On the historical development of regional differences in women's participation in Japan[1]

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Abstract

This study investigates the sources of regional differences in women's participation in Japan. While it is known that the female participation rate is low in Japan, it is perhaps less known that it differs significantly across regions within the country. In particular, in the Northern Coastal region of Honshu Island, the female participation rate is much higher than elsewhere. The participation rate increased throughout the twentieth century. Historically, urban areas had low participation, whereas non-urban areas had high participation. The participation rate rose steadily and significantly in urban areas, and to a lesser extent in non-urban areas. As a result, there was a significant convergence in female participation from 1930 to 2010. The Northern Coastal region, which is a non-urban region, emerged as the region with the highest participation in the 1960s.

1 This paper uses microdata of the Employment Status Survey (ESS) made available by the Ministry of Internal Affairs and Communication of Japan under Article 33-2 of the Statistics Act. Microdata cannot be released due to the terms of usage of the data. Part of the analysis using Census data is based on the data provided by the Center for Spatial Science, University of Tokyo. The first author thanks Ann Carlos for her generous support, encouragement, and advice. We thank participants of the 7th Cliometrics World Congress and seminar participants at Hokkaido University for helpful comments. Remaining errors are our own. This research is supported by the Japan Society for Promotion for Science Grant-in-Aid for Scientific Research (Grant Number C-23530261).
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Introduction

Japan faces serious economic problems, including a declining working-age population, low fertility, and sluggish economic growth. Often-cited figures by Daly (2007) assert that GDP in Japan could be raised substantially if female labor force participation were increased. Steinberg and Nakane (2012) examine a similar issue by using cross-country data. These authors emphasize the three features of female participation in Japan: (1) an M-shaped participation profile, with participation rates declining in the age group 25–34; (2) low participation by highly educated women; and (3) a low fraction of women among managers.

An additional feature that has received little recognition so far is the regional dispersion of female participation rates. In particular, areas in the Northern Coastal region of Honshu Island (Yamagata, Niigata, Toyama, Ishikawa, Fukui, Tottori, and Shimane prefectures) have very high levels of participation: in 2007, the employment-to-population ratio (E-P ratio from now on) of women aged 25–54 residing in this region was 80 percent, much higher than in Tokyo, where it was 69.3 percent. In 1982, the E-P ratio was as high as 73.9 percent in the Northern Coastal region, close to 20 percentage points higher than in Tokyo.[2]

High participation in the Northern Coastal region is even more striking because it is not due to the prevalence of part-time work, or to lower fertility. Women in this region are much more likely to work full time, marry, and have higher fertility rates than are women in other parts of Japan. Observable economic factors, such as male income, industrial structure, co-residence with grand-parents, and supply of childcare, do not fully explain cross-sectional differences in female participation and the high participation of this region in particular (Abe

[2] If we consider that in 2010, the E-P ratio of females in the same age group was 82 percent in Sweden, 76.6 percent in France, 76.3 percent in Germany, 74.4 percent in the United Kingdom, and 69.3 percent in the United States (figures are from statistics published by OECD), the participation rate in the Northern Coastal region is comparable to, or higher than, the rate in the countries with high participation.

2013). The observed dispersion of participation rates is puzzling, given that tax and other social systems are not very different across Japanese regions, and that migration is common.

Regional variation in female participation has recently attracted some attention. Fogli and Veldkamp (2011), for instance, examine the spatial correlation in participation behavior in the United States and consider the role of information transmission among women; Black, Kolesnikova, and Taylor (2013) analyze the role of differential commuting costs across major U.S. cities; Acemoglu, Autor, and Lyle (2004) and Goldin and Olivetti (2013) examine changes in women's labor supply across U.S. states during the World War II era and thereafter. Olivetti and Petrongolo (2008) study the effect of different participation levels on the gender wage gap across European countries.

Although high participation in the Northern Coastal region has already been pointed out (Abe et al. 2008; Abe 2013), little is known about the recent historical evolution of these regional differences in women's participation in the labor market. In this paper, we use two datasets to trace this evolution over time: Census data that cover the period from 1930 to 2010, and data from the Employment Status Survey (ESS) from 1982 to 2007, which allow us to characterize participation patterns by education and marital status.

