior college graduates" probably studied in 2-year vocational schools or technical colleges.

plausible for those younger than 25, because many people move at the ages of 18, 20 and 22 to enter college or start a job. Hence, our data include only people older than 25. The number of ever-married men and women are calculated by adding the number of marriages reported in the annual Vital Statistics to the ever-married population reported in the Census. Therefore, the ever-married population fluctuates with the number of marriages reported in the Vital Statistics. The Appendix describes the actual procedure in more detail. Eventually, we have a panel dataset of total and ever-married population by gender, prefecture and year of birth for birth-year cohorts 1956-1978. The summary statistics is shown in the second part of Table 1.

As an index for labor market conditions, we use the regional unemployment rates published for 10 regions[7] in the annual report of the Labour Force Survey since 1974. Since the prefecture-level unemployment rates are not available, we assign the same unemployment rate to each prefecture in the same region. The primary reason to use the regional unemployment rates despite this limitation is that, using the same variable as Genda, Kondo and Ohata (2010), we are sure that there are significant long-term effects on earnings and employment. This is important because, in order to merge the regional unemployment rate with fertility and marriage data, we have to assume that the region of residence at graduation or a specific age is the same as the region of residence at the time of survey. Admittedly, there must be some measurement errors; however, Genda et al (2010) demonstrate that such errors are not large enough to attenuate the effects on earnings even 12 years after graduation.[8] The summary statistics is shown in the last part of Table 1.

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[7] Hokkaido, Tohoku, Southern-Kanto, Northern-Kanto and Koshin, Hokuriku, Tokai, Kinki, Chugoku, Shikoku and Kyushu. Annual unemployment rates at the prefecture level had not been available until the survey redesign in 2002 because the sample size for small prefectures had not been large enough to calculate unemployment rates precisely.

[8] We have confirmed that the result of Genda et al (2010) can be replicated with the ESS, even though we have a different set of cohorts. We have also tried the prefecture-level active job opening to vacancy ratio (*yuko kyujin bairitsu*). The results are similar but less precisely

4. Empirical Findings

Initial evidence from 5-year first differences

Before going into regressions using individual data, let us first examine the correlation between the male unemployment rate and family formation behaviors by young women in the same region. Specifically, we obtain prefecture-level male unemployment rates and the fraction of married female population by age category from Census 1985-2005, and match the data with the prefecture's total fertility rate in the same year taken from the Vital Statistics Report. In addition, we calculate the fraction of married population by educational background (high school or less, junior college and college) from Census 1990 and 2000.

The first panel of Table 2 shows the estimated coefficient of the male unemployment rate from the following double-fixed effect model:

$$Y_{pt} = \alpha + \beta U_{pt} + \eta_t + \mu_p + \varepsilon_{pt} \ldots (1),$$

where Y_{pt} is the outcome variable in year t in prefecture p, U_{pt} is the male unemployment rate in year t in prefecture p. We try both the unemployment rate of all adult men and that of men in the same age group as the women. The year dummy, η, is included to control for the changes in nation-wide trends, and the prefecture dummy μ controls for time invariant characteristics of each prefecture. As shown in the table, the male unemployment rate does not have a statistically significant effect on the marriage rate of young women in the same prefecture. Although the effect on the total fertility rate is significantly positive, the size of the effect is not very large: a 1%-point rise in the unemployment rate lowers the total fertility rate by 0.02 point, where the average unemployment rate is around 4% and the total fertility

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estimated, perhaps because migration across prefecture substantially increased the measurement errors. The active job opening to vacancy ratio in the year of graduation does not have a statistically significant effect on subsequent earnings, either. Another reason to prefer the unemployment rate to the active job opening to vacancy ratio is that the first is a more internationally comparable measure than the latter.

rate is around 1.5.

The second panel of Table 2 shows the correlation between the first difference of the male unemployment rate and that of the female marriage rate by educational background and age category, from the following linear regression:

$$dY_p = \alpha + \beta dU_p + \varepsilon_p \ldots(2),$$

Interestingly, the male unemployment rate has modestly negative effect only for less educated women. It implies that a recession affects less and more educated women in the opposite ways.

Overall, we do not find a clear evidence that deteriorated employment of young men decreased marriage and fertility of young women. The strong negative correlation observed from the time series data is likely to be spurious.

Fertility

To identify the effects of unemployment rates at entry to the labor market and at present, we estimate the following Cox's proportional hazard regression for women who are aged 31-35 at the time of survey:

$$H_{it} = \lambda(birthy_i, age_{it}, edc_i)\exp(\alpha U_{p,t-1} + \beta \overline{U}_{p,y} + \delta_p), \ldots(2)$$

where H is the hazard rate of having the first child, $U_{p,t-1}$ is the unemployment rate in the previous year in the region, and $\overline{U}_{p,y}$ is the unemployment rate at the graduation. We also allow α and β to vary with the woman's age. Table 3 reports the estimated coefficients α and β for all women and two subgroups by educational background.

The upper panel shows that the unemployment rate in the year of graduation delays the timing of first births for female high school graduates. Interestingly, the effect is positive for college (including junior college) graduates, although the coefficient is not statistically significantly distinct from 0. Also, the contemporaneous unemployment rate

has modestly negative effect on fertility. It is puzzling that the coefficients of contemporaneous unemployment rates are positive for male high school graduates; it might imply that migration of single men is affected by the unemployment rates.

