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Abstract

This study examines the effects of inequalities in the lower, rather than the upper, tail of wage distribution due to a declining labor market on marriage behaviors based on gender in Japan. I apply a median-preserving spread to a marriage search model and then empirically analyze the theoretical hypothesis for cross-gender marriage behaviors using extensive individual Japanese data from the Employment Status Survey. The theoretical and empirical results show that gender wage inequalities in the lower and upper tails have positive and statistically significant effects on increasing the probability of unmarried people among both genders. On the other hand, an increase in male non-standard employment and unemployment rates have positive and significant effects on the probability of unmarried women, even after controlling with wage inequality indices. In addition, the median wage for women has a significant and negative effect on the probability of unmarried men. These results highlight the need for policies to promote a shift from male non-standard to standard employment and increased wages in the lower income class to raise marriage rates for both genders.

Key words: wage inequality, non-standard employment, marriage behavior, median-preserving spread, two-sided search

JEL Codes: J12; J31; D31

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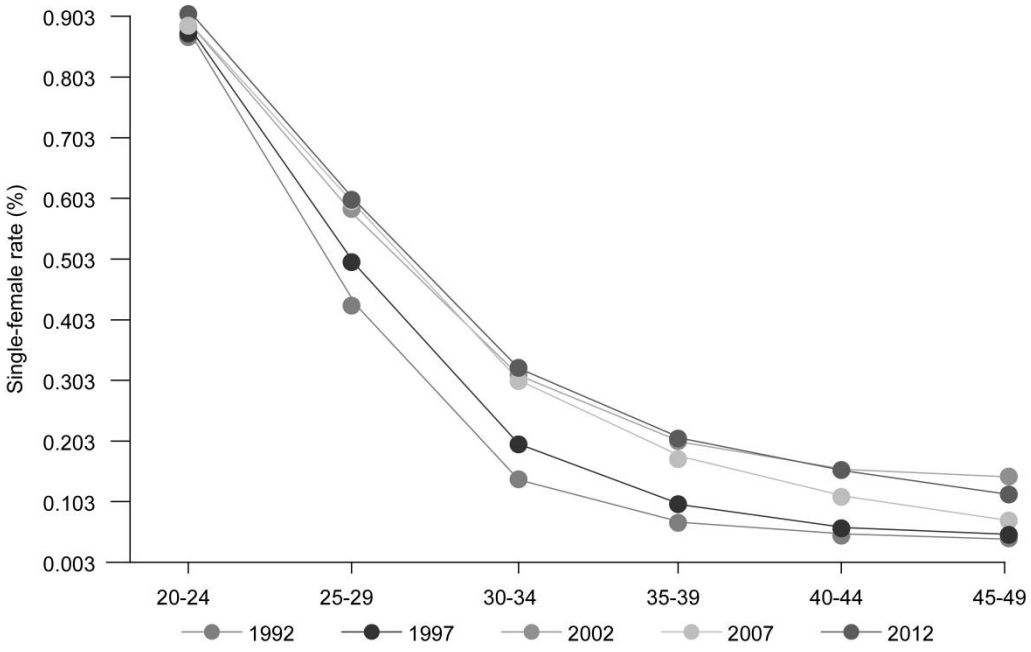
Introduction

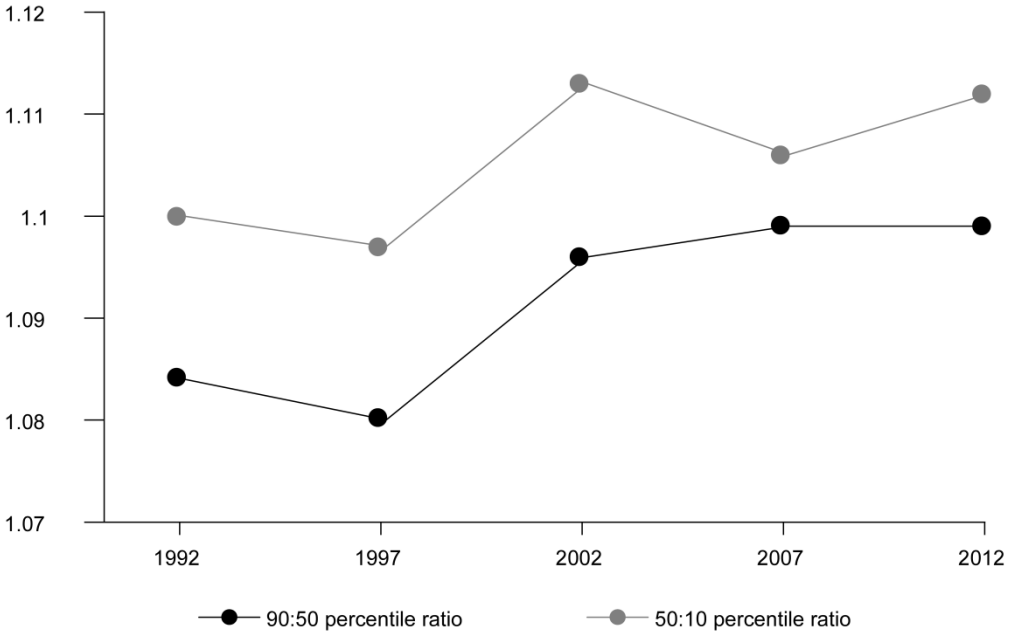
The declining birthrate has become a serious problem in Japan, and a key reason underlying this phenomenon is the tendency among the youth to remain single or delay marriage. The declining birthrate causes a drop in the future workforce and has a great influence on the sustainability of the social security system. Several studies have argued that this tendency among the youth is related to the increasing rate of non-standard employment[1] among them (Nagase, 2002; Ohta, 2007; Sakai and Higuchi, 2005). In addition, most children born are legitimate; thus, the marriage behavior precedes the birth behavior in Japan. In fact, in the past 20 years, the rate of unmarried women has gradually increased[2] (Figure 1). Figure 2 shows that the male wage inequality in the lower tail has been consistently larger than that in the upper tail,[3] and the former continues to increase, whereas the later has shown signs of leveling off in the past 20 years. Thus, the former is more noteworthy than the latter in Japan.

Figure 1: Trends of the rate of unmarried women



[1] The designation follows Kambayashi and Kato (2012).
[2] The rate of unmarried 20–34-year old women rose from 47.2% in 1992 to 58.7% in 2012.
[3] Female wage inequality in the lower tail also has been consistently larger than that in the upper tail.

Figure 2: Trends of the wage 90:50 and 50:10 percentile ratios for men



In fact, following the 1990s, the rate of unmarried Japanese women aged 20–34 years and that of non-standard employed Japanese men of the same age group have simultaneously increased over the years (Figure 3). In addition, Figure 4 indicates that the rate of unmarried women and the wage inequality of men in the lower tail follow the same trends. Therefore, it would be useful to examine the relationship between the increasing rates of unmarried females and lower-tail male wage inequality in Japan to clarify the tendency among young women to remain single or delay marriage.