Historically, urban areas had low participation, and non-urban areas had high participation. In 1930, female E-P ratio was 19 percent in Tokyo, the prefecture with the lowest participation at that time; and 72 percent in the ten prefectures with highest participation. Since then, the participation rate rose steadily and significantly in urban areas and to a lesser extent in the high-participation region. In 2010, the E-P ratio in the prefecture with lowest participation (Nara) was 62.2 percent, whereas the average in the ten prefectures with highest participation was 76.8 percent. While regional disparities in participation declined over time, the relative rank of prefectures has remained remarkably stable in the following sense: the league of regions with lowest participation, which includes most of the large metropolitan areas, has not changed its members from 1930 to 2010.

Data from the ESS, which cover the period from 1982 to 2007, are shorter than Census data but have the advantage that we can assess the roles of marital status and education. From the ESS data we show that: (1) regional disparities in female participation are large only for married women; (2) the E-P ratio of married women with college education is lower than that of married women with less-than-college education; (3) the sector participation rates (the number of people working in agriculture, manufacturing, and other industries, each of them divided by the population) are positively correlated across regions for married women but are negatively correlated for single women; and (4) compositional change in education, marital status, and age group explains one-third of the convergence from 1982 to 2007.

We use a simple economic model to estimate the contribution of supply and demand factors in explaining the cross-sectional and time-series variations in the E-P ratio of married women. We find that supply and demand factors explain a small fraction of time-series changes in the E-P ratio, and that supply factors explain more of the cross-sectional variations.

1. Regional variations in women's participation between 1930 and 2010: An Overview

Women's participation has been slowly rising since the early 1930s in Japan. As illustrated in Figure 2, this smooth trend was interrupted in the 1970s, only to resume at a faster pace thereafter. The increase in the average participation rates has been accompanied by a significant decline in its regional dispersion, driven mainly by urban areas catching up with non-urban areas.

To better document convergence, we have divided the 47 prefectures of Japan into five groups: (1) Tokyo; (2) the metropolitan areas other than Tokyo; (3) the Northern Coastal region;

(4) non-urban areas that had a high participation rate in 1975 (10 prefectures); and (5) non-urban areas that had a low participation rate in 1975 (22 prefectures).[3] Figure 3 plots the E-P ratio of women and men aged 25–54 from 1930 to 2010. The female E-P ratio increased in all regions over this period, but most of all in Tokyo, which started from a very low rate in 1930. On the other hand, male participation remained at a similar level from 1930 to 2010, and regional dispersion of male participation has been very small throughout the period.

In spite of this convergence in female participation, the relative rank of prefectures in terms of female participation rates has remained surprisingly stable: urban regions at the lowest participation rates for the entire period. Table 1A lists the 47 prefectures in Japan according to their rank in the female E-P ratio for the age group 25–54, for selected years between 1930 and 2010. The actual E-P ratios for each prefecture and year are listed in Table 1B, in a way that corresponds to the prefecture-year combination in Table 1A. The bottom part of Tables 1A and 1B consists of prefectures in urban areas.

Except for the group at the bottom of Table 1A, the regional ranking in female participation has changed over time. Before WWII, the prefectures at the top of the list were different from the top prefectures during the last three decades. After the War, the seven prefectures belonging to the Northern Coastal region (red entries) gradually emerged as the area with the highest female participation rate. We classify prefectures according to their female participation rank in 1975 because, as shown in Table 1A, the relative position of the five regions has not changed much from 1975 to 2010.