The lower panel of Table 3 reports the effect by four age groups: 18-22, 23-27, 28-32, 33-37. The effect of contemporaneous unemployment rate is positive for the youngest age category and turns to negative as women ages, regardless of their educational background. The positive effect for high school educated men in their twenties seems to correspond to the age-pattern for women, although it is not the case for college educated men. The effect of graduation year's unemployment rate is consistently negative for high school educated women and positive for college educated women. Again, the effect for men is not very clear.

Figure 3 presents the histograms of simulated number of births for each age category and educational background, using actual age-specific fertility rates and estimated coefficients reported in Table 3.[9] Overall, a recession decreases fertility for less educated women but increases fertility for more educated women. The aggregate effect is subtle.

To confirm this finding from a slightly different specification, we also estimate the following probit regression:

$$C_{ptyi} = 1 \quad if \quad \alpha + \beta' \overline{U}_{p,y} + \delta_p + \eta_y + \varepsilon_{ptyi} > 0 \text{ , ..(3)}$$

where C_{ptyi} takes 1 if person i has a child and 0 otherwise. Subscript p denotes the prefecture of residence, and y is the year of graduation. The remaining random errors are denoted as ε_{apt}, which may be correlated within prefecture (i.e. standard errors are clustered by prefecture). We estimate equation (3) for separate ages, gender and educational background.

Table 4 reports the estimated marginal effect of the regional unemployment rate in the

[9] The number of births when a unemployment rate at graduation rises by 1% = exp(β)*#actual births in the data *(1-simulated # births for the younger category)/ (1-actual # births for the younger category). The number of births when a contemporaneous unemployment rate rises by 1% = exp(α)*#actual births in the data.

year of graduation on the probability of having ever born a child at the ages of 26, 28, 30, 32 and 34. The unemployment rate at graduation has marginally significant negative effects on the probability of having a child for less educated women, and positive ones for more educated women. The effect for men is not very clear. Overall, we can confirm qualitatively the same results as presented in Table 3.

How about the effect on the probability of having two or more children? Does the delay in the first childbirth lead to a lower probability of having a second child? Table 5 suggests the answer is no. It shows that, *conditional on having at least 1 child,* the unemployment rate at graduation increases the probability of even for less educated women. This may be because women who experienced slack labor market conditions at entry to the labor market are less likely to be able to keep their full-time job after her first childbirth[10] and thus the opportunity cost of having an additional children is lower for them. Yet, we have to keep in mind that our sample is limited to those who were 33-37 years old at the time of survey because we cannot track births that occurred more than 17 years prior to the survey. Since 20 % of second and higher-order births are given by women older than 33, the result presented in Table 5 should be taken no more than suggestive evidence.

Marriage

The effects for marriage estimated in similar way as Table 4, with some modification to use the prefecture-birth year level data from the Census and the Vital statistics. First, since the data is at the prefecture level, we employ the following linear model instead of a probit:

[10] Imada and Ikeda (2006) show that female non-regular employees who are not eligible for a maternity leave tend to quit right before the birth of their first children. Since the rate of non-regular employment is strongly affected by labor market condition in the year of graduation in Japan (Genda et al, 2010), it implies that cohorts who face a slack labor market at entry to the labor market are less likely to continue to work at a full-time regular job after child-bearing.

$$M_{pty} = \alpha + \beta' \overline{U}_{p,y} + \gamma' X_{pty} + \delta_p + \eta_y + \varepsilon_{pty} > 0 \text{ , } \ldots \text{ (4)}$$

We cannot calculate the married population separately for each educational background, thus instead of splitting sample by education, we include the ratio of women/men with no more than high school education in X_{pty}. X_{pty} also includes male-to-female ratio in the population.

The estimated coefficients are reported in Table 6. A recession at graduation from high school delays marriage of the affected cohort of women. The effect for men is also negative, although not statistically significant. However, it is puzzling that the interaction term with the fraction of high school graduates is not negative for some age and gender groups.

Furthermore, Table 7 shows the effects of previous year's and graduation year's unemployment rates on the probability of getting married conditional of having never married until the previous year. The dependent variable is the probability of marriage conditional on having been unmarried until the previous year, which is defined as {(% unmarried as of age t - % unmarried as of age t+1)/% unmarried as of age t} for each cohort. The effect of the previous year's unemployment rate is positive for women and older men, in contrast to the negative effect for younger men. This might imply that women prefer to marry with older men in a recession, perhaps because older men are more likely to have a stable, high-paying job. The effect of the unemployment rate at graduation is negative for all groups, although the size and statistical significance vary.

Lastly, Table 8 shows the correlation between the unemployment rate at graduation and spouses' characteristics, namely education and age. Spouses' education is not significantly correlated with the unemployment rate at graduation, but cohorts who graduated during a recession tend to marry with younger spouses. A further look in to the data suggests that, at least for women, this decline in the age of husband is attributable to a decline in the fraction with a 4 or more years of age gap. Although it is not very clear why this is the case, the significant correlation with age difference implies that men who face a recession at entry to

the labor market might marry women in different cohort than they would have otherwise. This might explain why the effects for men are weaker than that for women.

