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Labor Market Inequality and Marital Segregation in East Asia

Shoichi Sasaki*

Abstract

This study examines the effects of inequalities in male educational wages and gender—such as the gender wage gap and barriers for labor force participation of female workers—on the labor market. It considers the effects of social infrastructure or public goods on marital segregation in Japan, South Korea, Republic of China, and Taiwan. The theoretical hypothesis that Fernández et al. (2005) build is empirically analyzed using individual data from East Asian Social Survey. The estimation results suggest that wage and gender inequalities in the labor market, such as skill wage premiums for men and full-time rates for married women, significantly affect marital segregation. These results show that policies to decrease inequality in the parental generation can decrease future inequality.

Keywords: Wage premium, skilled workers, gender gap, marital segregation, assortative mating, hypogamy

JEL classification: J11, J12, J16, J24, J31, J71

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1. Introduction

This study examines the effects of male educational wage and gender inequalities—such as gender wage gap and barriers for labor force participation of female workers—on the labor market in East Asia. It considers the effects of social infrastructure or public goods on marital segregation in Japan, South Korea, Republic of China, and Taiwan.

The expansion of income gap, increasing poverty, hierarchy sorting, and their persistency in each country and Taiwan, including Japan, is well understood. In fact, some researchers in western countries empirically report that the rate of educational assortative mating has increased, as well as the tendency of marriage between men and women with similar income levels, which substantially widens the household income gap in numerous countries (e.g., Sweeney and Cancian, 2004; Schwartz, 2010; Torche, 2010). Therefore, many studies focus on the mechanisms that determine marital tendencies between men and women with similar educational backgrounds and incomes. The economic theory models indicate that marrying a lower-educated or lower-income earning partner reduces household income for individuals who have high educational background or high income. Therefore, they avoid such marriages, instead preferring partners with similar educational background or income.

Therefore, I empirically determine whether the implications of this model are applicable to Japan, Korea, China, and Taiwan, where few studies exist on this topic.

The reason for examining this area is as follows. The chosen countries and Taiwan accomplished economic growth, dubbed "a miracle of Asia," while also bearing differences in time and stage. Moreover, the popularization of higher education among workers continues to increase. Although the income gaps of those countries is considered smaller than that of other developed countries, the International Monetary Fund (IMF, 2006) recently stated that the gaps widened between skilled and unskilled workers or with respect to educational backgrounds.[1] Additionally, Japan, South Korea, Republic of China, and Taiwan are regionally close, with similar cultural background underpinned by Confucianism.[2,3] Their ratios of assortative mating are traditionally higher than that of European countries or the United States. As opposed to western countries, they also commonly have broad gender inequalities that are deeper rooted, including stereotypical gender roles, labor market inequalities, and a considerable gender gap, as per World Economic Forum (2017). However, they also have different political–economic systems, economic growth stages, income gap among men of different educational backgrounds, and labor markets for women. Additionally, though the degree of Confucianism is different for each territory, they inhabit the same cultural area.[4] We identify this diversity through a comparison of the societies in terms of their similarities

[1] IMF (2006) points out that the rise in wage premiums for skilled worker demand by the Skill-Biased Technological Change (SBTC) caused wage inequalities in the East Asian countries after the 1990s.

[2] A detailed discussion on the Confucianism zone can be found in the main religion hypothesis of Smits et al. (1998).

[3] The average of the coefficient of partial correlation of educational years for married women is 0.519 in 15 European and American countries of the 34 countries, excepting 15 former communist countries Fernández et al. (2005) analyzes. However, the coefficients of correlation calculated using EASS data in this study are 0.475 (Japan), 0.710 (Korea), 0.671(Taiwan), and 0.563 (China), and thus, all coefficients are relatively high, except for Japan.

[4] Sechiyama (1996) classifies East Asian society into four categories from the viewpoint of Confucian penetration and political and economic system. He insists gender equality varies by society, such as China, Korea, and Taiwan.

and differences (Takenoshita, 2011). Therefore, they are suitable objects for this comparative study. Further, few studies on educational assortative mating exist for East Asian countries.

Therefore, it is important to verify whether the results are consistent with the economic theory hypothesis from extant studies, and comparable with the results of studies on Europe and the United States. Hereafter, I empirically analyze Fernández et al.'s (2005) theory hypothesis using comparable individual data from Japan, South Korea, Republic of China, and Taiwan.

The remaining paper is organized as follows. Section 2 reviews extant literature. Section 3 presents the theoretical hypotheses and estimation model. Section 4 describes the data. Section 5 reports and discusses the estimation results. Section 6 concludes the paper.

2. Literature review

Research on social sciences like economics or sociology has exhaustively examined assortative marriage in individuals who closely resemble in terms of education background, race, and religion. Particularly, trends in educational assortative marriage have been previously analyzed by country. Mare (1991), Francesconi (1995), as well as Schwartz and Mare (2005), show that the rate of educational assortative mating has been increasing in the United States. Blossfeld and Timm (2003) compare the trend of educational assortative mating internationally in cooperation with researchers in 13 developed countries in Europe and the United States. They show that it increased in almost all countries, largely because men tend to choose women of the same educational background owing to the increased labor force participation rate for women and income dependence on women in the family budget. Smith and Park (2009) indicate that, in 10 East Asian societies, educational homogamy tends to decrease with modernization, female employment, and reduced Confucian influence. In Japan, the National Institute of Population and Social Security Research (2003) and Miwa (2007) show that educational assortative mating tended to decrease recently, while Kohara (2001), Higuchi et al. (2003), Abe (2005), and others find that the law of Douglas–Arisawa does not hold, with the appearance of high educational or income couples.

We find that Korea and China exhibit the following trends in assortative mating. Han (2010) in Korea and Park and Smith (2005) in China find that assortative mating increased in both countries. However, some studies also examine the tendency to marry within same educational background using certain hypotheses.[5] In economics, Becker (1974) considers theoretically how men and women match through their marriage behaviors based on the household production theory. He concludes that, when the human capital of men and women in the process of creating a household has a complimentary relation, assortative mating, that is, marriage between men and women of higher human capital, in turn induces high utility for each couple, as well as optimality for society. Additionally, Chadwick and Solon (2002) and Ermisch et al.

[5] Smits et al. (1998) reviews hypotheses on the reasons why the educational assortative mating is common to all countries from a sociological viewpoint. These are classified roughly into modernization (economic growth), labor force participation, and dominant religion hypotheses. The modernization (economic growth) hypothesis posits the assortative mating rate has an inverse U-shaped relationship with economic growth. Fernández et al.'s theoretical model (2005), which this study follows, chooses "Romantic hypothesis" or labor force participation hypothesis. Their idea is that women strengthen their preferences for elements other than income, for example, chemistry and love, over the same education or income levels, given the rising economic power of women relative to men.

(2006) empirically confirm that assortative mating greatly affects the intergenerational transfer of household income based on sorting and income inequality among households through marriage and the transfer of earning ability between generations through education. Further, researchers in Europe and the United States build a model that unified marriage behavior of the present generations and transfer of earning ability to future generations to examine their effects on household income inequality. On the theoretical side, Kremer (1997) insists that, even if the extent of marital segregation increases, it hardly influences the income distribution and education.