Role of sectors

In this subsection, we show that convergence in female participation is the result of decline in

[3] The urban area includes Kanagawa, Saitama, Chiba, Aichi, Kyoto, Osaka, and Hyogo prefectures.

agriculture and manufacturing. For that purpose, we introduce industry participation measures as follows: (1) the fraction of agriculture sector workers in the population; (2) the fraction of manufacturing sector workers in the population; and (3) the fraction of other than the above two. These measures are calculated for the cell defined by gender and prefecture, taking the number of workers in each sector as the numerator and the population as the denominator. The sum of these three measures is the E-P ratio:

$$EPR = P_A + P_M + P_O \,. \tag{1}$$

The variance of the EPR is as follows:

$$\begin{aligned} Var(EPR) &= \{Var(P_A) + Var(P_M) + Var(P_O)\} \\ &+2\{Cov(P_M, P_A) + Cov(P_M, P_O) + Cov(P_A, P_O)\} \end{aligned} \,. \tag{2}$$

Among those aged 25–54, 26% of men and 29% of women worked in agriculture in 1955. In 1995, the same rate was 4% for both men and women. However, participation in this sector was already quite low in Tokyo, as early as in 1940. Agriculture declined in all regions outside of Tokyo, which decreased the regional dispersion in agricultural participation. This effect explains most of the convergence in female participation from 1955 to 1985. Since the 1990s, the role of agriculture on convergence has been small, but instead, the decline in manufacturing contributed to the fall in dispersion.

In Table 2, we show the standard deviations of the E-P ratio and sector participation rates, as well as the covariances of sector participation rates. The upper panel shows the standard deviations, and the lower panel shows the variances and covariances, in a way corresponding to Eq. (2). The agriculture and manufacturing participation rates have large regional dispersions. In the United States in the 1980s, manufacturing created regional disparities in labor demand (Bound and Holzer 2000). Looking at historical data in Japan, agriculture, in addition to manufacturing, was the sector that created large regional disparities in sector participation rates.

The significantly smaller regional dispersions in male participation than in female participation, shown in Figure 3, are the result of covariances. The variances of sector participation are, in fact, greater for men than for women. Were it not for covariances, the dispersion of men would be greater than that of women; the standard deviation of the male E-P ratio decreases to one-tenth, because of the negative covariances make the variance of the male E-P ratio much smaller than the sum of variances (Eq.(2)). The negative covariances for men are the direct consequences of the fact that, the male E-P ratio is close to 0.95 everywhere. For instance, manufacturing participation has a large regional dispersion. A region with a high manufacturing participation has to have a low participation in other sectors, making the covariance terms negative.

For men, the covariances between manufacturing and agriculture are negative; for women, they are small negative before 1975 and small positive thereafter. The likely reason for the positive covariances for women is that, new manufacturing establishments located in areas where agricultural participation used to be high; the Northern Coastal region from the 1960s to the 1970s is such an example.

Covariances between agriculture and two other sectors diminished over time. This is because the proportion of agriculture declined everywhere: since the agricultural participation has the lower-bound at zero, the overall decline in agriculture makes regional dispersion small. After the 1990s, manufacturing participation started to fall as well, making the regional dispersion of manufacturing smaller than in the 1980s. The patterns explained above are visually seen from Figure 4, in which sector participation in five regions are plotted for women and men for the period from 1955 to 2010. Regional dispersion in sector participation is large in agriculture and manufacturing, and is small in the other sector. For women, the regions that have high agricultural participation also have high manufacturing participation, and the Northern

Coastal region is the prominent example. For men, on the other hand, the regions that have high manufacturing participation have low participation in the other sector.

2. E-P ratio by marital status and education: 1982–2007

As shown in Figures 1 and 2, the female participation rates across regions converged significantly from 1930 to 2010. The Census data used in the previous section do not distinguish participation by marital status and education. We can use ESS micro data, which are only available from 1982 to 2007 to consider these characteristics.[4] Here, we distinguish female participation by marital status (married and single) and by education (less than college and college). Previous research has shown that female participation behavior differs significantly by education in Japan (see Abe 2011).

Figure 5 plots the E-P ratio of married and single women, for the two education groups, in five macro regions. Three notable patterns emerge. First, regional differences in the E-P ratio are much greater for married women than for single women. As a result, we conclude that the large regional disparities in participation rates documented by the Census data in Section 1 are driven mainly by married women's participation differences.

Second, the regional ranking of the E-P ratio is the same for the college educated and the less educated married women: the Northern Coastal region has the highest participation, Tokyo and the urban regions have the lowest participation, and the other two non-urban regions are in the middle. Therefore, although we observe the female E-P ratio in Tokyo is higher than the urban region and is almost the same as the non-urban-low region in 2010 (Figure 3), when we restrict attention to married women, Tokyo's rate is still lower than the rate in the

[4] The numerator of the E-P ratio includes all types of workers, including wage earners, as well as the self-employed and those who work in family businesses or family farms.

non-urban-low region. Clearly, the composition of education and marital status in the population is different across regions, and the overall level is affected by it.