Figure 3: Trends of the rate of unmarried women and non-standard employment rate for men

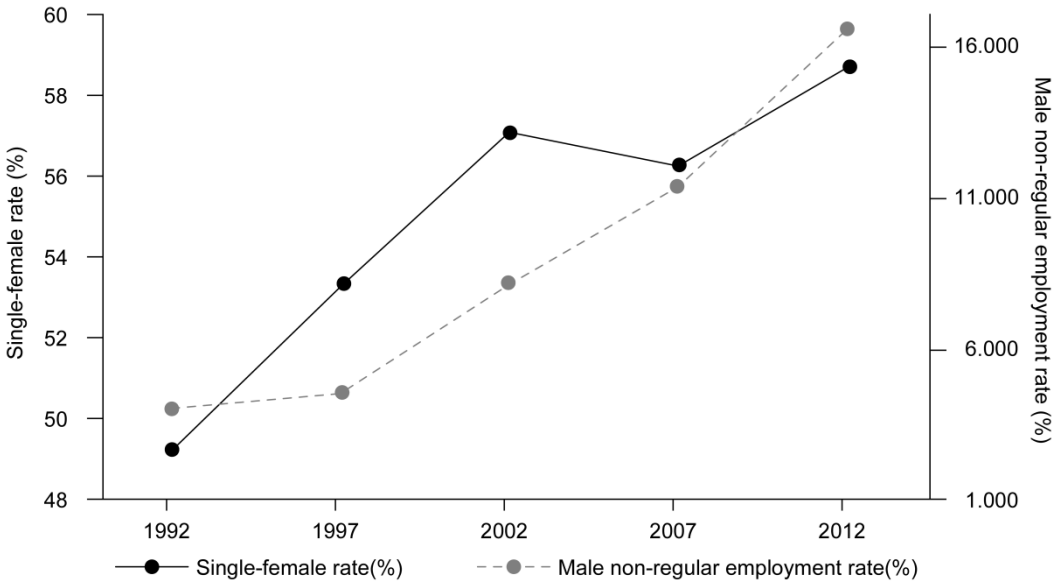
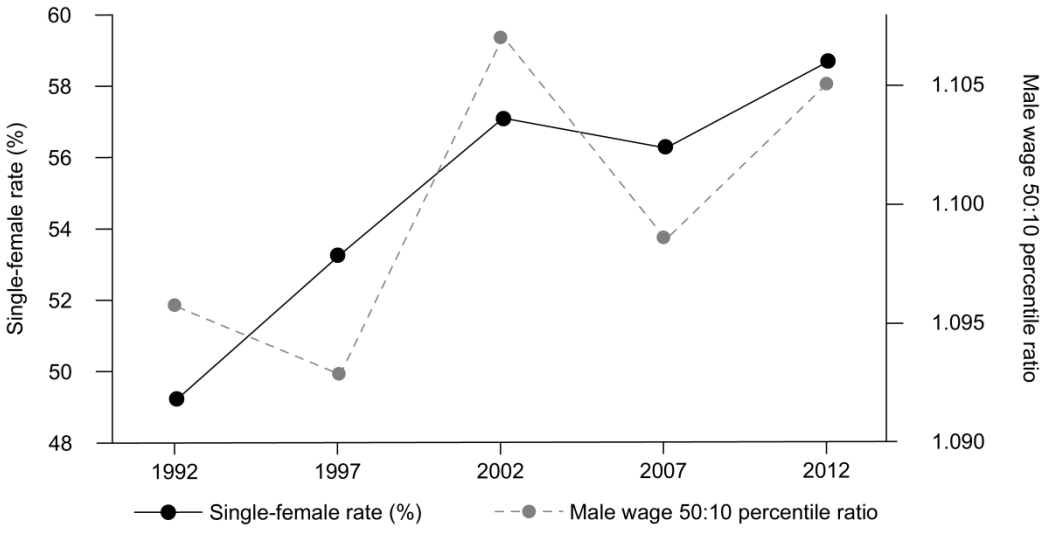


Figure 4: Trends of the rate of unmarried women and 50:10 percentile ratios for men



The mainstream economic approach to examine the tendency among women to remain single or delay marriage is founded on Becker (1973). Becker performed a cost–benefit analysis on the basis of factors such as the declining benefits of marriage or the increasing opportunity cost of marriage for women, including the popularization of

higher education and reduction of gender-based wage gaps.[4] In particular, most studies examine the influence of individual attributes such as age, educational background, income, and employment as factors influencing the probability of women remaining unmarried.[5] However, recent studies in the U.S. and other countries have examined macroeconomic factors such as an increase in the non-standard employment rate and male wage inequality in their marriage markets, even though such studies are limited in the context of Japan owing to the lack of suitable statistical data.

Most U.S.- and Europe-based studies on the relationship between the rate of unmarried women and macroeconomic factors are divided into two types and are independent of each other. The first type focuses on the decreasing number or the rate of men who are suitable for marriage because of, for example, the declining labor market. The second type concerns the changing male wage distribution, that is, the increasing wage inequality among men. Given their close association, both issues must be analyzed using an integrated analysis framework. Therefore, in this study, I first model the relationship between the greater lower-tail male wage inequality and female marriage behavior by applying a median-preserving spread. This framework allows asymmetric distributional moves between the upper and lower tails. Data for the study are Japanese individual data from the Employment Status Survey.

The remainder of this paper is outlined as follows. Section 2 reviews the extant literature. Section 3 presents the theoretical hypothesis and estimation model. Section 4 describes the data. Section 5 reports and discusses the estimation results and Section 6 concludes.

Literature review

Some studies in the literature examine the relationship between the male labor market and female marriage behavior. As mentioned, recent works examining the increasing tendency among women to remain single or delay marriage are divided into two types. The first is built on the concept that the number of desirable men who can marry (the so-called “marriageable men”) is decreasing, while that of men with low incomes is increasing owing to the declining male labor market. The second type is based on the notion that increasing male wage inequality raises the expected value for

[4] Oppenheimer (1997) suggests that the specialization model based on marriage gain is essentially an argument for non-marriage, not delayed marriage.

[5] Stevenson and Wolfers (2007) also propose a hypothesis for the determinants of the rate of marriage, including cohabitation, birth control and household technologies, change in the legal structure of marriage, and shock to the matching function of the marriage market.

women to remain unmarried and continue their search for a partner.

Wood (1995) is an example of the first type and examines Wilson's (1987) hypothesis that fewer marriageable black men, due to the labor market decline in urban areas, have contributed to the decreasing female marriage rates. He further suggests that the decreasing number of regularly employed men indicates an increasing number of low-income earners and a simultaneous decrease in the number of marriageable men, which leads to higher rates of unmarried women.[6] Blau et al. (2000), Brien (1997), and Lichter et al. (1992) also find that the worsening male labor market conditions negatively affect the female marriage rate. Oppenheimer et al. (1997) argue that the uncertainties of career entries lead to delayed marriage; in other words, those employed in stop-gap jobs are less likely to marry than those with a career because the former is a sign of career immaturity, uncertainty about long-term prospects, and low labor market positions.