Fernández and Rogerson (2001) build a simulation model of hierarchical stratification by education acquisition and marital segregation between generations, concluding that income inequality widens with hierarchization. Fernández (2002) obtains a similar result after refining the model by introducing the quality of matching (i.e., chemistry or love) into the utility function of marriage, as well as the household income level. Fernández et al. (2005), whose model this study relies on, derive a theoretical hypothesis wherein the extent of marital segregation increases according to the extent of the gender inequality. They incorporate elements of gender inequality in the labor market in their model. Further, using cross-sectional data of 34 European and American countries, they obtain an empirical result consistent with the theoretical hypothesis. However, they have mainly two empirical problems. First, they cannot remove the unobserved fixed effects of the countries and region individually because of the data's cross-country-sectional nature. Second, the range of the marriage markets they assumes is in country unit and too wide.

Therefore, this study uses multi-year data on local areas or economic blocks in Japan, South Korea, Republic of China, and Taiwan to examine the effects of labor market inequality (e.g., income inequality among educational backgrounds, gender gap in income, and entry barriers to the labor market) on the extent of marital segregation by controlling effects of unobserved factors characteristic to each country.

3. Theoretical hypotheses and estimation model

This study is based on Fernández et al.'s (2005) model—a generation overlapping model with three periods. The economic agents choose the amount of labor skill formation and their marriage partner in the first period. They work, reproduce, and raise children in the second period, with skilled workers repaying educational investment expenses over this period. In the third period, they consume based on their income minus educational loans, also assuming the role of monitors for repaying the educational loans of their children. The next section explains the theoretical model with a focus on marital sorting in the first period.

3.1 Marital segregation model

3.1.1 Model setup

This study assumes no gender gaps, such as income gap between men and women in the labor market, at first. Men and women obtain utilities from two elements on which their consumption is based—household income and quality of matching (chemistry or love)—according to Fernández et al. (2005). The utility function of men and women is formulated as below:

$$V(I, q) = u(I) + q, \quad (1)$$

where I represents household income, and q, the amount of love (quality of matching), converted into monetary value. Here, (*s*) represents the skilled workers, and (*u*), unskilled workers. If a worker has high skills, he/she obtains net income $\widetilde{w}_s \equiv w_s - d$, formed of wage w_s minus the monetary cost to be a skilled worker through educational investment *d* paid in the second and third periods. Then, an unskilled worker obtains wage w_u in the second and third periods. Households are classified as combinations of skill levels between husband and wife:[6]

$$I_{ij} = \begin{cases} 2\widetilde{w}_s, & if\ i,j = ss \\ \widetilde{w}_s + w_u, & if\ i,j = su. \\ 2w_u, & if\ i,j = uu \end{cases} \quad (2)$$

Each worker has two opportunities for matching in the marriage market. In the first meeting stage, he/she meets a spousal candidate whose level of love is *q* with a random skill level, and then, leaves the marriage market if he/she accepts marriage. A worker who does not marry at the first meeting stage, proceeds to the second meeting, meeting another spousal candidate whose level of love is μ,[0, $\bar{q}$] with the same skill level, finally deciding whether to marry.

The situation of a skilled worker is as follows. If he/she meets an unskilled lower wage worker with a high level of love (*q*) in the first meeting stage, he/she decides whether to marry the unskilled worker or a skilled higher wage worker whose level of love is μ in second meeting stage. In other words, the skilled worker faces a trade-off between love and money.

Even if the skilled worker marries whichever, the utilities are indifferent when $V_{su}(q) = V_{ss}(\mu)$ holds. Here, as $V_{i,j}(q) \equiv u(I_{i,j}) + q$ is true, we analytically calculate the level of *q* at which utilities become indifferent, and derive the solution below:

$$q^* = u(2\widetilde{w}_s) - u(\widetilde{w}_s + w_u) + \mu. \quad (3)$$

The difference of expected amount of love $q^* - \mu$ becomes equal to the loss of utility in the case of marrying an unskilled worker $u(2\widetilde{w}_s) - u(\widetilde{w}_s + w_u)$; that is, q^* refers to the amount of love that compensates the utility loss from the decreasing household income when a skilled worker marries an unskilled worker.

3.1.2 Wage inequality and marital sorting

Here, we analyze how exogenous changes in skilled and unskilled workers' wages affect marital sorting. From equation (3), we differentiate q^*, and obtain:

$$\frac{\partial q^*}{\partial \widetilde{w}_s} = 2u'(I_{ss}) - u'(I_{su}),$$

$$\frac{\partial q^*}{\partial w_u} = -u'(I_{su}) < 0. \quad (4)$$

The rise in the wage of the unskilled worker decreases the extent of marital segregation by decreasing q^*. Then, the rise of skilled workers' wages increases the degree of marital sorting if we assume a shape of the utility function with weak concavity according to Fernández et al. (2005).

[6] Society bipolarizes households of skilled worker couples as rich and the ones of unskilled workers as poor if marriages do not occur across hierarchies.

From the above, the increase in the wage premium of skilled workers $\widetilde{w_s}/w_u$ increases the amount of love needed to compensate the utility loss from a decreasing household income when a skilled worker marries an unskilled worker. Then, the probability that skilled workers marry unskilled workers decreases, while the degree of marital segregation increases.

3.1.3 Gender inequality and marital sorting

Next, we examine a model that includes gender inequality explicitly. Men spend all their productive time in the labor market, while women decide how much time they devote for childcare and work in the labor market. If we assume that time spent on childcare contributes to the child's human capital accumulation, the household utility function is described as follows:

$$\mathrm{U}(w_{mi}, w_{fj}) = ln(w_{mi} + w_{fj}t_j) + \beta ln[(1 - t_j)\psi_j], \quad (5)$$

where $\beta < 1$ and $\mathrm{i,j} \in \{s, u\}$ refer to skill types. *m* and *f* represent men and women, while t_j refers to the time women of *j* type work; $(1 - t_j)\psi_j$ represents the child's human capital level. Moreover, total hours are standardized as 1. The first order condition of t_j the household utility maximizes is described as follows:

$$\frac{w_{fj}}{w_{mi}+w_{fj}t_j} - \beta\frac{1}{1-t_j} = 0 \text{ with } t_j \geq 0, \quad (6)$$

then optimal labor hours are described as follows:

$$t_j = \begin{cases} \frac{w_{fj}-\beta w_{mi}}{w_{fj}(1+\beta)}, if\ w_{fj} > \beta w_{mi} \\ 0, otherwise \end{cases}. \quad (7)$$

Therefore, the hours a woman works in the labor market increase according to the rise in her wage and decrease with the rise of the spouse's wage. For men and women, the utility from marriage can be described as $\mathrm{U}(w_{mi}, w_{fj}) + q_{mi}$ and $\mathrm{U}(w_{mi}, w_{fj}) + q_{fj}$, respectively. Since we can categorize the main discriminative practices against women in the labor market into the wage gap between men and women and entry barriers to the labor market, their effects on marital segregation are derived.