Finally, the E-P ratio is lower for the highly educated than for the less educated, which means that college educated married women are less likely to work than less-educated married women. It has been pointed out that one of the problems of Japan's female participation is in the low participation among the highly educated. Figure 5 shows that there exist large regional differences in participation rates among college graduate married women.

Role of sectors by marital status and education

The convergence in the female E-P ratio took place because the sectors that had large regional disparities shrank over time. These include agriculture and manufacturing for the less educated.[5] As the share of employment in these sectors fell, the dispersion of female participation diminished, leading to the convergence in the E-P ratio. Employment in agriculture and manufacturing shrank for men as well, but the difference between men and women is in the sizes of covariance terms (Section 1).

ESS data allow us a separate examination by marital status. Table 3 provides the sector decomposition as in Table 2, separately for married and single women. Figure 6 plots the levels of sector participation in five regions by education, marital status, and age group. Four graphs in Figure 6 show that, for the sectors that have sizable differences across regions, the ranking of the five regions in sector participation rates is almost the same: the Northern Coastal region has the highest participation, followed by non-urban-high region, then by non-urban-low region, and the urban region and Tokyo have the lowest rate. This pattern visually indicates the positive

[5] For the highly educated, teachers are such occupation, but we do not report a separate analysis for this occupation in this paper.

covariances in sector participation by married women: the region that has higher-than-mean participation in one sector also has higher-than-mean participation in other sectors, irrespective of education and age groups.[6]

As shown in Table 3, the standard deviation is larger for married women than for single women: in 2007, it is 0.066 for the married and 0.025 for singles. In 2007, the standard deviations of sector participation are similar for the married and singles. In the 1980s, agriculture participation was somewhat high for older married women with less-than-college education, but it has declined since then (Figure 6), and accordingly, the dispersion of agricultural participation and the absolute values of covariances that involve agriculture declined over time (Table 3). Manufacturing participation is sizable for less-educated married women, but it has declined over time (Figure 6). College graduate married women work mostly in the other sector; their participation rates in agriculture and manufacturing are minimal in all regions.

Just as in the comparison of men and women, the major differences between married and single women are in the covariance terms: as shown in Table 3, they are *all* positive for married women but they are mostly negative for single women. This suggests that positive covariances for married women are due to local labor supply factors, such as childcare availability, which is more relevant for married women than for single women in Japan. If supply factors are more important than demand factors (sector composition in the region), then in regions where constraints for participation are eased, married women work in *any* sectors, leading to positive covariances between sectors: again, the Northern Coastal region has the

[6] The corresponding figure and table for men are provided as Figure A1 and Table A1 in the Appendix. For men's case, the regional ranking of sector participation rate is reversed in different sectors, most notably in manufacturing and other sectors. They are the source of negative covariances.

highest supply of childcare and highest participation in all three sectors.[7]

3. Accounting for compositional change

As shown in Figures 1 and 2, regional dispersion in female participation have compressed over time. When we examine participation behavior disaggregated by education, marital status, and age groups, regional variations have been stable after 1982. A part of convergence in regional variation, therefore, is a consequence of compositional change: an example of such a change is the decline in marriage rates. Figure 7 shows the marriage rates of women aged 25–54, in five regions, from 1955 to 2010 for all education groups, and from 1982 to 2007 for the two education groups (college and less than college). On the one hand, the marriage rates have been much lower in Tokyo than elsewhere throughout the entire period, and this pattern holds for both of the two education groups. The Northern Coastal region, on the other hand, has had the highest marriage rates for the entire period. Furthermore, the marriage rates rose from 1955 to 1980, started to decline in the 1980s, and the falling trend continued until 2010.