5. Discussion and preliminary conclusion

We have shown that a high regional unemployment rate and a low employment rate of the men in the same cohort lowers the probability of being married for young Japanese women. In contrast, the aggregate effect of local labor market conditions on fertility is subtle. However, a further look by educational background reveals that the effect of unemployment rate at entry to the labor market on fertility is negative for less educated women and positive for more educated women.

Why the effect varies with educational back ground of women? It suggests that the positive substitution effect is stronger for more educated women, while the negative income effect is stronger for less educated women. It might be the case that more educated women are more likely to have a full-time regular job if they are single, therefore the opportunity cost may be higher for them if they were to quit the job after childbearing. Another potential reason is that more educated women tend to marry with more educated men, who suffer less from a persistent loss of earnings due to entering the labor market during a recession. Therefore, more educated women may not worry about their spouses' earnings as much as less educated women.

However, the effect of unemployment rate at entry for less educated men is insignificant even though they suffer from income loss the most. Therefore, a bigger decline of potential spouses' earnings is not likely to be the reason of stronger income effect for less educated women. Alternative possibility is that the effect of the unemployment rate at entry does not attributable to the declined income but operates through matching process at work place. As Nagase (2002) speculates in the discussion of her results, regular full-time

employment might have offered some sort of matching opportunity for young women and also pressured them to marry by a certain age. In addition to this potential effect on marriage probability, Iwasawa (2004) shows that women who had non-regular job at the time of marriage tend to have fewer children than those who had regular job or those who did not have a job. This may be because, as shown by Imada and Ikeda (2006), most non-regular employees are not eligible for maternity leave and have more difficulty in keeping their job after childbirth than regular employees.

In any case, the overall effect of labor market conditions experienced in youth on family formation is weak, despite the well-documented persistent effect of labor market conditions at entry on subsequent employment and earnings. Although it might have delayed marriage timing slightly, the deteriorated employment prospects for young Japanese men is not likely to be the primary reason of the declining fertility. This result implies that, even though recovering employment prospects of young Japanese is an important policy challenge on its own, it is not likely to be an effective policy for increasing the fertility rate.

Appendix

Identification of each woman's children

To identify the year of child births, we made several important assumptions. First, we follow children up to 17 years old, assuming they live with their mother. The reason for this assumption is that 18 is the age when people graduate from high school and start leaving their parents' home in Japan. This assumption is probably tolerable because about 97% of 16 and 17 year-olds in the sample are children or grand children of household heads. The fraction of heads and wives increases from less than 3% at the age of 15-17 to 12.7% at the age of 18, and it keeps growing with the age thereafter. Regarding the measurement errors due to

divorce, the probability of divorce within 15 years since marriage is about 20% in Japan.[11] Once divorced, the custody went to the mother for 75% of the cases of divorces that occurred in the 1980s and 1990s, according to the Vital Statistics Report. Taking into account that the probability of divorce is higher at the initial stage of marriage before the couple has a child, roughly speaking, the fraction of children whose step-mother is misidentified as their biological mother is at most 5 %.

Second, we assume that a woman can have a child only between the ages of 18 and 45. This assumption is based on the special issue of Vital Statistics Report in 2005: only less than 0.3% of women who were born in the period of 1953-1974 had a child prior to the age of 18, and virtually no one had a child after she reached the age of 45. Thus, women who could have a child must be 18-62 years old at the time of survey.

Then, for each woman in the sample who was 18-62 years old at the time of survey, we tried to determine her children's age by the following process.

1) If there were not any children in the household, all adult women in the household are assumed not to have any children younger than 17.
2) If she was the only adult woman younger than 62 in the household and all children were born in the periods when she was fertile, they are assumed to be her children.
3) If there are more than one adult women younger than 62 in the household, we check the age differences between each adult woman and the children. Then, if the following conditions were satisfied for one of the women, all children in the household are assumed to be her children and the other women in the household are assumed not to have any children younger than 17.
   i. She has married (incl. already divorced/widowed)
   ii. All children was born when she was 18-45 years old

[11] Based on the average of (# divorce within 15 years in year t)/(# marriage formed in year t-10), where t = 2000, 1995 and 1990, based on the Vital Statistics.

iii. None of the children was born when the other women in the household were 18-45 years old.

Up to this point, about 97% of the women who were 18-62 years old at the time of survey are identified as either a mother of all children in the household or not having any children younger than 17.

For the remaining 3%, we further go on the following speculation:

4) For all pairs of a child and an adult woman in the household, we checked whether the child was born when the woman was 18-62 years old. Then, if every child in the household has only one woman in the household who could be his/her mother, the woman is assumed to be the child's mother.
5) If the process 4) still can't identify the mother of children, we checked if the women in the household are a pair of mother and daughter(s). If so, then
   i. If the youngest child in the household was born when the mother was older than 45, we guess all children are the younger woman's. That is, the older woman is a grandmother of the children. To avoid contradiction, we check whether the oldest child was born after the daughter got 18 years old.
   ii. If the oldest child in the household was born when the younger woman was younger than 18, we guess all children in the household are the older woman's. That is, the younger woman is a sister of the children. To avoid contradiction, we check whether the youngest child was born before the mother got 45 years old.