First, decision-making regarding marriage for the skilled labor woman with a gender wage gap between men and women is considered, then the level of love, which becomes indifferent between assortative and non-assortative mating for skilled women, is:

$$q_{fs}^* = \mu + \lambda' [U(w_{ms}, w_{fs}) - U(w_{mu}, w_{fs})]$$
$$= +\lambda' [(1 + \beta)] ln\left(\frac{w_{ms}+w_{fs}}{w_{mu}+w_{fs}}\right), \quad (8)$$

where λ' represents the probability of meeting a skilled man; the results in equation (7) are used as household utility. When obtaining $\partial q_{fs}^*/\partial w_{fs} < 0$ from equation (8), utility loss of the marriage with a non-skilled labor man decreases through a decrease of q_{fs}^* when the woman's wage increases; that is, since the quantity of love that compensates decrease in household income from a skilled woman marrying an unskilled man decreases in a society where the wage gap between men and women is small or the wages of high educational background women are relatively high. As such, the probability that a female skilled labor woman marries an unskilled labor man increases, as does the extent of marital segregation.

Then, this study considers the effects of entry barriers to the labor market, for women, on women's marriage behavior. We compare a society where women can choose work hours freely (i.e., $w_{fs} > \beta w_{ms}$) with a society where they cannot choose the amount of labor supply freely. We then obtain the difference in the level of love at which the utilities between assortative mating and hypogamy, under which a skilled woman marries an unskilled man, become indifferent:

$$q_{fs}^{*} - \tilde{q}_{fs}^{*} = \lambda^{'} \left[(1+\beta) ln\left(\frac{w_{ms}+w_{fs}}{w_{mu}+w_{fs}}\right) - ln\frac{w_{ms}}{w_{mu}}\right] < 0. \quad (9)$$

The probability of women—who can work freely in the labor market—marrying unskilled men due to decreasing q* increases. In other words, the degree of marital segregation decreases with higher labor force participation from married women.

From Fernández et al.'s (2005) model, we can predict that the extent of marital segregation increases in a society where the gender gap, such as gender wage gap or the extent of entry barriers to the labor market, is wider.

3.2 Estimation model

The hypothesis derived from the theoretical model is that increases in the skill premium and gender gap in the labor market increase the extent of marital segregation by increasing the amount of love (q^{*}) a skilled woman accepts for marrying an unskilled man and decreasing the probability of marrying across hierarchies. For examining this theoretical hypothesis, this study defines a skilled woman as a university graduate, and examines the effects of the skill premium and gender gap on the probability of choosing educational hypogamy, under which a university graduate woman marries a lower educational background man. For the empirical analysis, we divide Japan, South Korea, Republic of China, and Taiwan into 21 local areas/economic blocks[7] to examine the validity of the hypothesis in the countries and region individually, controlling for the fixed effects of these local areas/economic blocks.

An estimation model is derived as follows. From (3), a university graduate woman chooses hypogamy when the q of the marriage partner exceeds q^{*}. In other words, $q - q^{*} > 0$. Here, if $q - q^{*} = y^{*}$ holds, she chooses hypogamy when $y^{*} > 0$ holds. Conversely, she chooses assortative mating when $q - q^{*} = y^{*} \leq 0$ holds. Therefore, this study estimates a probit model that takes the value 1 when a university graduate woman chooses hypogamy and 0 otherwise (educational assortative mating):

$$y_{lrt}^{k*} = \alpha^{k} A_{lrt} + \beta^{k} X_{rt}^{k} + \gamma^{k} Z_{rt}^{k} + R_{r}\delta^{k} + \varepsilon_{lrt}^{k}, \quad (10)$$

$$y_{lrt}^{k} = 1 \; if \; y_{lrt}^{k*} > 0, y_{lrt}^{k} = 0 \; otherwise,$$

where y_{lrt}^{k*} is a latent variable that takes the value 1 when a university graduate woman *i*, who lives in local area or economic block of country or region *r*, marries a man whose educational background is below university, and 0 otherwise. Additionally, A_{lrt} is an age group dummy, X_{rt}^{k} a skill premium (wage inequality) index of each local area or economic block, Z_{rt}^{k} a gender gap index, R_{r} a dummy variable of local areas or economic blocks, and ε_{lrt}^{k} the error term.

[7] The list of 21 local areas/economic blocks is provided in the Appendix 1.

In reference to Fernández et al. (2005), we use skill premiums of skilled workers, as opposed to unskilled workers (wage inequality among educational backgrounds), and gender gap as explanatory variables. First, a university graduate man is defined as a skilled worker, while lower educational background workers, as unskilled. Second, four educational wage inequality indices are set up,[8] with four variables—average annual income ratio of university graduate men and other lower educational background men; "Wage ratio," log of raw average wage of a university graduate men and other lower educational background men; "Log of raw wage," the coefficient of an university graduate man dummy variable in the basic Mincer wage function; "Skill indicator, " an expected earning rate per educational year in the basic Mincer wage function; and "Mincer coefficient." Four variables are also taken as gender indices—[9]average yearly income ratio of university graduate men and women; "Wage Gap," men's wage premium for full-time work; "Male coefficient," a labor participation rate of married women; and the full-time worker ratio. Moreover, the GDP per capita of each local area or economic block is extrapolated as "GRDP," a representative variable of economic development stage or living standard.

We assume the effects of each explanatory variable on hypogamy for university graduate women based on the theoretical hypothesis and conventional studies. First, we predict that only "Log of raw wage" of lower educational background man (wage of unskilled workers) has a positive effect on the probability of hypogamy; all other indices have a negative effect on hypogamy based on the theoretical hypothesis. GRDP per capita is assumed to have a positive effect on the probability of hypogamy based on the empirical results of Fernández et al. (2005). Next, we assume gender gap indices have negative effects on the probability of hypogamy when they become wider. In other words, "Wage Gap" and "Male coefficient" have negative effects, while the labor force participation rate of married women and the full-time worker ratio have positive effects.

4. Data

This study uses data from 2006 and 2008 based on the individual data of the East Asian Social Survey (EASS), which analyzed Japan, Korea, China, and Taiwan, and was jointly conducted every two years from 2006. EASS establishes common questions based on issues and concerns unique to East Asian societies, consistent with the Japanese General Social Surveys (GSS), Korea GSS, China GSS, and Taiwanese Social Change Survey, which are national-scale investigations that cover the adult population in line with the United States GSS. The data contain respondents' (and spouse's if married) sex, age, marital status, educational level or years, job status, and yearly income, making them suitable for this study. Further, these data can be subdivided by local area or economic block,[10] as well as for countries/regions. Therefore, the effects of the situation on each labor market of all local areas or economic blocks are analyzed; that is, the men's skill premium and gender gap on marital sorting. Additionally, we harmonize

[8] The calculation method for wage inequality indices for men is explained in Appendix 2.