A decline in the marriage rate of the same degree results in convergence in the E-P ratio across regions. This is because the gap in the E-P ratio between married and single women is larger in urban areas than in non-urban areas (Figure 5). Let m_r represent the marriage rate in region r, and let EPR_{jr} represent the E-P ratio of the *j*-th marital status ($j = m, s$) in region r. Then, the overall E-P ratio in region r is:

$$EPR_r = m_r \cdot EPR_{mr} + (1 - m_r) \cdot EPR_{sr} . \tag{3}$$

Differentiating Eq. (3) by m_r gives

$$\frac{\partial EPR_r}{\partial m_r} = EPR_{mr} - EPR_{sr} . \tag{4}$$

The RHS of Eq. (4) is negative and its absolute value is greater in urban areas than in non-urban

[7] The childcare availability in the five regions from 1951 to 2010 is shown in Figure A2.

areas. The same decline in the marriage rate increases the overall E-P ratio more in urban than in non-urban areas. Since the overall E-P ratio is lower in urban than in non-urban areas, the decline in the marriage rate reduces regional disparities in the E-P ratio, even though the E-P ratios by marital status (EPR_{mr} and EPR_{sr}) remain constant. Therefore, a part of the convergence we observe in Figure 1 is attained by the composition effects, and we quantify its extent using the ESS data in 1982 and 2007.

We compare the standard deviations of actual labor force measures with those of counterfactual measures. As labor force measures, the E-P ratio and the three sector participation rates (agriculture, manufacturing, and other) are used. For each labor force measure, we derive the counterfactual measure, which is the participation rate keeping the composition constant at its distribution in 1982. Specifically, we use labor force measures for each cell (defined by the combination of age group, marital status, and education) in 2007 and weight them with the age-education-marital status share of women in 1982, as follows:

$$\widehat{LF_{cf}} = \sum_{e,a,m} p_{eam,1982} LF_{eam,2007} \text{ ,}$$

where LF stands for a labor force measure, p_j is the population share of group *j* defined by the combination of education, age group (young or old) and marital status (married or single), and *e, a, m* are the indices of education, age group, and marital status. In addition to the standard deviations of the E-P ratio, we calculate the standard deviations and the covariances of sector participation rates, in order to gauge the contribution of each sector.[8] The results are shown in Table 4.

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[8] Another important dimension of decomposing the E-P ratio is by employment type: regular full-time employment, non-regular employment, and other employment (including self-employment and workers in family businesses). The effect of compositional change is most prominent in regular, full-time employment: for this, the participation rate would not have changes if the education-marital status-age composition remained at the 1982 distribution.

The E-P ratio compressed both because of the compositional change and of the changes in participation behavior. The dispersion in the E-P ratio fell from 0.081 in 1982 to 0.045 in 2007. According to the counterfactual measure, among the decline of 0.036, one-third (0.057-0.045 = 0.012) is due to compositional change in education, marital status, and age group. In other words, one-third of the compression in the E-P ratio from 1982 to 2007 is due to compositional change, and the remainder is due to changes in participation behavior.

The standard deviation of agricultural participation fell from 0.046 to 0.010. For this sector, the decline in dispersion is largely due to participation rate and the role of compositional change is minimal. For manufacturing, the standard deviation fell from 0.059 to 0.035, and a small fraction of that decline is due to compositional change. The dispersion in participation in other sector did not change much, except for a small change due to compositional effect (from 0.034 to 0.031). The largest component of the compositional effect comes from the covariance between manufacturing and other sectors. Had the composition remained at the 1982 level, this covariance would have been zero, but the actual 2007 covariance was negative. This is perhaps because this covariance is positive for married women, but is negative and is large in absolute value for single women. The fall in marriage rates increased the weight for single women, for whom the covariance is negative, making the actual covariance negative even though the composition-constant covariance is zero.

In summary, the compositional change in education, marital status, and age account for one-third of the convergence in the E-P ratio from 1982 to 2007. When we decompose the E-P ratio into sectors, the decline in dispersion comes mainly from decline in agriculture and manufacturing, the two sectors with large regional dispersions.