Appendix Table A1 shows how many are identified as each category.

Total and ever-married population

For total population, for each prefecture and sex, we define the population of each age in an inter-Census year as a weighted average of population of the same birth-year cohort in the nearest two Census years. For example, the population of age 28 in 1997 is defined as

follows:

$$Population\_age28\_in1997$$
$$= 0.6 * Population\_age26\_in1995 + 0.4 * Population\_age31\_in2000$$

Using seven waves of the Population Census, we construct annual panel spanning from 1975 to 2005.

This definition does not take into account different migration rates for different ages. This omission may cause non-random measurement errors for the teens and the early twenties because many of them move from rural areas to large cities to enter college or start a new job, especially at the ages of 18, 20 and 22. Yet, we believe that such errors are negligible for the population of age 25 or older;[12] therefore, we focus on marital status at the age of 25 or older.

For the ever-married population of unmarried, we use the number of marriages by age of the bride and groom registered in each prefecture, published annually as a part of the Vital Statistics, in addition to the never-married population by single age, sex and prefecture taken from the Population Census. Using these data, first, we subtract the number of marriages formed after the latest Census from the never married population reported in the Census. Let us call this "forward imputation." Second, we add the number of marriages to be formed by the next Census to the never married population reported in this next Census. Let us name this "backward imputation." Lastly, we take a weighted average of the forward and backward imputations. For example, the never-married population of age 28 in 1997 is calculated as

[12] For 1991-2005, we tried an alternative definition that uses the annual population estimates reported in *jinko suikei nenpo*. Since the annual estimated population is available only for five-year age categories, we decomposed each five-year age cell into five single-year age cells using the ratio obtained from nearest two Census waves. For example, the population of age 28 in 1997 is defined as follows: $Population\_age28\_in1997 = EstPopulation\_age25\sim29\_in1997 *$
$$\left(\frac{Population\_age26\_in1995}{Population\_age23\sim27\_in1995} + \frac{Population\_age31\_in1995}{Population\_age28\sim32\_in1995}\right)/2$$
We confirmed that the difference between this alternative definition and the definition used in the main analysis is negligible for population older than 24.

follows:

1. Forward imputation: the never-married population of age 26 in 1995 - the number of marriages with 27-year-old brides in 1996 – the number of marriages with 28-year-old brides in 1997.
2. Backward imputation: the never-married population of age 31 in 2000 + the number of marriages with 31-year-old brides in 2000 + the number of marriages with 30-year-old brides in 1999 + the number of marriages with 29-year-old brides in 1998.
3. Weighted average: 0.6*forward imputation + 0.4* backward imputation.

The ever-married population is equal to total population – never-married population.

For years prior to 1980, only the "backward imputation" is available because Census 1975 does not provide with the never married population by single age. Thus, we regress the imputed never-married population on the backward imputation and interaction terms of age dummies and dummies for years since the last Census, using the data after 1980 and separately for each prefecture, to get the predicted never-married population for years prior to 1980 based on the backward imputation. The underlying assumption is that the difference between the forward and backward imputations depends only on the age and how far the last Census was.

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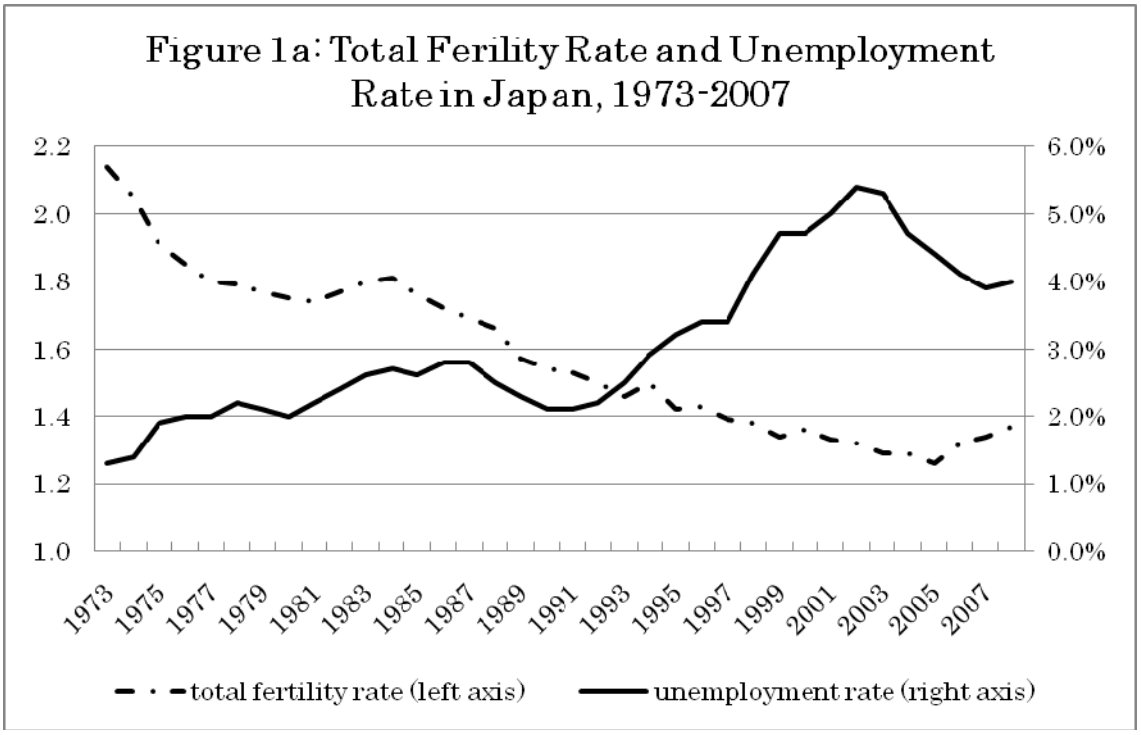