[9] The calculation method for the gender gap indices is explained in Appendix 3.

[10] This study uses six areas for Japan, according to the Statistics Bureau, Ministry of Internal Affairs and Communications; five areas in Korea, according to Shin (2009); three areas in Taiwan, according to Noda (1992) and more; and seven economic blocks in China, according to Kato (2003). This study also uses various wage inequality indices for each area and economic block. The list of all 21 areas and economic blocks is provided in Appendix 1.

the wages of the countries and region by converting local currencies to USD using the exchange rate for the two respective years as per the American Federal Reserve Board (2012), and adjusting the 2006 prices when calculating wage inequality and gender gap indices.

We use the observations for the two years for 26- to 45-year-old married university graduate men and women.[11] In choosing the sample, it is necessary to avert the endogeneity problem of the wage premium of university graduate workers and marital segregation. In Fernández et al.'s model (2005), first, each man and woman of this generation decides his/her education level, then the ratio of university graduate men and women and wage premium of university graduates are determined in the society, thus theoretically determining the degree of the marital segregation through marriage behaviors. Therefore, as per the theoretical model, and for analysis, the economic agents has to be among the age groups that completed their education investments in order to begin marriage behavior. In fact, the tendency to marry later in life increases remarkably in Japan, South Korea, Republic of China, and Taiwan, with the average age of first marriage for men in urban areas exceeding 30 in Japan, Korea, and China. Therefore, sample selection bias is possible for a young age-group (i.e., early 20s), which is why observations for the 26–45 age group are used. The descriptive statistics of the variables are shown in Table 1. The four men's skill premium indices rank from high to low as follows: China, Korea, Taiwan, and Japan. This is consistent with the results of Chan and England (2011), who decompose the factors of the gender wage gap in Japan, Korea, and Taiwan using the same data. The labor force participation rate of married women is highest in China, followed by Taiwan, Japan, and Korea. The full-time working rate for married women is highest in Taiwan, Japan, China, and Korea in that order. Additionally, the GRDP per capita is highest in Japan, Korea, Taiwan, and China in that order.

Table 1. Descriptive statistics of variables

Variable		**Japan**				
		Obs.	Mean	Std. Dev.	Min.	Max.
Hypogamy dummy		77	0.195	0.399	0	1
Skill wage premium indices	Wage ratio	77	1.258	0.127	1.002	1.684
	Log raw wage (Log of average annual income of university graduate men	77	10.673	0.243	10.166	11.082
	Log raw wage (Log of average annual income of other lower educational background men)	77	10.547	0.187	10.134	11.092
	Skill indicator	77	0.295	0.143	0.032	0.532
	Mincer coefficient	77	0.091	0.222	0.053	0.126
	Wage gap	77	1.991	0.660	1.000	3.004
	Male coefficient	77	0.909	0.280	0.420	1.193

[11] This age-group is divided into the 26–35 and 36–45 age groups, and the skill premium (wage inequality) index is developed to correspond to each age-group and gender gap indices. However, Fernández et al. (2005) use the 36–45 age group.

Gender gap indices	Labor market participant rate of married women	77	0.583	0.109	0.294	0.742
	Full-time worker rate of married women	77	0.445	0.218	0.045	0.681
GRDP per capita		77	37,757	4,147	28,166	42,445
Age-grade dummy (36-45 years old)		77	0.506	0.503	0	1

Variable		**Korea**				
		Obs.	Mean	Std. Dev.	Min.	Max.
Hypogamy dummy		232	0.142	0.350	0	1
Skill wage premium indices	Wage ratio	232	1.768	0.388	1.128	2.450
	Log raw wage (Log of average annual income of university graduate men	232	8.543	0.341	7.042	9.163
	Log raw wage (Log of average annual income of other lower educational background men)	232	7.996	0.209	7.611	8.276
	Skill indicator	232	0.444	0.115	0.263	0.601
	Mincer coefficient	232	0.097	0.025	0.027	0.123
	Wage gap	232	1.766	0.473	1.056	3.243
Gender gap indices	Male coefficient	232	0.576	0.133	0.198	0.973
	Labor market participant rate of married women	232	0.466	0.084	0.278	0.700
	Full-time worker rate of married women	232	0.333	0.099	0.111	0.640
GRDP per capita		232	21,476	2,510	16,357	25,320
Age-grade dummy (36-45 years old)		232	0.595	0.492	0	1

Variable		**China**				
		Obs.	Mean	Std. Dev.	Min.	Max.
Hypogamy dummy		45	0.422	0.499	0	1
Skill wage premium indices	Wage ratio	45	8.323	0.365	7.378	9.229
	Log raw wage (Log of average annual income of university graduate men	45	7.777	0.399	7.090	8.497
	Log raw wage (Log of average annual income of other lower educational background men)	45	0.599	0.214	0.280	0.984
	Skill indicator	45	0.599	0.214	0.280	0.984
	Mincer coefficient	45	0.123	0.029	0.052	0.157
	Wage gap	45	1.368	0.277	0.905	2.000
Gender gap indices	Male coefficient	45	0.328	0.118	0.199	0.572
	Labor market participant rate of married women	45	0.777	0.072	0.610	0.885

	Full-time worker rate of married women	45	0.415	0.136	0.167	0.590
GRDP per capita		45	3,377	1,458	1,204	6,490
Age-grade dummy (36-45 years old)		45	0.400	0.495	0	1

Variable		**Taiwan**				
		Obs.	Mean	Std. Dev.	Min.	Max.
Hypogamy dummy		110	0.273	0.447	0	1
Skill wage premium indices	Wage ratio	110	1.270	0.195	1.013	1.739
	Log raw wage (Log of average annual income of university graduate men	110	7.461	0.244	7.079	7.927
	Log raw wage (Log of average annual income of other lower educational background men)	110	7.232	0.226	6.936	7.568
	Skill indicator	110	0.336	0.145	0.102	0.463
	Mincer coefficient	110	0.090	0.010	0.083	0.122
Gender gap indices	Wage gap	110	1.296	0.124	1.000	1.418
	Male coefficient	110	0.322	0.068	0.240	0.436
	Labor market participant rate of married women	110	0.719	0.030	0.645	0.806
	Full-time worker rate of married women	110	0.586	0.069	0.468	0.721
GRDP per capita		110	17,125	812	16,317	17,933
Age-grade dummy (36-45 years old)		110	0.500	0.502	0	1

Moreover, the sample size is considerably smaller compared to the population of the countries or region and in comparison to the original sample size of EASS, which is a remarkable tendency in China and Japan particularly. The sample of university graduate women who are 26–45 years old, however, does not have a sample selection bias concerning the university graduate and marriage rates. For example, according to Figures 1 and 2, in China, the marriage rate of women is not as low, although the university graduate rate is considerably lower, thus the decrease in sample size. Japan has lower university graduate rates for women than Korea and Taiwan, as well as lower marriage rate for women compared to the others, thus the sample size is small.