4. The contribution of supply and demand factors to prefectural differences in

the employment population ratio of married women

In this section, we investigate whether and to what extent regional supply and demand factors account for the observed regional differences in participation by married women. We start by positing that local labor markets are competitive and that, in each market, the supply and demand of each type of labor are balanced by changes in wages. There are four types of labor: young and less educated (YL), young and better educated (YH), old and less educated (OL) and old and better educated (OH). For each group, let labor supply and demand be $E_{gr}{}^{D}$ and $E_{gr}{}^{S}$ respectively, where *g* is for the group and *r* is for the prefecture. Denote also w_{gr} as the real wage and D_{gr} and S_{gr} as vectors of supply and demand shifters. Assuming that both supply and demand are linear functions, and dropping the group subscript for simplicity, we write[9]

$$E_{rt}{}^{D} = a_0 - a_1 w_{rt} + a_2 D_{rt} \tag{5}$$

for the demand, where *t* is for time, and

$$E_{rt}{}^{S} = b_0 + b_1 w_{rt} + b_2 S_{rt} \tag{6}$$

for supply. In equilibrium, demand equals supply and equilibrium employment is a function of supply and demand shifts:

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9 This specification can be obtained if firms maximize profits for given prices under the following CES technology: $Y = \left[E_{YL}{}^{\theta} + E_{YH}{}^{\theta} + E_{OL}{}^{\theta} + E_{OH}{}^{\theta} \right]^{\frac{1}{\theta}}$.

$$E_{rt} = k_0 + \frac{a_2 b_1}{a_1 + b_1} D_{rt} + \frac{a_1 b_2}{a_1 + b_1} S_{rt} \tag{7}$$

It is useful to decompose supply and demand shifts into the following components: $D_{rt} - D_r$, D_r, $S_{rt} - S_r$ and S_r, where D_r and S_r are time invariant supply and demand factors. Then (7) can be re-written as

$$E_{rt} = k_0 + [\frac{a_2 b_1}{a_1 + b_1} D_r + \frac{a_1 b_2}{a_1 + b_1} S_r] + \frac{a_2 b_1}{a_1 + b_1}(D_{rt} - D_r) + \frac{a_1 b_2}{a_1 + b_1}(S_{rt} - S_r) \tag{8}$$

The empirical counter-part of Eq. (8) is

$$E_{rt} = \gamma_0 + \gamma_1(D_{rt} - D_r) + \gamma_2(S_{rt} - S_r) + \lambda_r + \varepsilon_{rt}, \tag{9}$$

where λ_r is a vector of time invariant local labor effects and ε is the error term. Conditional on controls for time invariant local effects, parameters γ_1 and γ_2 are identified by the within-prefectural variations of supply and demand factors over time.

Our data cover 47 prefectures for the period from 1982 to 2007, and are available for every five years. Therefore, we have six data points for each prefecture. In an effort to attenuate reverse causality problems, we use 5-year lags of our indicators of supply and demand shifts. We include in the vector of supply shifts *S* the following indicators: childcare availability (computed as enrolment in childcare facilities divided by the number of women aged 15–34 who reside in the region),[10] the share of households where three generations cohabit, and average log real husband's income. We include in vector *D* a linear trend and an index of demand shifts,

[10] A similar measure is used by Unayama (2012).

which we compute by gender, education, and marital status. The higher the index for group *g*, the higher the relative demand in favor of that group. Following Katz and Murphy (1992), Blau et al. (2000; 2004), and Abe (2013), the demand shift indicator DS is computed as

$$DS_{gr} = \log \sum_{j} s_{gj} \frac{EMP_{jr}}{EMP_{r}} \quad , \tag{10}$$

where s_{gj} is the nationwide share of employment of group *g* in sector *j*, EMP_r is the total employment in prefecture *r*, and EMP_{jr} is the sector-*j* employment in prefecture *r*. Thus, DS_{gr} measures the strength of labor demand for group *g* predicted from the sector composition in the region. A change in the sector composition in a prefecture generates a demand shift toward group *g*, if EMP_{jr} of a sector that has high s_{gj} increases.