Source: Labour Force Survey (unemployment rate) and Vital Statistics (TFR).

Table 1: Summary Statistics

a. Fertility History Data from the Employment Status Survey

	Women		Men	
Sample size (33-37 years old at the time of survey)	147,724		142,357	
By highest school graduated:				
Junior high school	8,031	(6.9%)	11,956	(5.4%)
High school	76,645	(51.8%)	69,802	(48.9%)
Junior College (AA equivalent)	45,759	(30.9%)	15,918	(11.2%)
College (BA) and graduate school	17,289	(11.7%)	44,681	(31.3%)
Median age of first birth (incl. never have child)	29		33	

Marriage sorting by education

		Husbands				
		Jr. high school	High school	Jr. college	College	Total
Wives	Jr. high school	2,522	2,360	213	222	5,317
		(47.4%)	(44.4%)	(4.0%)	(4.2%)	(100.0%)
		[26.6%]	[4.3%]	[1.9%]	[0.6%]	[4.7%]
	High school	5,679	38,794	4,992	10,914	60,379
		(9.4%)	(64.3%)	(8.3%)	(18.1%)	(100.0%)
		[59.9%]	[70.4%]	[44.2%]	[28.8%]	[53.1%]
	Jr. college	1,178	12,425	5,340	16,307	35,250
		(3.3%)	(35.2%)	(15.1%)	(46.3%)	(100.0%)
		[12.4%]	[22.6%]	[47.3%]	[43.1%]	[31.0%]
	College	95	1,505	747	10,393	12,740
		(0.7%)	(11.8%)	(5.9%)	(81.6%)	(100.0%)
		[1.0%]	[2.7%]	[6.6%]	[27.5%]	[11.2%]
	Total	9,474	55,084	11,292	37,836	113,686
		(8.3%)	(48.5%)	(9.9%)	(33.3%)	(100.0%)
		[100.0%]	[100.0%]	[100.0%]	[100.0%]	[100.0%]

b. Prefecture- cohort level marriage data, from Census and Vital Statistics

Prefecture*birth-year cohorts, born 1956-1978	
Sample size	1081
Median age of marriage	27
Ratio of high school or less educated, women	50.9%

c. Regional unemployment rates, 1974-2006

	mean	Sd
Unemployment rate	3.02	1.28
Residual net of prefecture and year dummies	0.00	0.32

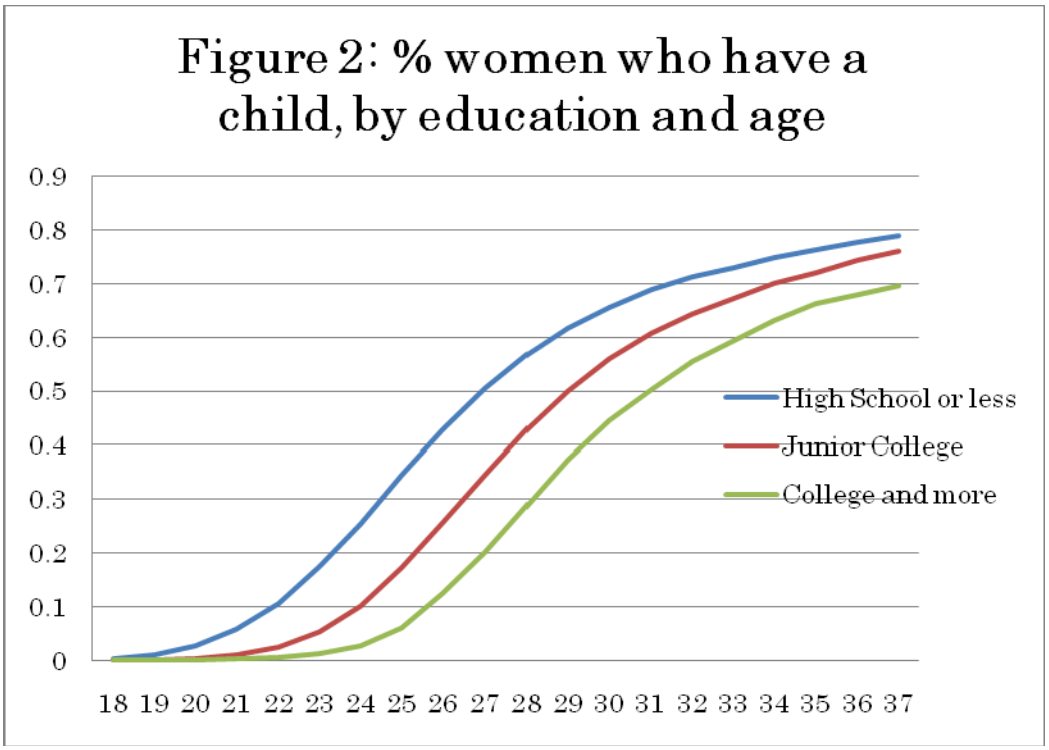


Figure 2: % women who have a child, by education and age
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37
High School or less
Junior College
College and more