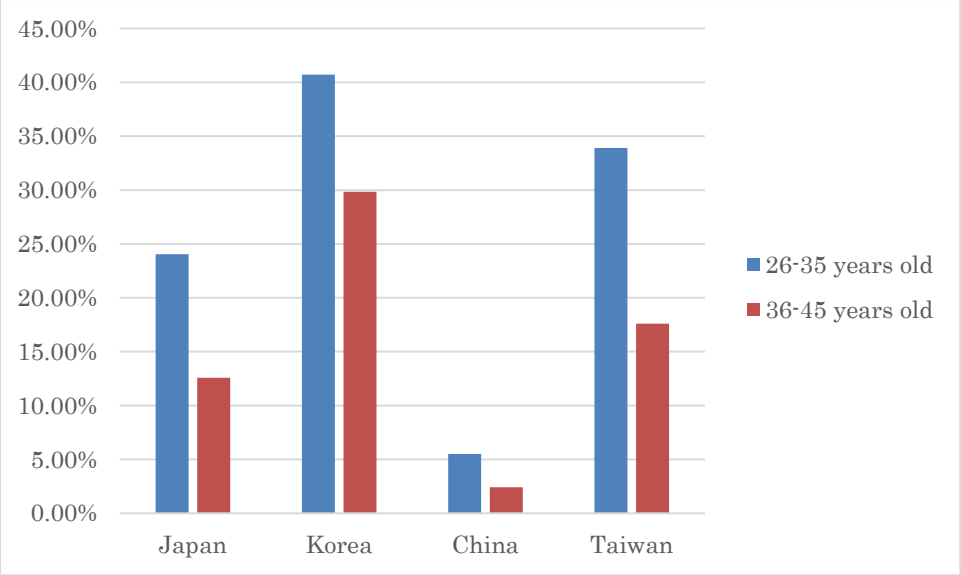

Figure 1. University graduate rates for women

Source: Author's calculations using EASS (2006, 2008)

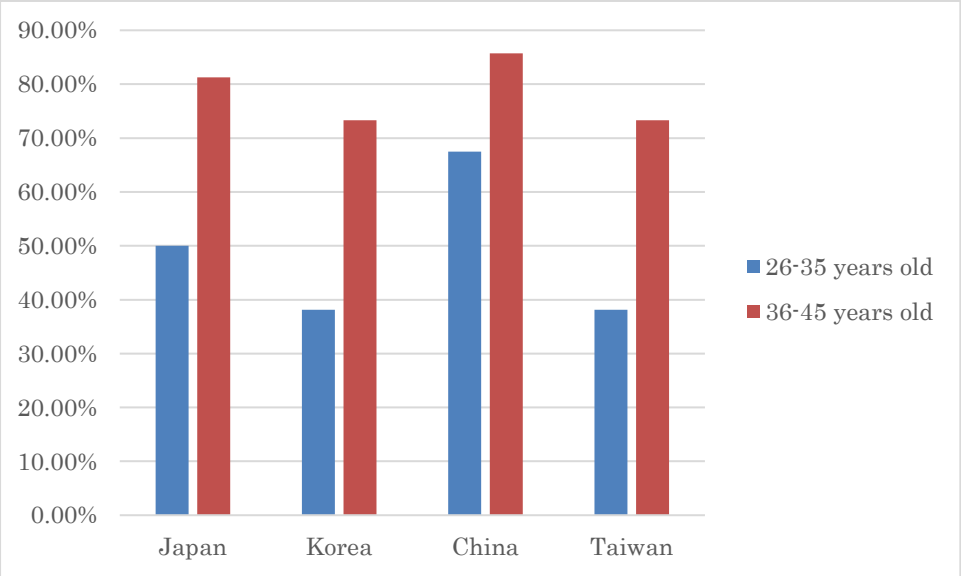

Figure 2. Marriage rates for women

Source: Author's calculations using EASS (2006, 2008)

Figures 3–5 present the relationships between the hypogamy rate for women and "Skill indicator," "Wage gap," and full-time worker ratio for married women in each local area and economic block using scatter plots, where the red, blue, yellow, and green circles represent Japan, Korea, China, and Taiwan, respectively. Moreover, the size of the circles expresses the scale of the sample in each local area or economic block. The scatter plots show a negative relationship between skill premium and hypogamy rate in Japan, South Korea, Republic of China, and Taiwan. Further, the hypogamy rate does not have a

correlation with “Wage gap.” Instead, a weak positive correlation is registered between the hypogamy rate and full-time worker ratio of married women.

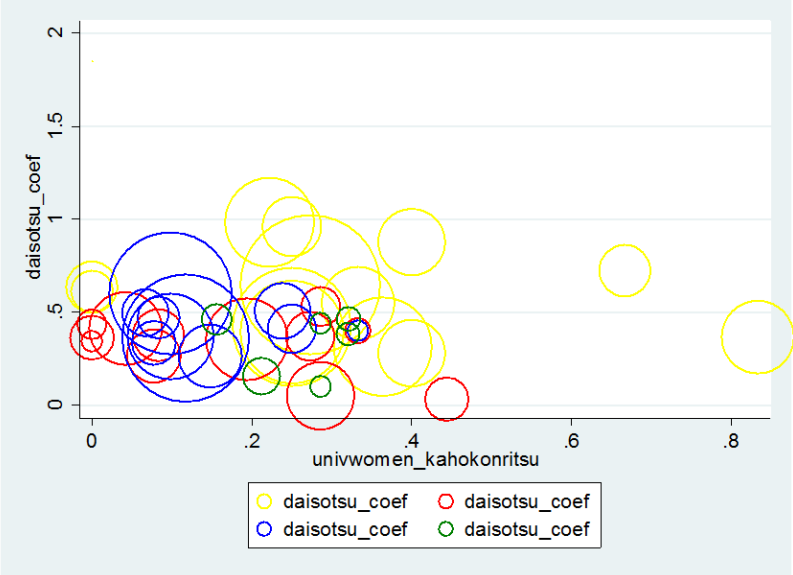

Figure 3. Scatter plot of the hypogamy rate for women and the skill indicator

The red, blue, yellow, and green circles represent Japan, Korea, China, and Taiwan, respectively.