In Japan, Nagase (2002), Ohta (2007), and Sakai and Higuchi (2005) find that the rate of marriage among those who worked as part-time employees (e.g., non-standard employees) as their first job or are unemployed is lower than that of standard employees; such employees also report delayed marriages. Hashimoto and Kondo (2012) also find that deterioration in the employment opportunities of young workers contributes to the decreasing tendency to marry among young women. Sasaki (2016) empirically examines the effects of an increase in gender-based, non-standard employment rates on the increase in unmarried individuals of both sexes and presents results consistent with the theoretical hypothesis. However, the data do not include prefecture-level information for the marriage markets.

Examples of the second type of studies include Coughlin and Drewianka (2011), Gould and Paserman (2003), Kuo (2008), and Loughran (2002). These studies examine the search model hypothesis that the varying dispersion in male wage distribution increases marriage reservation wage and the tendency to postpone marriages among women, thus indicating a decrease in marriage rate for women. In particular, Loughran (2002) analyzes these issues for women aged 22–30 years using 90:50 and 50:10 percentile ratios of hourly wages for men aged 21–45 years as income inequality indices. Using data from the U.S. census for 1970, 1980, and 1990, he finds that higher male wage inequality in the upper, not the lower, tail indicates significantly delayed marriages among women. Gould and Paserman (2003) address the same issues for women aged 21–30 years using the standard deviation of weekly wages of full-time

[6] Wood (1995) finds that the decline in marriageable men increased the rates of unmarried women by 3–4%.

male workers aged 16–64 years as the main wage inequality indices, controlling for city fixed effects. They argue that 25% of the decline in marriage rate among women from 1970 to 1990 can be attributed to increasing inequality in male wages. Coughlin and Drewianka (2011) estimate the effects of increasing male wage inequality on female marriage hazard rate and conclude that wage inequality promotes delayed marriages among young women.

In Taiwan, where the rate of those unmarried is rapidly increasing, Kuo (2008) examines the issues using data from the Manpower Utilization Survey for women aged 22–30 years for 1980–2005, controlling for geographic and linear-time fixed effects. Kuo concludes that while the increasing inequality in male wages negatively affects the marriage rate among women, the effect is neither large nor significant. Kuo also shows that, rather than the upper tail, the lower tail of male wage inequality has a larger negative effect on female marriage rate by simultaneously estimating the 90:50 and 50:10 percentile ratios, without controlling for geographic and linear-time fixed effects. This result differs from those based on U.S. data.

In Japan, researchers have rarely employed individual data to conduct marriage market-level analysis because such data are difficult to obtain. Tachibanaki and Kimura (2008), among others, have used aggregate data based on official government statistics instead of individual data and performed a simple empirical analysis without controlling for various factors. Yugami and Sasaki (2011) conducted an analysis using individual data from the Japanese General Social Survey; however, their estimation neither uses the 90:50 and 50:10 percentile ratios owing to data limitations nor provides a clear result for the effects of increasing non-standard employment rates.

Not all studies employ an analysis framework that connects both types of studies. In addition, the mechanisms used for analyzing the increasing rate of unmarried women differ based on the relevant cause, that is, fewer marriageable men or increasing male wage inequality. The former focuses on female behavioral responses to the lower tail of male wage distribution, while the latter considers the upper tail. Furthermore, the first mechanism is yet to be clarified in detail using a micro-foundation analysis such as a search model. Overcoming these limitations, the present analysis framework helps explain the responses of female reservation wage and marriage probability to asymmetric wage distribution among men at the boundary of the lower and upper tails. This phenomenon—higher inequality in the lower rather than the upper tail—is due to the rise in the rate of non-standard employment and unemployment among men, given the recent decline in Japan's male labor market.

I first formulate an integrated analysis framework by applying a median-preserving

spread instead of a mean-preserving one to the marriage search model. The theoretical hypothesis thus derived is based on more realistic wage inequality changes in Japan compared with those in previous studies. An advantage of this framework is that it explains consistently occurring phenomena in the youth labor and marriage markets. In addition, I empirically analyze the theoretical hypothesis using large Japanese individual samples from the Employment Status Survey.

Theoretical hypothesis and estimation model

The theoretical model is based on Gould and Paserman (2003), Kuo (2008), and Loughran (2002). However, it differs from those in previous works in two ways. First, I apply a median-preserving spread to a marriage search model to examine the effects of the recent increase in lower-tail male wage inequality on female marriage behavior. The asymmetric dispersion between the lower and upper tails can be attributed to the recent increase in the non-standard employment rate among Japanese men. Second, I adopt the concept of a two-sided search, because in the field of marriage behavior, theoretical studies addressing search behaviors of men and women tend to be mainstream (Bloch and Ryder, 2000; Burdett and Coles, 1999; Chade and Ventura, 2002; Shimer and Smith, 2000). Thus, I first empirically examine the effects of lower-tail wage inequality and non-standard employment rate for women on the rate of unmarried men, which, to the best of my knowledge, is yet to be examined in the context of Japan.

Search model applying median-preserving spread

In this subsection, I explain the effects of increasing male wage inequality on the rate of unmarried women using the search model. The interpretation presented differs from that in previous studies. More specifically, non-standard employees are generally low-wage earners, and, therefore, the higher the number of such employees, the lower the mean male wage in the marriage market, and the greater the dispersion of wage distribution in the lower tail. Thus, the change in male wage distribution is asymmetric between the upper and lower tails. However, the mean-preserving spread should be applied only when the wage distribution spreads symmetrically around the mean wage because it holds the mean constant. In fact, according to Loughran (2002), the mean-preserving spread does not hold when the wage inequality in the lower tail is higher than in the upper tail.

To avoid this problem, this study applies Aldashev's (2010) median-preserving spread as an analysis framework to allow for asymmetric distributional changes

between the upper and lower tails.[7] I incorporate a median-preserving spread into a marriage search model, which, to the best of my understanding, no study has done till date, and I derive a theoretical hypothesis for the effect on female reservation wages in the case of median changes and increasing inequality in the upper or lower tails.

Deriving the effects of median change

First, I derive the effects of a median change on reservation wage.

The effects of an increase in the median of the male wage distribution on the acceptance probability of a marriage offer, p, is described as follows:

$$\frac{\partial p}{\partial \theta} = \frac{F'}{w^*}\left[1 - \frac{p}{p+r}\right] > 0, \quad (1)$$

where F is the distribution function of male wage w, which is conditional on individual attributes such as age group, education, year, and prefecture. w^* is the female reservation wage. θ is the value to which the median of the wage distribution increases. As a result, the higher the male median wage, the greater the acceptance probability of a marriage offer, and thus the lower the rate of unmarried women.

Effects of greater wage inequality in the upper and lower tails

When the female reservation wage is higher than the median of the male wage distribution, a greater wage inequality in the lower tail does not affect the reservation wage for women who adopt suitable search strategies. Therefore, the reservation wage is assumed to be lower than the median.

The marginal effect of the dispersion in the upper tail of male wage distribution on the probability of acceptance of a marriage offer is described as follows:

$$\frac{\partial p}{\partial \sigma_U} = -\lambda F'(w^*)\frac{\partial w^*}{\partial \sigma_U} - \lambda F_{\sigma_U}(w^*, \sigma_U) < 0, \quad (2)$$

where w^* is reservation wage and σ_U is dispersion in the upper tail.