Table 2: Contemporaneous Correlations between Male Unemployment Rate and Marriage and Fertility of Young Women

a. Fixed effect regression with all Census from 1985-2005

Dependent variable:	% married in women aged 25-29		% married in women aged 30-34		Total fertility rate
Male unemployment rate	0.309		0.052		-0.028***
(based on age 15-64)	[0.295]		[0.141]		[0.005]
Male unemployment rate		-0.189		-0.119	
(based on same age group)		[0.295]		[0.166]	
Observations	235	235	235	235	235

Note: Linear regressions with prefecture dummies and year dummies in the RHS. Heteroskedasticity -robust standard errors are in brackets.

b. First difference between 1990 and 2000, marriage rate of women by education

	Highs school or less, age 25-29	Jr college or more, age 25-29	Highs school or less, age 30-34	Jr college or more, age 30-34
Male unemployment rate	-0.913*	0.167	-0.130	-0.072
(based on age 15-64 all education)	[0.507]	[0.751]	[0.228]	[0.343]
Observations	47	47	47	47

Note: Linear regressions with no other controls than a constant term. Heteroskedasticity -robust standard errors are in brackets.

Table 3 The Effects of regional unemployment rate at graduation and in the previous year on the hazard of first child's birth

Cox's proportional hazard model, 33-37 years old at the time of survey

a. pooled

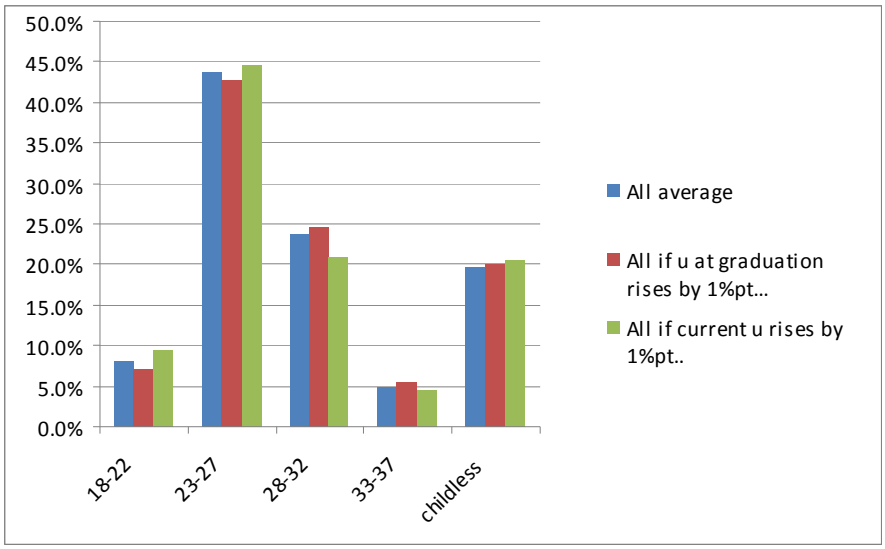
	Women			Men		
	All	High school	College	All	High school	College
Previous year's	-0.068**	-0.084	-0.050	0.036	0.122*	-0.055
Unemployment rate	[0.035]	[0.055]	[0.066]	[0.043]	[0.062]	[0.053]
Unemployment rate	-0.021	-0.113**	0.081	-0.011	-0.011	-0.017
In the year of graduation	[0.067]	[0.053]	[0.093]	[0.064]	[0.065]	[0.077]
Observations	1629267	836572	792695	1874765	1006406	868359