Source: Author’s calculations using EASS (2006, 2008)

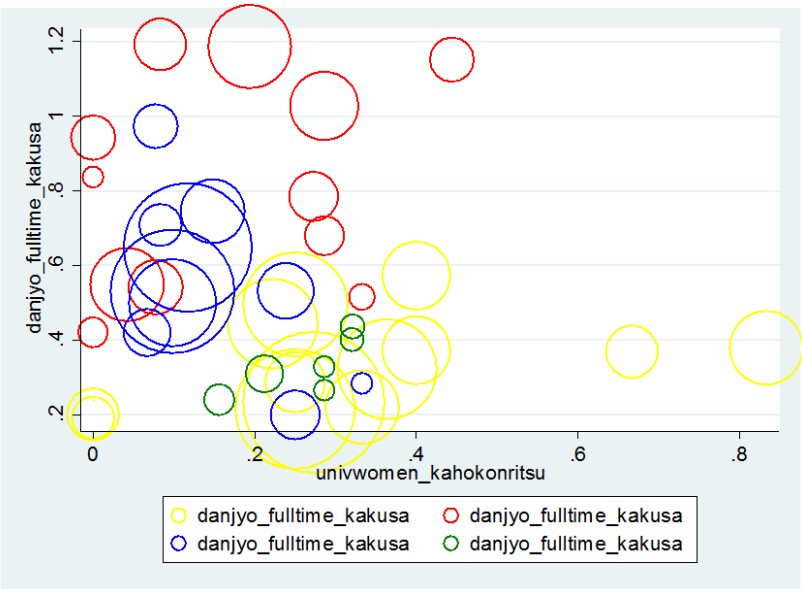

Figure 4. Scatter plot of the hypogamy rate for women and wage gap

The red, blue, yellow, and green circles represent Japan, Korea, China, and Taiwan, respectively.

Source: Author’s calculations using EASS (2006, 2008)

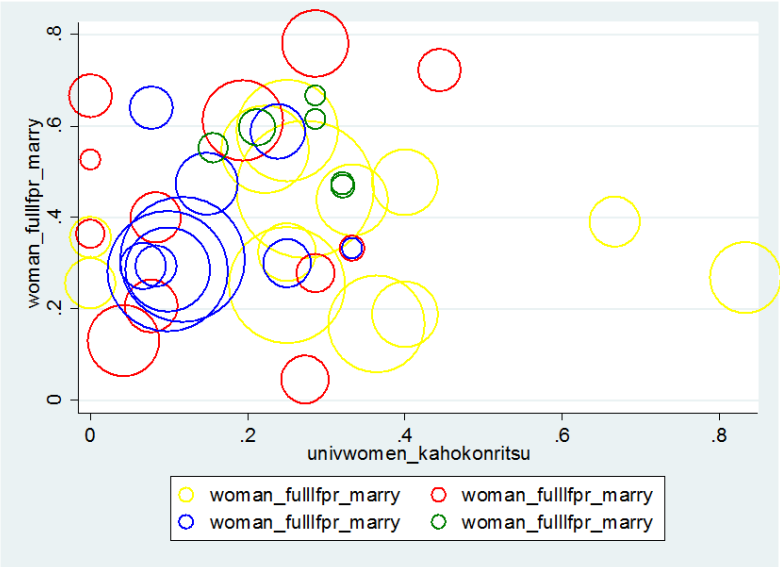

Figure 5. Scatter plot of the hypogamy rate of women and full-time worker rate for married women
The red, blue, yellow, and green circles represent Japan, Korea, China, and Taiwan, respectively.
Source: Author's calculations using EASS (2006, 2008)

5. Estimation results and discussion

5.1 Baseline estimation results

First, this study estimates the effect of the increase in the wage premium of university graduate men on the probability of a university graduate woman choosing hypogamy using four educational wage inequality indices for men. Table 2 presents the baseline estimation results.

Table 2. Effects of various wage premiums for men

	Japan		**Korea**		**China**		**Taiwan**	
Wage ratio	-0.487		0.240		0.200		0.872	
	(1.957)	**	(0.186)		(0.300)		(0.639)	
Log of raw wage	-6.528		0.543		-0.845		0.617	
	(2.911)	**	(0.209)	***	(1.547)		(1.171)	
	4.873		1.245		0.262		1.801	
	(2.969)		(0.691)	*	(0.225)		(1.628)	
Skill indicator	-5.850		-2.070		-1.591		--1.977	
	(2.907)	**	(0.405)	***	(0.992)		(0.347)	***
Mincer coefficient	-29.965		-4.335		8.648		0.644	
	(33.647)		(1.727)	**	(11.786)		(9.050)	

Notes:

Dependent variables: university graduate woman: choice of hypogamy=1, others=0

Observation numbers of each country and region are follows: Japan: 77, Korea: 232, China: 39, Taiwan: 110

Other explanatory variables are 36–45 years old dummy and dummy of local areas or economic blocks.

The second-step parentheses indicate standard errors modified by clustering based local areas or economic blocks.

***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Column 1 shows all four indices have a significant negative effect on the probability of hypogamy for university graduate women, and are consistent with the theoretical hypothesis for Japan. Among them, the Wage ratio and Log of raw wage have significant effects at the 5% confidence level. Column 2 indicates three indices (except Log of raw wage) of university graduate men also have significant negative effects, and are consistent with the theoretical hypothesis for Korea. Among them, the Log of raw wage of other lower educational level men, Skill-indicator, and Mincer coefficient have significant effects at the 10%, 1%, and 5% confidence levels, respectively. Column 3 demonstrates all four indices have no significant effects for China. However, the coefficient signs of Log of raw wage of other lower educational level men and Skill indicator are consistent with the theoretical hypothesis. Column 4 shows the Skill indicator has negative significant effect at the 1% confidence level in Taiwan. The results show the effect of the Skill indicator is almost significant in relation to the theoretical hypothesis in the countries/area examined. Thus, the increase of the skill wage premium decreases the probability of hypogamy for university graduate women, while the extent of marital segregation increases. This suggests that, because the other three indices depend on age and years of job experience, it is appropriate to use the skill premium that controls them.

5.2 Alternative factor

Fernández et al. (2005) take the degree of economic development or standard of living as an alternative factor that affects the extent of marital segregation, and examine their effects using GRDP per capita as a proxy. Smits et al. (1998) also analyze the hypothesis wherein the educational assortative mating rate has an inversed U-shaped relationship with economic development. Therefore, this study adds GRDP per capita to the above baseline estimation according to these studies. Table 3 presents the results.

Table 3. Effects of various wage premiums for men with GRDP per capita

	Japan		**Korea**		**China**	**Taiwan**
Wage ratio	-5.020		0.041		0.243	0.347
	(2.306)	**	(0.183)		(0.601)	(0.237)
GRDP per capita	1.40E-04		9.98E-05		3.99E-05	2.89E-04
	(1.71E-04)		(2.68E-05)	***	(3.18E-04)	(2.89E-04)
Log of raw wage	-6.860		0.019		-0.922	0.023
	(2.988)	**	(0.552)		(1.446)	(0.387)
	3.498		0.217		0.124	3.295
	(3.567)		(1.206)	*	(0.375)	(1.203)
GRDP per capita	1.66E-04		9.08E-05		5.70E-05	4.01E-04
	(1.90E-04)		(7.62E-05)		(1.68E-04)	(5.24E-05)
Skill indicator	-6.868		0.269		-1.669	-1.766

	(	2.490	)	**	(	1.558	)		(	1.373	)		(	0.649	)	***
GRDP per capita		-1.31E-04				1.09E-04				4.35E-05				3.83E-04		
	(	2.06E-04	)		(	6.48E-05	)	*	(	2.06E-04	)		(	6.05E-05	)	
Mincer coefficient		-30.900				5.530				10.816				-65.450		
	(	36.217	)		(	2.95E+00	)	*	(	15.234	)		(	16.294	)	***
GRDP per capita		1.51E-04				1.41E-04				9.67E-05				4.77E-04		
	(	2.11E-04	)		(	3.18E-05	)	***	(	3.01E-04	)		(	1.10E-04	)	***

Notes:

Dependent variables: university graduate woman: choice of hypogamy=1, others=0

Observation numbers of each country and region are follows: Japan: 77, Korea: 232, China: 39, Taiwan: 110

Other explanatory variables are 36–45 years old dummy and dummy of local areas or economic blocks.