Here, $F_{\sigma_U}(w^*, \sigma_U)$ in the second term of the right-hand side is a partial differentiation of the distribution function of the dispersion (σ_U) in the upper tail. Thus, it is zero if the reservation wage is lower than the median, as assumed above. That is, a greater dispersion in the upper tail increases the reservation male wage (first term on right-hand side) and the rate of unmarried women.

[7] Labor economics studies using the median-preserving spread in a search model include Aldashev (2010) and Möller and Aldashev (2007).

On the other hand, the probability of accepting a marriage offer, expressed as the size of dispersion (σ_L) in the lower tail, is described as follows:

$$\frac{\partial p}{\partial \sigma_L} = -\lambda F'(w^*)\frac{\partial w^*}{\partial \sigma_L} - \lambda F_{\sigma_L}(w^*, \sigma_L).$$

(3)

The right-hand side indicates the difference between the effect of a decline in the female reservation wage due to higher male wage inequality in the lower tail (first term) and that of a variance in the male wage distribution below the female reservation wage (second term). However, it is highly possible that the dispersion of male wage distribution in the lower tail is so large that the latter effect is dominant, assuming that the increasing number of low-income non-standard employees among young Japanese men is acceptable. Therefore, when the latter effect exceeds the reduction effect of female reservation wage, the probability of accepting a marriage offer declines and the rate of unmarried women increases. It is essential to examine this finding using a positive analysis framework.

Estimation model

Here, I empirically examine the theoretical hypothesis mentioned above. The basic empirical reduced-form specification for regressions is a probit model of a woman's propensity to remain single.

$$\mathrm{P}(y_{ijalt} = 1) = \Phi\left(\beta_0 + \beta_1\theta_{jalt} + \beta_2\sigma_{U_{jalt}} + \beta_3\sigma_{L_{jalt}} + \beta_4 L_{jalt} + \beta_5 Z_{jalt} + \beta_6 X_{ijalt} + \varepsilon_{ijalt}\right),$$

(4)

where y_{ijalt} is a dummy variable that takes the value of 1 if woman i living in prefecture j of age group a with education l at time t has never been married, and 0 otherwise. In Eq. (4), θ, σ_U, and σ_L are the median, 90:50 percentile ratio, and 50:10 percentile ratio, respectively, of male wages categorized by age group, education, prefecture, and year in the context of a local marriage market.[8] L is the vector of male employment indices such as non-standard employment and unemployment rates segmented by the abovementioned elements. Local marriage markets are categorized by these factors because women tend to search for similar characteristics in marriage

[8] The marriage markets are divided into 3 (age group) × 4 (education) × 47 (prefecture) × 5 (year) = 2,820 cells.

partners, and thus they should respond most strongly to changes in wages and employment indices of such men (Loughran, 2002).[9] Z_{jalt} is a vector of variables for local marriage market conditions faced by women such as sex ratio, prefecture, and year; X_{ijalt} is a vector of individual characteristics including age group, education, and habitation dummy in large urban areas; and ε_{ijalt} is the error term that captures unobservable geographic and time-specific effects.

A key explanatory variable is the parameter for wage inequality in the lower tail, σ_L, which is expected to be positive based on the search theory model with a median-preserving spread. Parameter σ_U is expected to be positive, and θ is expected to be negative. On the other hand, L is expected to have no significant effect because L's effects can be absorbed by σ_U's effect. Sex ratio is defined as the male-to-female population ratio in the marriage market by age group, education, prefecture, and year. This variable can affect the prospect of marriage (Angrist, 2002; Fossett and Kiecolt, 1991; Hara, 2013; South and Lloyd, 1992); that is, the higher the ratio, the greater the advantage for women in the marriage market, and, thus, the lower the probability of women being unmarried. The prefecture dummy captures related unobserved characteristics correlated with marriage behavior and inequality consistent over time, for example, marriage market fixed effects.[10] The year dummy represents a common time trend in marriages across individuals. The probability of a woman remaining unmarried is probably higher in large urban areas given its weaker social norms regarding marriage. In addition, according to previous studies, the tendency of women remaining unmarried would be lower for higher age groups and those with lesser education (Kuo, 2008; Gould and Paserman, 2003; Loughran, 2002). The standard errors of the coefficients are modified by clustering with age groups, education levels, prefectures, and years.

According to Gould and Paserman (2003), the abovementioned search model can be applied in the case of marriage rates being negatively correlated with female wage inequality. However, they suspect that the effect of female wage inequality on decisions made by men is less than that of male wage inequality on those made by women. Nevertheless, I also perform regressions for men's decision to remain unmarried.

Data

[9] Previous studies have found that educational assortative mating continues to be deeply rooted in Japan (Shida et al., 2000; Shimizu, 1990; Watanabe and Kondo, 1990).

[10] The estimations in columns 2 and 4 in Tables 4 and 5 include a cross-term dummy with prefecture and year to consider prefecture-specific linear trends.

This study adopts data from Japan's Employment Status Survey for 1992, 1997, 2002, 2007, and 2012. The data comprise vast individual information: age, sex, educational attainment, employment status, wage, work hours, marriage status, household composition, childbirth, age of children, prefecture, and size of city where the individuals live. I restrict the sample to men and women aged 20–34 years because the rate of unmarried individuals of both sexes declines sharply in these age groups; however, this rate is shown to increase over time in Japan (Figure 1). The final sample for analysis includes 583,207 women and 597,770 men.

I use an hourly wage to calculate the logarithm median wage[11] and wage inequality indices because the cyclical change in labor supply influences annual wage inequality (Loughran, 2002). I also estimate the employment indices and sex ratio in the marriage market for each age group, education level, prefecture, and year. Female wages are imputed to the regression results value by Heckit[12] (Heckman, 1974) because many women change their labor supply and employment status around the time of marriage or childbirth. From similar reasons, I estimate the female employment indices using only unmarried or non-childbirth samples. The descriptive statistics of the variables used in this analysis are shown in Table 1.

[11] Drawing on Genda (2007) and Lemieux (2006), I use the median of each wage grade as personal wage and multiply it 1.4 times for the high-end annual wage group. The real wage is based on the 1992 consumer price index. From 1992, however, each wage group in the Employment Status Survey questionnaire is further subdivided. Therefore, I standardize the wage groups according to those of 1992 and 1997, following Kambayashi (2010a), Shinozaki (2006), and Yugami and Sasaki (2011), to remove the influence of class interval changes on the setup conditions of wage inequality indices. In addition, I define the non-standard employment rate, as per Ohta (2007), in terms of all the employees and the unemployment rate as a proportion of the population.

[12] The first step of the regression includes variables affecting the propensity of a woman's labor supply such as education, age group, employment status, marital status, childbirth, and age of the youngest child.