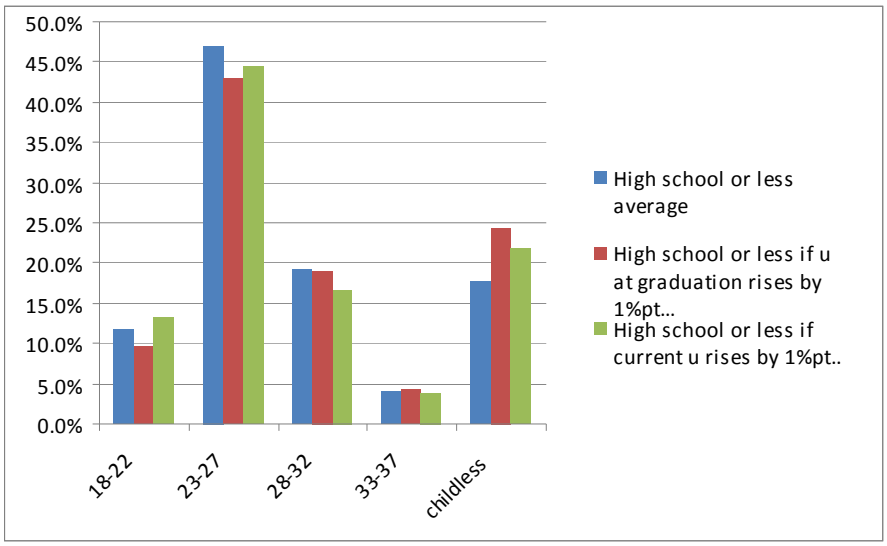
b. interaction with age

	Women			Men		
	All	High school	College	All	High school	College
Previous year's unemp. r.	0.169***	0.108	-	-0.04	0.138	-
* age 18-22	[0.065]	[0.071]	-	[0.406]	[0.390]	-
Previous year's unemp. r.	0.018	-0.055	0.176***	0.084***	0.176**	-0.042
* age 23-27	[0.047]	[0.070]	[0.025]	[0.029]	[0.073]	[0.103]
Previous year's unemp. r.	-0.116***	-0.114*	-0.075	0.012	0.099	-0.105*
* age 28-32	[0.040]	[0.064]	[0.073]	[0.049]	[0.082]	[0.056]
Previous year's unemp. r.	-0.107	-0.07	-0.087	-0.002	0.057	-0.086
* age 33-37	[0.139]	[0.187]	[0.133]	[0.065]	[0.104]	[0.101]
Graduation year's unemp. r.	-0.133	-0.198		0.136	-0.056	
* age 18-22	[0.126]	[0.125]		[0.437]	[0.474]	
Graduation year's unemp. r.	-0.034	-0.116*	0.024	-0.018	-0.032	-0.02
* age 23-27	[0.063]	[0.068]	[0.103]	[0.063]	[0.062]	[0.116]
Graduation year's unemp. r.	0.022	-0.091*	0.15	0.008	-0.001	-0.002
* age 28-32	[0.079]	[0.052]	[0.107]	[0.058]	[0.082]	[0.076]
Graduation year's unemp. r.	0.142	0.009	0.294***	-0.014	0.012	-0.078
* age 33-37	[0.143]	[0.252]	[0.089]	[0.070]	[0.123]	[0.081]
Observations	1629267	836572	515483	1874765	1006406	602146

Note: The baseline hazard is stratified by birth year cohort and education, and the proportional part includes region dummies. Standard errors in the brackets are clustered by region.

Figure 3: Simulation of changes in number of births by mother's age





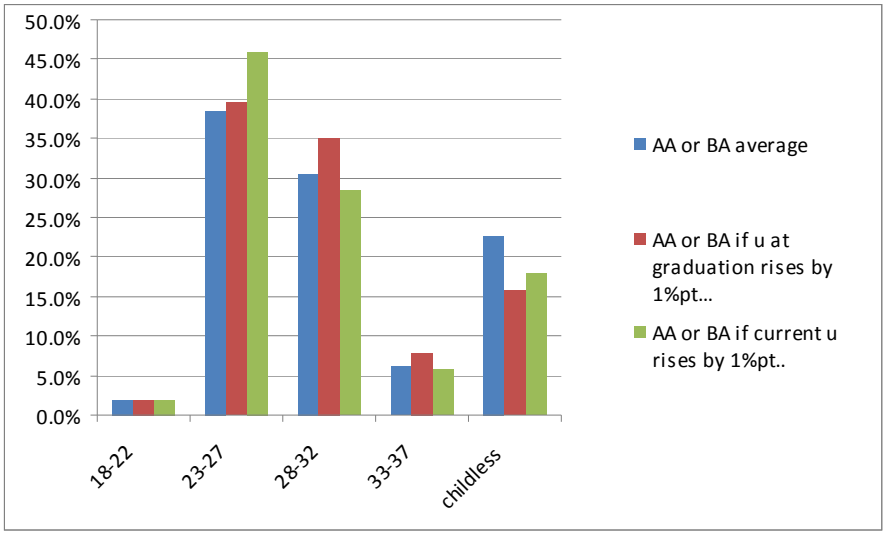


Table 4: The effect of regional unemployment rate at graduation on the probability of having a child by a specific age

Marginal effects from probit regression

a. women, high school or less

Age	26	28	30	32	34
Marginal effect of	-0.007	-0.016	-0.009	-0.026	-0.059*
Graduation year's u rate	[0.016]	[0.018]	[22.712]	[0.017]	[0.035]
Observations	132469	132469	132469	119774	90428

b. women, college or more

Age	26	28	30	32	34
Marginal effect of	0.019*	0.048***	0.033	0.050***	0.014
Graduation year's u rate	[0.011]	[0.016]	[84.284]	[0.015]	[0.018]
Observations	119625	119625	119625	107335	80645

c. men, high school or less

Age	26	28	30	32	34
Marginal effect of	0.005	-0.005	-0.011	0.014	-0.022
Graduation year's u rate	[0.017]	[0.018]	[31.728]	[0.023]	[0.046]
Observations	138091	138091	138091	123828	91879

d. men, college or more

Age	26	28	30	32	34
Marginal effect of	0.013**	0.003	-0.001	0.003	0.001
Graduation year's u rate	[0.006]	[0.015]	[0.018]	[0.019]	[0.026]
Observations	118317	118317	118317	107005	82524

Note: all regressions include dummies for education (high school graduates vs less, junior college vs four year college), region, and year of graduation. Standard errors in the brackets are clustered by region.