The second-step parentheses indicate standard errors modified by clustering based local areas or economic blocks.

***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

The signs of the coefficients on GRDP per capita are positive in every country and region, except for a part of Japan, while having statistically positive significant effects especially in Korea and Taiwan. This suggests that the degree of marital sorting tends to decrease as living standards increase. However, for educational wage inequality indices, the signs of Skill indicator and Mincer coefficient are opposite only in Korea. Moreover, in Korea, multicollinearity between GRDP per capita and the explanatory variables exists. For Japan and Taiwan, the skill premiums on the labor market have positive significant effects on marital segregation by considering GRDP per capita an alternative hypothesis.

5.3 Gender gap

Table 4 shows the estimation results obtained by adding various gender gap indices as hypogamy determinants for university graduate women considering the educational wage inequality index for men. Here, we use the Skill indicator, which best fits the theoretical hypothesis with respect to the baseline estimation of the four male income inequality indices, as does the educational wage inequality index.

Table 4. Effects of various gender gap indices with Skill indicator

	Japan			**Korea**			**China**			**Taiwan**		
Skill indicator	-4.827			-1.622			-1.624			-0.937		
	(2.873)	*		(0.572)	***		(0.872)	*		(0.833)		
Wage gap	0.707			0.416			0.335			2.059		
	(0.601)			(0.471)			(0.514)			(1.418)		
Skill indicator	-4.501			-2.450			-1.633			-0.417		
	(3.618)			(0.389)	***		(0.798)	**		(0.687)		
	0.656			-0.536			0.211			4.543		

Male coefficient	(	0.864	)		(	1.142	)	*	(	0.983	)		(	2.311	)	***
Skill indicator		-6.243				-1.989				-1.558				-2.051		
	(	2.817	)	**	(	0.480	)	***	(	1.051	)		(	0.235	)	***
Labor market participation rate for married women		-1.128				0.817				-0.872				-3.104		
	(	2.257	)		(	1.035	)		(	2.364	)		(	6.648	)	
Skill indicator		-1.286				-1.547				-1.324				-1.827		
	(	3.720	)		(	0.810	)	*	(	1.137	)		(	0.205	)	***
Full-time worker rate for married women		3.083				1.221				-2.304				1.402		
	(	1.372	)	**	(	1.359	)		(	2.955	)		(	3.229	)	

Notes:

Dependent variables: university graduate woman: choice of hypogamy=1, others=0

Observation numbers of each country and region are follows: Japan: 77, Korea: 232, China: 39, Taiwan: 110

Other explanatory variables are 36–45 years old dummy and dummy of local areas or economic blocks.

The second-step parentheses indicate standard errors modified by clustering based local areas or economic blocks.

***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Among gender gap indices, the “Wage gap” between men and women is high in Japan and Korea as per the descriptive statistics, but relatively low in China and Taiwan. However, this does not have significant effect, although the coefficient is positive for all Japan, South Korea, Republic of China, and Taiwan. Therefore, considering only wage, there are no significant effects of the advancement of women on marital segregation.

Labor market penetration by women has a positive effect in promoting hypogamy for university graduate women because the labor force participation rate of married women, as an index of entry barriers to the labor market for women, has significant effects in no country or region. However, this index includes support employees, such as part-timers and family employees. Yet, when the full-time worker rate for married women increases, the probability of hypogamy for university graduate women tends to increase in Japan, Korea, and Taiwan. Specifically, the effect of the full-time worker rate for married women has a significant effect in Japan. In the examined East Asian countries and region, the probability of hypogamy for university graduate women decreases with a rising wage premium that, in turn, increases the extent of marital segregation. For the gender gap indices, the extent of marital segregation decreases with the probability of hypogamy for university graduate women when the full-time worker rate for married women increases in every country, except China, and one region. Further, GRDP as the index of degree of economic development and standard of living in each local area or economic block has a negative effect of the extent of marital segregation through decreasing the probability of hypogamy. In other words, economic development and standard of living affect the extent of marital segregation, while

wage inequality for men and the opportunity of the full-time work as the gender gap decreases in the labor market are also important factors for the extent of marital segregation.

5.4 Discussion

The results suggest that increase of wage premiums for university graduate men increases the extent of marital segregation by decreasing the tendency of hypogamy for university graduate women. As previously mentioned, increases in relative demand for skilled workers due to skill-biased technical change increases wage premiums for university graduates. Like extant studies on Europe and the United States, the technical changes in each country and Taiwan also increase the extent of marital segregation by increasing wage inequality, and thus, prompt educational or earning ability assortative mating in East Asia. However, the effect of the gender gap on a labor market for high educational background women varies by country or region. First, although wage inequality between university graduate men and women is highest in Japan, no significant results are obtained. Second, the results show that an increase in the full-time worker rate of married women decreases the extent of marital segregation.

In the case of Japanese university graduate women, it is thought that promotion of full-time work, as continuous employment which women are able to make use of the accumulated human capital, decreases the degree of the marital segregation and wage inequality among households. The results on gender gap in Japan might be common to Korea and Taiwan to some extent, but are not statistically significant; that is, the expansion of opportunities for full-time work for married women has a significant effect on marriage behavior, rather than the wage gap between men and women. In other words, encouraging labor force participation of women in consideration of quality, rather than quantity, of work is important in East Asia.

Interestingly, in China, all gender gap indices have no significant effects on marital sorting, probably because China encourages an advanced society for women through its national economic system. Additionally, since the gender wage gap for the high educational background group is small, the formation of a competitive labor market, similar to a capitalist society, might be developing (Ishizuka, 2010).

6. Conclusions

The expansion of income gap, increasing poverty, hierarchy sorting, and their persistency in each country and region, including Japan, is well understood. Therefore, numerous studies focus on the marriage behavior of men and women, and the function of transfer of earning abilities between generations thereof, from the perspectives of both economics and sociology.

First, this study theoretically examined the effects of male educational wage inequality and gender gap—such as gender wage gap and barriers for the labor force participation of married women—on marital segregation. Second, empirical examinations of the theoretical hypothesis are performed using data on Japan, South Korea, Republic of China, and Taiwan. All accomplish remarkable economic growth so as to be considered the “miracle of Asia,” but with widening income gaps between skilled and unskilled workers or among educational backgrounds. Consequently, the study confirmed that the wage premium of university graduate men has a positive significant effect on the extent of marital segregation, which is

consistent with extant studies on Europe and the United States. In regard to the effect of gender gap (e.g., wage or employment), the gender wage gap was found to have no significant effect, confirming that the full-time worker rate for married women tends to decrease the extent of marital segregation in Japan, Korea, and Taiwan.