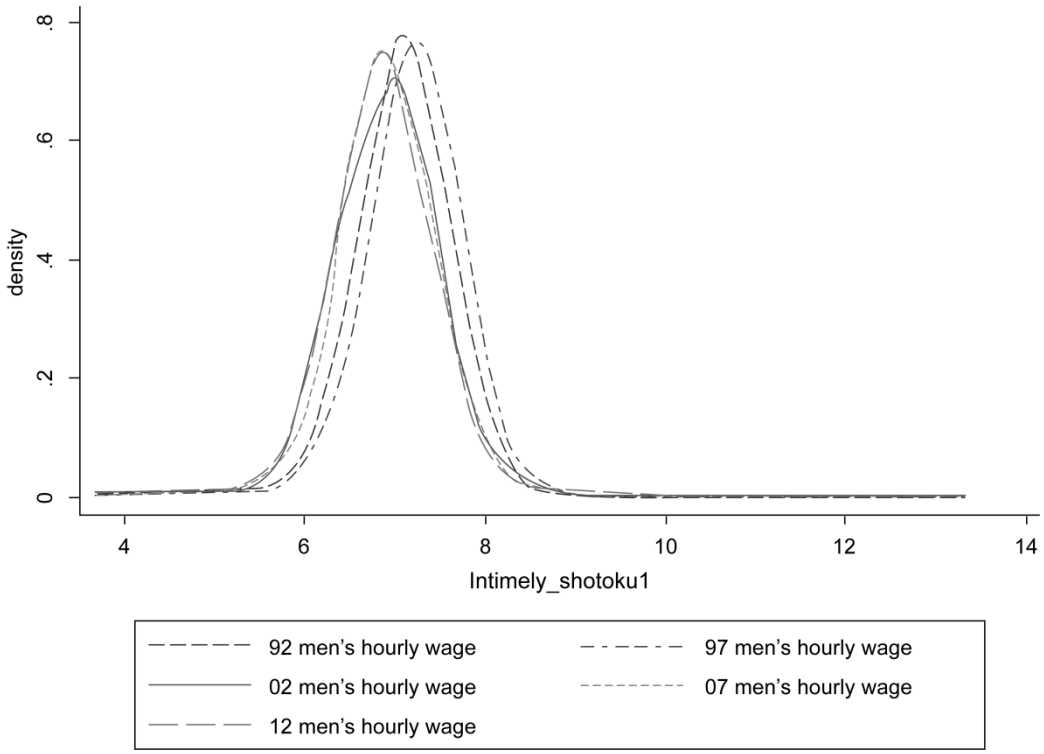
Table 1: Descriptive statistics of variables

Variables		Male age: 20–34 years					Female age: 20–34 years				
		Obs.	Mean	Std. dev.	Min.	Max.	Obs.	Mean	Std. dev.	Min.	Max.
Age group dummy	20–24 years	583,207	0.319	0.466	0.000	1.000	597,770	0.317	0.465	0.000	1.000
	25–29 years	583,207	0.329	0.470	0.000	1.000	597,770	0.328	0.469	0.000	1.000
	30–34 years	583,207	0.315	0.477	0.000	1.000	597,770	0.355	0.478	0.000	1.000
Education dummy	Below junior high school graduate	583,207	0.072	0.258	0.000	1.000	597,770	0.046	0.209	0.000	1.000
	High school graduate	583,207	0.490	0.500	0.000	1.000	597,770	0.485	0.500	0.000	1.000
	Graduate from vocational school	583,207	0.085	0.279	0.000	1.000	597,770	0.260	0.439	0.000	1.000
	Higher than college graduate	583,207	0.348	0.476	0.000	1.000	597,770	0.205	0.404	0.000	1.000
Unmarried probability		583,085	0.662	0.473	0.000	1.000	597,977	0.551	0.497	0.000	1.000
Logarithmic hourly wage in marriage market	Median (logarithmic)	582,823	7.002	0.271	3.798	9.448	375,744	6.993	0.213	6.119	7.610
	90:10 percentile ratio	582,823	1.202	0.046	2.376	2.376	375,744	1.024	0.014	1.000	1.062
	90:50 percentile ratio	582,823	1.092	0.028	1.000	1.579	375,744	1.004	0.007	1.000	1.044
	50:10 percentile ratio	582,823	1.101	0.030	1.000	1.839	375,744	1.020	0.013	1.000	1.051
Employment conditions in marriage market	Non-standard employment rate	575,762	0.096	0.130	0.000	1.000	596,840	0.328	0.168	0.000	1.000
	Regularly employed non-standard employment rate	575,762	0.035	0.077	0.000	1.000	596,840	0.155	0.118	0.000	1.000
	Irregularly employed non-standard employment rate	575,762	0.031	0.070	0.000	1.000	596,840	0.126	0.081	0.000	1.000
	Unemployment rate	583,207	0.146	0.158	0.000	1.000	597,770	0.327	0.115	0.000	1.000
Sex ratio in marriage market		583,052	1.301	0.663	0.060	8.000	597,615	0.976	0.563	0.060	8.000
Dummy of habitation in large urban areas		315,338	0.331	0.471	0.000	1.000	320,640	0.337	0.473	0.000	1.000
Year dummy	1992	583,207	0.191	0.393	0.000	1.000	597,770	0.198	0.398	0.000	1.000
	1997	583,207	0.198	0.399	0.000	1.000	597,770	0.196	0.397	0.000	1.000
	2002	583,207	0.168	0.374	0.000	1.000	597,770	0.166	0.397	0.000	1.000
	2007	583,207	0.146	0.353	0.000	1.000	597,770	0.166	0.372	0.000	1.000
	2012	583,207	0.296	0.457	0.000	1.000	597,770	0.294	0.456	0.000	1.000

Note: The non-standard employment rate is the ratio of non-standard employees to all employees.

Figure 5 depicts changes in the kernel distribution of 20–34-year-old males' logarithmic hourly wage for five years (unwaged persons are excluded). The overall wage distribution seems to be more skewed toward the upper side in 1997 compared with that in 1992. It then shifts to the lower side with a slightly higher lower tail inequality in 2012 than in 1992.

Figure 5: Changes in the kernel distribution of log hourly wages for men
Source: Employment Status Surveys, 1992, 1997, 2002, 2007, and 2012.



Estimation results and discussion

Baseline estimation results

I first estimate the effects of male wage inequality and employment indices on the probability of a woman choosing to be unmarried. Table 2 presents the baseline estimation results. I use the male 90:50 and 50:10 percentile ratios as the wage inequality indices in the upper and lower tails of the wage distribution. In addition, non-standard employment and unemployment rates for men are used as employment indices for the declining labor market.