Table 5 Suggestive evidence about the effect on the probability of having two or more children (probit marginal effect, women 33-37 year old)

	unconditional on number of children			with at least 1child		
	All	High school	College	All	High school	College
Unemployment rate at graduation	0.018 [0.026]	-0.016 [0.014]	0.049 [0.040]	0.033*** [0.008]	0.026*** [0.007]	0.033** [0.017]
Obs	139,324	76,581	62,743	100,319	57,136	43,183

Note: all regressions include dummies for education (high school graduates vs less, junior college vs. four year college), region, and year of graduation. Standard errors in the brackets are clustered by region.

Table 6 The effect of unemployment rate at age 18 on the probability of having ever married by a specific age

a. Women

Age	26	29	32	35
Unemployment rate in the year when the cohort was 18 years old	-0.008* [0.005]	-0.006*** [0.002]	-0.003* [0.002]	-0.005* [0.002]
Ratio of high school graduates	0.14 [0.173]	0.071 [0.082]	0.031 [0.052]	0.127 [0.092]
Male/female population ratio	0.024 [0.071]	0.052* [0.027]	0.032** [0.013]	-0.085 [0.079]
Observations	940	940	846	705

b. Men

Age	26	29	32	35
Unemployment rate in the year when the cohort was 18 years old	-0.002 [0.002]	-0.002 [0.002]	-0.003 [0.002]	-0.008 [0.007]
Ratio of high school graduates	0.214* [0.108]	-0.013 [0.109]	-0.217** [0.092]	-0.022 [0.167]
Male/female population ratio	0.085*** [0.025]	0.033 [0.024]	-0.056** [0.023]	-0.240* [0.126]
Observations	940	940	846	705

Note: linear regression using birth year – prefecture level panel. All regressions include dummies for prefecture and dummies for birth year. Standard errors in the brackets are clustered by region.

Table 7 The effect of unemployment rate on Pr(getting married in t | unmarried until t-1)

	Women Age 25-29	Men Age 25-29	Women Age 30-34	Men Age 30-34
Last year's unemployment rate	0.005**	-0.004***	0.005***	0.005***
	[0.002]	[0.001]	[0.001]	[0.001]
Unemployment rate in the year when the cohort was 18 years old	-0.005**	-0.001	-0.002	-0.007**
	[0.002]	[0.001]	[0.003]	[0.003]
Ratio of high school graduates	-0.011	0.003	-0.043	-0.115**
	[0.072]	[0.031]	[0.053]	[0.049]
Male/Female population ratio	-0.091**	-0.029***	-0.066***	-0.097***
	[0.039]	[0.011]	[0.024]	[0.028]
Observations	4700	4700	4230	4230

Note: linear regression using birth year – prefecture level panel. All regressions include dummies for prefecture and dummies for birth year. The dependent variable is defined as (% unmarried as of age t-1 - % unmarried as of age t)/% unmarried as of age t-1 for each cohort. Standard errors in the brackets are clustered by region.

Table 8 Suggestive evidence about unemployment rates at graduation and marriage sorting

a. Spouses' years of schooling (OLS)

	Women			Men		
	All women	High school or less	Jr college or more	All men	High school or less	Jr college or more
Unemployment rate at graduation	-0.046 [0.061]	0.020 [0.049]	-0.105 [0.103]	-0.018 [0.046]	0.115 [0.091]	0.032 [0.077]
Obs	106952	59086	47866	89844	47553	42291

b. Age difference (spouse's age minus own age, OLS)

	Women			Men		
	All women	High school or less	Jr college or more	All men	High school or less	Jr college or more
Unemployment rate at graduation	-0.177 [0.117]	-0.210* [0.102]	-0.314 [0.183]	-0.365* [0.185]	-0.319 [0.281]	-0.250 [0.195]
Obs	106249	58507	47742	89557	47242	42315

Note: all regressions include dummies for education (high school graduates vs less, junior college vs four year college), region, and year of graduation. Standard errors in the brackets are clustered by region.

Appendix Table A1: identification of women's maternal status

			obs	%	cum %
Identified as a mother	2)	the only woman in hh	396,890	28.04	28.04
	3)	the only likely woman in hh	69,238	4.89	32.93
	4)	all children has one mother	6,151	0.43	33.36
	5)	i	3,079	0.22	33.58
	5)	ii	1,749	0.12	33.7
Identified as having no child younger than 17 at the time of survey	1)	No child in the hh	841,684	59.45	93.16
	2)	too old or too young	4,283	0.3	93.46
	3)	the other woman is the mom	73,446	5.19	98.65
	4)	the other women are the mom	9,182	0.65	99.29
	5)	i turned out to be grandmother	1,805	0.13	99.42
	5)	ii turned out to be sister	3,938	0.28	99.7
Not identified in either way			4,248	0.3	100