Recently, scholars have noted that assortative mating causes inequality in the earning abilities of latter generations through the transfer of household wages between generations (Chadwick and Solon, 2002; Ermisch et al., 2006). Therefore, this study's analytical results—that inequality in the labor market affects marital segregation significantly—show that policies to decrease the inequality in parental generation can also decrease inequality in future generations. In other words, a policy to reduce income inequality between educational backgrounds in East Asia is necessary. However, because the educational wage inequality is a problem due to the labor demand side, the effectiveness of the labor market might decrease if direct policy interventions, such as the lower wage limits, are implemented for the labor demand side. Therefore, it becomes important to adopt policies for the labor supply side, such as enhancement of skill formation support for youth workers; that is, improving the quality of higher education, and increasing its ratio. Additionally, the environmental improvement of the labor market for married women would allow women to continue working full-time after child birth, thus decreasing the degree of marital segregation through marriage behavior. Specifically, it would be effective to promote or support mechanisms that enable work–family life balance in companies and society in general. In the part of East Asia on which this study focused, the younger generation faces increasing inequality, such as educational wage inequality in the labor market through the increase in the rate of non-regular workers. In conclusion, the challenge of examining the effects of marital segregation on younger generation remains, which requires analysis of more recent data.

Appendix 1. Local areas and economic blocks

Local areas and economic blocks are as follows:

Country/Area	Local area/ economic block	Prefecture/Metropolitan/City/County/Province
Japan	Hokkaido and Tohoku area	Hokkaido, Aomori, Iwate, Miyagi, Akita, Yamagata, Fukushima, and Nigata prefectures
	Kanto area	Tokyo metropolitan, Ibaragi, Tochigi, Gunma, Saitama, Chiba, Kanagawa, Yamanashi, and Nagano prefectures
	Chubu area	Toyama, Ishikawa, Fukui, Gifu, Shizuoka, Aichi, and Mie prefectures
	Kinki area	Shiga, Kyoto, Osaka, and Hyogo, Nara, and Wakayama prefectures
	Chugoku and Shikoku area	Tottori, Shimane, Okayama, Hiroshima, Yamaguchi, Tokushima, Kagawa, Ehime, and Kochi prefectures

	Kyushu and Okinawa area	Fukuoka pref., Saga pref., Nagasaki pref., Kumamoto pref., Oita pref., Miyazaki pref., Kagoshima pref., Okinawa pref.
Korea	Metropolitan area	Seoul metropolitan, Incheon et., Gyonggi province
	Chung-Cheong area	Daejeon metropolitan, Chungcheing province
	East-South area Daqing area	Busan, Ulsan, and Deagu metropolitan, Gyeongsang province, Jeju-do
	Hunan area	Gwangiu metropolitan, Jeolla province
	Gangwon-do area	Gangwon province
China	Jing wing economic block	Beijing, Tianjin, Heibei, Liaoling, Shandong and Hunnan provinces
	Sekichu–Tianshui Economic block	Shanxi, Inner Mongolia, Neimenggu, Leimonggu, Shaanxi province, Qinghai province, Ningxia Hui Autonomous Region
	Northeast Economic block	Heilongjiang
	Yangtze River Delta Economic block	Shanghai, Zhejiang and Anhui provinces
	Chengdu–Chongqing Economic block	Hubei province, Chongqing, Sichuan province, Xizang
	Central Economic block	Fujian, Jiangxi, and Guangdong provinces, Hainan
	North Economic block	Jinlin (Linan), Guangxi Zhuang Autonomous Region, Guizhou province, Yunnan province, Gansu province, Xinjiang Uygur Autonomous Region
Taiwan	North area	Keelung city, Taipei city, New Taipei city, Taoyuan county, Hsinchu city, Hsinchu county, Ilan county, Hualien county
	Central area	Taichung city, Miaoli, Taichung, Nantou, Changhua, and Yunlin counties
	South area	Chiayi, Tainan, and Kaohsiung cities, Chiayi, Tainan, Kaohsiung, Pingtung, and Taitung counties

Appendix 2. Wage premium indices for university graduate men

We explain the four wage premiums for university graduate men. Except "Log of raw wage," three indices are proposed according to Fernández et al. (2005). All four indices indicate increases when the wage rises. Additionally, this study uses each "Log of raw wage" for university graduate men and other lower educational background men, which Fernández et al. (2005) do not use. The reason this study uses each these indices is to examine the theoretical hypotheses derived from the model by separating the effect of increasingly skilled workers from the one of unskilled workers because we assume a shape of the utility function with weak concavity when deriving the effect of the increase in skilled workers.

(1) "Wage ratio" represents the ratio of each average annually income of university graduate men and other lower educational background men who are 26–35 and 36–45 years old in each local area or economic block.

(2) "Log of raw wage" represents each log of raw average annual wage of university graduate men and other lower educational background men who are 26–35 and 36–45 years old in each local area or economic block.

(3) "Skill indicator" represents the coefficient of university graduate men's dummy variable in the basic Mincer wage function, calculated by the following estimation model as a_1 using the 30–60 age group sample of each local area or economic block for men:
$log(e_i)$=$a_0 + a_1 I_i + a_2(age - s_i - 6) + a_3(age - s_i - 6)^2$.

(4) "Mincer coefficient" represents an expected earning rate per educational year in the basic Mincer wage function, calculated by the following estimation model as b_1 using the 30–60 age group sample of each local area or economic block for men:
$log(e_i) = b_0 + b_1 s_i + b_2(age - s_i - 6) + b_3(age - s_i - 6)^2$.

Appendix 3. Gender gap indices

We explain the four gender gap indices. "Wage gap" is made according to Fernández et al. (2005). Additionally, we calculate the "Male coefficient" as men's wage premium for all full-time workers. While Fernández et al. (2005) build the labor market participation rate for women regardless of marital status, this study uses the labor market participation rate and full-time workers rate for married women as more consistent variables with the theoretical model.

(1) "Wage Gap" represents an average annual income ratio of university graduate men and women who are 26–35 and 36–45 years old in each local area or economic block, for which higher vales indicate a wider gender gap.

(2) "Male coefficient" represents men's wage premium for full-time work in the basic Mincer wage function, calculated by the following estimation model as c_1 using the 30–60 age group sample of each local area or economic block for men:
$log(e_i)=c_0 + c_1 M_i + a_2(age - s_i - 6) + a_3(age - s_i - 6)^2$.

(3) Labor force participation rate is calculated as the ratio of those who participate on the labor market and all married women. When its value increases, the gender gap becomes a less important entry barrier to the labor market. It is an index to measure the degree of quantitative labor market entry barriers for women regardless of employment type.

(4) Full-time worker ratio is calculated as the ratio of full-time workers and all married women. When its value increases, the gender gap becomes a less important entry barrier on the labor market for full-time job. This index considers the quality of work in comparison with the labor participation rate for married women.

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