Table 2: Marginal effects of various male employment indices

	Male employment indices			
	Non-standard employment rate	Unemployment rate	Regularly employed non-standard employment rate	Irregularly employed non-standard employment rate
	Marriage market: calculated using age group, educational background, prefectures, and years			
Male wage 90:50 percentile ratio	0.732 (0.389)*	0.027 (0.523)	0.763 (0.404)*	0.675 (0.398)*
Male wage 50:10 percentile ratio	0.839 (0.324)***	0.500 (0.294)*	0.729 (0.343)***	0.836 (0.324)***
Male employment indices	0.174 (0.073)**	0.811 (0.100)***	0.157 (0.070)**	0.259 (0.164)
Male median wage	-0.083 (0.108)	0.045 (0.097)	-0.073 (0.108)	-0.082 (0.113)
No. of obs.	311,380	318,312	311,380	311,380

Notes:

1. Dependent variables (female): unmarried = 1, others = 0.
2. Male wage is a logarithmic value.
3. Other explanatory variables are female educational background dummy, female age group dummy, sex ratio in marriage market, and female habitation dummy in large urban areas.
4. The second-step parentheses indicate standard errors modified by clustering on the basis of age group, educational background, prefectures, and years.
5. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Columns 1 and 2 show that the coefficients of the 50:10 percentile ratio have significant positive effects at the 1% and 10% confidence levels on the probability of women remaining unmarried in both cases, which is consistent with the theoretical hypothesis and similar to the results of a previous Taiwan-based study by Kou (2008). The 90:50 percentile ratio in column 1 also has a significant positive effect at the 10% confidence level on the probability of women remaining unmarried, which is also consistent with the theoretical hypothesis and similar to the results of previous U.S.-based studies (Gould and Paserman, 2003; Loughran, 2002). The coefficient of the 90:50 percentile ratio in column 2 is positive but does not have a significant effect. The

marginal effects of the 50:10 percentile ratio are larger than those of the 90:50 percentile ratio in both cases. On the other hand, both the non-standard employment and unemployment rates for men have a significant positive effect at the 1% confidence level on the probability of women remaining unmarried, which is contrary to expectations. The coefficients for the male median wages have no significant effect.

The results in columns 3 and 4 demonstrate the effects of regularly and irregularly employed non-standard employment rates. The 90:50 and 50:10 percentile ratios have significant and positive effects on the probability of women remaining unmarried in both cases. The regularly employed non-standard employment rate has a significant positive effect at the 1% confidence level on the probability of women remaining unmarried, whereas the irregularly employed rate has no significant effect. The male median wages also have no significant effect.

The control variables are statistically significant and have the expected sign: the rate of unmarried women increases with higher education, habitation in large urban areas and passing of time but declines in older age groups. The sex ratio has no significant effect. These results indicate that women postpone their marriage on the basis of both tails of men's wage distribution and employment indices, such as non-standard employment rate and unemployment rate.

Opposite direction effects

Here, I present the estimation results for the effects of wage inequality and employment indices for women on the probability of men remaining unmarried in Japan, adapting the concept of a two-sided search model.

Table 3 presents the estimation results for the 90:50 and 50:10 percentile ratios and employment indices for women. The coefficients for both the 90:50 and 50:10 percentile ratios have statistically significant and positive effects at the 1% confidence level on the probability of men remaining unmarried in all four cases, which is consistent with the theoretical hypothesis. The marginal effect of the 90:50 percentile ratio is larger than that of the 50:10 percentile ratio, which is in contrast to the results in Table 2. This indicates that men postpone marriage depending on both tails of women's wage distribution. Furthermore, the marginal effects of both variables are larger than those in the case of men, which are in stark contrast to the prediction by Gould and Paserman (2002).

Table 3: Marginal effects of various female employment indices

	Female employment indices			
	Non-standard employment rate	Unemployment rate	Regularly employed non-standard employment rate	Irregularly employed non-standard employment rate
	Marriage market: calculated using age group, educational background, prefectures, and years			
Female wage 90:50 percentile	3.107 (0.934)***	3.434 (1.101)***	3.138 (0.917)***	3.028 (0.914)***
Female wage 50:10 percentile	2.114 (0.739)***	2.280 (0.748)***	2.071 (0.720)***	2.069 (0.729)***
Female employment indices	-0.039 (0.070)	-0.075 (0.092)	-0.062 (0.090)	-0.016 (0.111)
Female median wage	-0.777 (0.160)***	-0.844 (0.190)***	-0.762 (0.148)***	-0.746 (0.148)***
No. of obs.	312,830	313,050	312,830	312,830

Notes:

1. Dependent variables (male): single = 1, others = 0.
2. Female wage is a logarithmic value.
3. Other explanatory variables are male educational background dummy, male age group dummy, sex ratio in marriage market, and male habitation dummy in large urban areas.
4. The second-step parentheses indicate standard errors modified by clustering on the basis of age group, educational background, prefectures, and years.
5. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

The coefficients of female median wage have negative and statistically significant effects at the 1% confidence level on the probability of men remaining unmarried in all four cases, which is consistent with Fukuda's (2013) result. Fukuda (2013) argues that in Japan, women's earnings have a positive effect on marriage for the post-1970 cohort, and, thus, wives' economic contributions to the family are considered important. In addition, Burgess et al. (2003) propose that higher wages among women have a "self-reliance effect" and "good catch effect." The former effect means that women earn a livable wage that is independent of men, and the latter indicates that higher wages increase the probability of women being considered a desirable marriage partner by

men. This can be interpreted as the good catch effect exceeding the self-reliance effect, which is contrary to findings presented in the literature (e.g., Becker, 1973; Burgess et al., 2003; Miyoshi, 2013). In all cases, female non-standard employment and unemployment rates have no significant effect.

As for the control variables, higher male education dummies, sex ratio, and later year dummy have significant positive effects on the probability of men remaining unmarried in all cases. In addition, older age group dummies have significant negative effects on the probability of men remaining unmarried in all cases, thus supporting the theoretical hypothesis.

Robustness check: estimation results including same-sex indices

Loughran (2002) adds female mean wages and employment rates as utility factors for unmarried women to avoid an omitted-variable bias. Undoubtedly, these variables are endogenous, and thus cannot be causally interpreted in these regressions. His aim is a robustness check, that is, whether the primary variables continue to have an effect on female marriage propensities, even after controlling with these added variables. Similarly, I add female median wages and employment indices in regressions for the probabilities of women's tendency to remain unmarried. I also add median wages and employment indices for men to the regressions for their probability to remain unmarried.

Columns 1 and 2 in Table 4 show the effects of the non-standard employment rate among men, and columns 3 and 4 show the effects of their unemployment rate. Columns 1 and 3 include only a prefecture dummy as a marriage market fixed effect. Columns 2 and 4 are controlled with a prefecture and cross-term dummy, with the prefecture and year dummy being a marriage market-specific linear trend.
The 50:10 percentile ratio has positive and significant effects at the 1% confidence level in all cases, even after adding median wage and employment indices for women. On the other hand, the 90:50 percentile ratio loses significant effects in all cases. Male employment indices have significant and positive effects at the 1% confidence level in all cases, which is similar to the results presented in Table 2, and the marginal effects are larger. By contrast, female employment indices do not have a significant effect in all cases. Male median wages have no significant effects in all cases, although female median wages have negative and significant effects at the 1% confidence level in cases with non-regular employment rates.

Estimation results including female indices

Table 4: Marginal effects of male and female employment indices

	Male and female employment indices			
	Non-standard employment rate		Unemployment rate	
Male wage 90:50 percentile ratio	0.361 (0.491)	0.361 (0.491)	0.172 (0.447)	0.172 (0.575)
Male wage 50:10 percentile ratio	0.956 (0.353)***	0.956 (0.353)***	0.582 (0.285)**	0.582 (0.194)**
Male employment indices	0.208 (0.080)***	0.208 (0.080)***	1.180 (0.123)**	1.180 (0.123)***
Female employment indices	-0.033 (0.133)	-0.003 (0.133)	-0.553 (0.106)***	-0.553 (0.184)***
Male median wage	-0.145 (0.112)	-0.145 (0.112)	0.099 (0.082)	0.099 (0.331)
Female median wage	-2.041 (0.507)***	-2.041 (0.508)***	-0.546 (0.573)	-0.546 (0.182)
Prefecture dummy	Yes	Yes	Yes	Yes
Prefecture × year cross-term dummy	No	Yes	No	Yes
No. of obs.	311,229	311,229	318,291	318,291

Notes:

1. Dependent variables (female): single = 1, others = 0.
2. Male and female wages are in logarithmic value.
3. Other explanatory variables are female educational background dummy, female age group dummy, sex ratio in marriage market, and female habitation dummy in large urban areas.
4. The second-step parentheses indicate standard errors modified by clustering on the basis of age group, educational background, prefectures, and years.
5. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Among the control variables, higher education, female habitation in large urban areas, and passing of time have significant and positive effects at the 1% confidence level on the probability of women remaining unmarried in all cases. The older age group dummy has a significant and negative effect in all cases at the 1% confidence level. In addition, including a marriage market-specific liner trend does not affect the

results.

In sum, the 50:10 percentile ratio and employment indices for men dominate the probability of women remaining unmarried, even after controlling for female wage and employment status. This confirms the robustness of the results.

Estimation results including male indices for probability of males being unmarried

Table 5: Marginal effects of male and female employment indices

	Female and male employment indices			
	Non-standard employment rate		Unemployment rate	
Female wage 90:50 percentile ratio	3.923 (1.072)***	3.925 (1.072)***	1.068 (1.043)	1.064 (0.309)
Female wage 50:10 percentile ratio	1.787 (0.796)**	1.787 (0.025)**	0.386 (0.668)	0.386 (0.563)
Female employment indices	-0.012 (0.067)	-0.012 (0.853)	-0.371 (0.067)***	-0.371 (0.067)***
Male employment indices	0.007 (0.089)	0.007 (0.941)	0.752 (0.081)***	0.752 (0.081)***
Female median wage	-0.661 (0.167)***	-0.661 (0.167)***	-0.120 (0.106)	-0.121 (0.536)
Male median wage	-0.176 (0.100)*	-1.176 (0.076)*	-0.076 (0.069)	-0.076 (0.269)
Prefecture dummy	Yes	Yes	Yes	Yes
Prefecture × year cross-term dummy	No	Yes	No	Yes
No. of obs.	309,239	309,239	313,045	313,045

Notes:

1. Dependent variables (male): single = 1, others = 0.
2. Female and male wages are in logarithmic value.
3. Other explanatory variables are male educational background dummy, male age group dummy, sex ratio in marriage market, and male habitation dummy in large urban areas.
4. The second-step parentheses indicate standard errors modified by clustering on the basis of age group, educational background, prefectures, and years.
5. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 5 shows that the 90:50 and 50:10 percentile ratios for female wages have significant and positive effects on the probability of men with a non-standard employment status remaining unmarried, which is similar to the results presented in Table 3; however, they have no effect with unemployment rates. Female unemployment rates have significant and positive effects, although non-standard employment rates for women have no significant effect. Female and male median wages have significant and negative effects on the probability of men remaining unmarried in the case of non-standard employment rates. As for controlling variables, higher education and later years have significant and positive effects on the probability of men remaining unmarried in all cases. The older age group has a significant and negative effect in all cases. Sex ratios have a significant and positive effect on the probability of men remaining unmarried in all cases. Considering a marriage market-specific linear trend does not affect the results, which is similar to the results presented in Table 4.

In sum, female wage inequality indices and median wages for both genders dominate the probability of men remaining unmarried in the case of non-standard employment rates; on the other hand, both gender employment indices dominate the probability of men remaining unmarried in the case of unemployment rates.

Alternative hypotheses

This section provides alternative hypotheses associated with the negative correlation between wage inequality and the tendency to marry.

Change in preference for marriage

The first alternative hypothesis is that changes in wage inequality reflect changing preferences for marriage among men and women (Gould and Paserman, 2003; Loughran, 2002). Hashimoto (2009) mentions that men's marriage aspiration strongly and positively correlate with their social status, such as education, income, and occupation, and therefore low income earners have a relatively low incentive to marry. The larger the number of unmarried men who are lower income earners in the marriage market, the higher the wage inequality, especially in the lower tail of the distribution. If so, the possibility of a reverse causality or simultaneity is doubtful and the estimation results contain a bias. To control this bias, I employ measures of 90:50 and 50:10 percentile ratios from my samples to restrict men who are currently married and aged 20–34 years. The basic results remain unchanged compared with those in Table 2.

Female wage inequality due to higher labor supply

The second hypothesis is that women may strategically increase labor supply to exploit higher returns in response to higher female inequality, which is independent of male wage inequality. Thus, women may delay their marriage or risk-averse women may work more to hedge against the increased risk of their partners' wages. Gould and Paserman (2003) directly test whether women work more in areas with higher male inequality. Using their approach, I attempt to test this hypothesis controlling for their marital status and whether they have children. The results of a probit for those working full-time and a censored regression for weekly hours worked are consistent with their findings and reject the second hypothesis.

Asymmetric information

The third hypothesis is related to asymmetric information. Bergstrom and Bagnoli (1993) propose that high-type men marry later in life once their type is fully revealed and distinguish themselves from low-type ones since asymmetric information about earning ability exists in marriage markets. Therefore, the implication is that men who are high-income earners might marry later than those who are low-income earners. I test this hypothesis using the probit model for the effects of males' log hourly wage on the probability of them remaining unmarried. The other variables are identical to those in Table 2. However, the coefficient for log hourly wages is negative and statistically significant for the probability of men remaining unmarried, which is consistent with the previous literature, and rejects third hypothesis.

Discussion

Effects of non-standard employment rate

From the results, we see that wage inequality indices have significant effects on cross-gender unmarried rates. In addition, male employment indices, non-standard employment rate, and unemployment rate robustly dominate the probability of women remaining unmarried.

Here, I explain the properties of non-standard employment, a common form of work for the youth and a social issue that has recently emerged in Japan. Among young men, non-standard employees not only earn a lower income but are also subject to the probability of income dispersion and unemployment probability that is three times greater than that of standard employees, and, therefore, they face higher employment and income risks (Abe, 2013). Sakaguchi (2011) argues that a division structure in

which unemployment risk is centered on non-standard employees is stable in the Japanese labor market.

In addition, it is considered that Japanese companies manage human resources, for example, develop abilities, on the basis of employee designation. Furthermore, companies tend to hire non-standard employees by designation and treat them as a buffer for labor adjustment because laying off standard employees costs far more in Japan. Moreover, some studies have shown that designation has a greater influence on working conditions and lifetime income than tenure (Kambayashi, 2013; Kambayashi and Kato, 2012; Kawaguchi et al., 2011). Thus, it can be said that non-standard employment reflects characteristics such as low income, uncertainty, and instability.

On the other hand, unemployed men in Japan are labeled as individuals with no prospect of employment or high income earnings, even in the long term. Thus, employment indices such as the non-standard employment and unemployment rates can capture the long-term uncertainty effects of employment, which a wage inequality index fails to do. In other words, it is suggested that women predict long-term increases in low income and unstable employment in the marriage market on the basis of a rise in the non-standard employment rate, designation, and unemployment rate. As a result, they postpone marriage, which is consistent with Oppenheimer et al.'s (1997) argument that job uncertainty delays marriage. However, men do not consider long-term aspects based on female employment indices.

I now discuss non-standard employment. Standard and non-standard employment are designation ("name at work") types in the Employment Status Survey. Such a classification method is peculiar to Japan and is uncommon in the U.S. and European countries. In addition, the survey classifies positions according to employment agreements; for example, workers with an agreed employment term of more than one year are classified as regularly employed, and those with a term of less than one year are grouped as being irregularly employed. Considering the classifications of designation and employment status on the basis of an agreed term, we group employment positions into four categories: regularly employed standard employee, irregularly employed standard employee, regularly employed non-standard employee, and irregularly employed non-standard employee.

In Japan, the number of regularly employed non-standard employees has increased in recent years (Kambayashi, 2010b). It has been recognized that the employment agreement of regularly employed non-standard employment is often renewed so that the actual duration of the service is relatively long, although their wages remain low (Koyō no Arikata ni Kansuru Kenkyukai [Meeting to Study Systems of Employment], 2009).

However, non-standard employment contracts, even if regularly employed, are not being renewed given the deteriorating labor market conditions in recent years.

Do the increasing rates of regularly and irregularly employed non-standard employment have different effects on the rate of unmarried women? The results show that only the regularly employed non-standard employment rate has a positive and significant effect on the rate of unmarried women. Therefore, even the term "non-standard" is shared since the increasing regularly employed non-standard employment rate for men could accelerate the rate of growing unmarried women, which is a concern.

Factors contributing to changes in marriage rate for both genders

Using the estimation results for the marginal effect of male wage inequality, employment condition indices, and median wage, I attempt to predict the magnitude of change in the probability of women aged 20–34 years remaining unmarried between 1992 and 2012. Drawing on the estimated marginal effects presented in Table 2, Table 6 shows the extent to which changes in the rate of unmarried women can be explained by the male wage inequality and trend of employment rate indices.

Table 6: Contribution of changes in wage inequality and employment indices on changes in marriage propensity for females during 1992–2012

	Average change	Marginal effect	Predicted change	Contribution
△ Female-single rate	0.0948			
△ Male 90:50 percentile ratio	0.015	0.732*	0.011	11.6%
△ Male 50:10 percentile ratio	0.010	0.839***	0.008	8.9%
△ Male median wage	-0.254	-0.083	0.021	22.2%
△ Male non-standard employment rate	0.125	0.174**	0.022	22.9%

Note: Calculations are based on estimated coefficients for the four variables in column (1) of Table 2.

The rate of unmarried women aged 20–34 years has increased by 9.48% in the past 20 years. During this period, the average changes in the 90:50 and 50:10 percentile ratios of the male wage in the same age group show a 0.015 and 0.010 point increase. In addition, the marginal effect coefficients are 0.732 and 0.939 when the above indices are

simultaneously used as explanatory variables. Thus, the predicted changes are 1.1% and 0.9% on the basis of the average changes multiplied by the coefficients of marginal effect.

From these results, the changes in 90:50 and 50:10 percentile ratios for men explain the 11.6% and 8.9% increase in the rate of unmarried women, respectively. Using a similar calculation method, median wage and non-standard employment rate for men can be used to predict the 22.2% and 22.9% increase in the rate of unmarried women, respectively. These indices, except male median wage, have significant explanatory powers. Table 7 shows that changes in the 90:50 and 50:10 percentile ratio, median wage, and non-standard employment rate for women contribute 38.2% and 62.3%, −116.5%,[13] and −26.9%, respectively, to the rate of unmarried men.

Table 7: Contribution of changes in wage inequality and employment indices on changes in marriage propensity by males during 1992–2012

	Average change	Marginal effect	Predicted change	Contribution
∆ Male-single rate	0.0407			
△ Female 90:50 percentile ratio	0.005	3.107***	0.016	38.2%
△ Female 50:10 percentile ratio	0.012	2.114***	0.025	62.3%
△ Female median wage	0.061	-0.777***	-0.047	-116.5%
△ Female non-standard employment rate	0.281	-0.039	-0.011	-26.9%

Note: Calculations are based on estimated coefficients for the four variables in column (1) of Table 3.

Conclusions

Clarifying the tendency among the youth to remain unmarried or delay marriage, which is potentially the main cause for the declining birthrate in Japan, is an urgent social need. Some recent studies in the U.S. and other countries have applied the implications of search models to marriage behavior. Using a mean-preserving spread, they suggest that women delay marriage in response to the increasing inequality in the

[13] The contribution rate of female median wage becomes −73.6% when male median wage and non-employment rate are included.

lower, rather than upper, tail of male wage distribution. However, previous analysis frameworks have been unable to strictly analyze such phenomena as male wage inequality in the lower tail than in the upper tail in Japan. In addition, conducting a sophisticated study using Japanese individual data is difficult owing to data limitations.

In this study, I model the relationship between asymmetric changes in the male wage distribution and female marriage behavior using a median-preserving spread framework. This method allows us to analyze the effects of asymmetric inequality changes between the upper and lower tails of wage distribution. In addition, I adopt the concept of a two-sided search and estimate the dual-directional effects of the theoretical hypothesis in Japan using large individual data from Japan's Employment Status Survey.

The results show that the wage inequality indices for both sexes have significant and positive effects on cross-gender unmarried probabilities, which is consistent with the theoretical hypothesis. However, male employment indices, such as non-standard employment and unemployment rates, robustly dominate the probabilities of women remaining unmarried. The non-standard employment and unemployment rate for men can be interpreted as long-term low-income levels and job uncertainties, which Oppenheimer et al. (1997) discuss in their study. Thus, it is suggested that women predict a long-term rise in lower income and unstable employment in the marriage market by considering an increase in non-standard employment and unemployment rates by designation and therefore, delay marriage. To this effect, in Japan, the male employment status based on designation and male wage inequality play equally important roles in female marriage behaviors. As per the present marriage market condition, men delay marriage in response to female wage distribution in both tails, although they do not respond to female employment indices as a long-term marriage market condition.

The policy implications derived from the results of the positive analysis are as follows. It is essential to increase the low wage levels for both genders and support a shift from non-standard to standard employment for men by improving the labor market environment. To this effect, an ability development program, employment training improvement, and accurate evaluation systems for occupation abilities are necessary. An additional requirement is improving income security. However, the challenge of examining these influences on the so-called "lost-decade generation," who were born in the 1980s and face serious job scarcity, remains and needs the accumulation of more recent data.

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