In the spirit of Card and Krueger (1992), our estimation strategy proceeds in two steps: in the first step we focus on variations within prefectures and, using the panel structure of the data, we estimate Eq. (9) by feasible generalized least squares (FGLS), allowing both for a prefecture-specific fixed effects and for (common) first order serial correlation in the error term. Since our data are grouped, we use as weights the number of individuals in each group. In the second step, we focus instead on the variation between prefectures: we retrieve the estimated coefficients of the prefectural fixed effects and their standard errors, and run a second step regression of prefecture effects on a set of covariates. The covariates included are demand (the demand index), supply (childcare, the share of three generations households, and the log of earnings of the husband) and other factors. The second-stage regressions are weighted by the reciprocal of the estimated variances in the first step. As other factors, we consider measures of local climate (average temperature), ruggedness (share of mountainous terrain) and population density, measured as total active population over the land area in squared kilometres.

This two-step approach has been selected because the between-prefecture variation in the E-P ratio is greater than the within-prefecture variation for married women (Figure 4). Table 5 shows the summary statistics of the variables used in the regressions, Tables 6 presents the first step estimates for each of the four groups, and Tables 7 and 8 show our second-step estimates, separately for married women with less-than-college education and those with college education.

Starting from the first step estimates, we report in Table 6 both the estimated coefficients associated to supply and demand variables and two indicators of goodness of fit, RV1 and RV2. The former measure is the ratio of the variance of predicted E-P ratio when the only covariates allowed are prefectural fixed effects to the variance of the actual E-P ratio. The latter measure is the ratio of the variances of predicted and actual E-P ratio when predicted E-P ratio is obtained from a regression that includes both fixed effects and supply and demand factors. These measures suggest two things: first, the between-prefecture variance is dominant, especially in the case of young less educated women, for whom RV1 reaches 0.96; second, the contribution of supply and demand factors is higher for the highly educated.

Next consider the second stage, reported in Tables 7 and 8. The former table refers to the less educated and the latter table to the highly educated. Each table is organized in six columns, three for the young (ages 25–39) and three for the old (ages 40–54). For each group of columns, the first refers to the least parsimonious specification, which includes the 1982 values of supply and demand factors as well as local density, average temperature and ruggedness, the second to a specification that excludes the supply variables, and the third to the most parsimonious specification, which excludes both supply and demand variables. In a contrast with the first step, the tables suggest that the inclusion of prefecture-specific supply and demand factors contribute to improve the goodness of fit substantially. To illustrate, in the case of the less educated, goodness of fit – measured by the R^2 – is 0.912 for the young and 0.812 for the old in the least parsimonious, and 0.324 and 0.381 for the young and old in the most parsimonious specification. A comparison of the R^2 across columns also points out that the contribution of demand factors to explain the cross-sectional variation is relatively small compared to the contribution of supply factors. As expected, childcare and the share of three generation households attract positive and statistically significant coefficients. Furthermore, the demand index has a positive and statistically significant effect for less-educated married women but not for highly educated married women. This is consistent with the fact that, industries in which college graduate married women work do not differ across regions; they work in the other sector, outside of agriculture or manufacturing, in all regions. This implies their participation decision do not depend on local industry structure, which is the main component of the demand index.

Overall, these results suggest two things: first, within-prefectural variations of the E-P ratio from 1987 to 2007 have been relatively small compared with between-prefectural variations. Second, supply factors have contributed the most to the cross-prefectural variation in the E-P ratio of married women in Japan.[11]

5. Conclusions

In this paper, we use data from the Japanese Census and the Employment Status Survey to describe regional differences in labor market participation by prime-aged women. Regional disparities in the E-P ratio were much larger in 1930 than in 2010. During the 80 years, a

11 The second stage results explain a high proportion of variations in the permanent regional dispersion. However, it is important to note that, although the R^2 from the regressions are high, the residuals of the second stage have systematic regional patterns. Most notably, the residuals from the Northern Coastal prefectures are large positive, compared with other areas, even after controlling for supply and demand factors.

significant convergence in female participation rates took place; the male participation rates remained at the similar level and their dispersion changed little during the same period. When we divide the overall E-P ratio into the three sectors (agriculture, manufacturing, and other) and define sector participation as the number of people working in each sector divided by the population, we find that sector participation rates are negatively correlated across regions for men but are positively correlated for women; these covariances in sector participation are the source of gender differences in regional dispersion in the E-P ratio. From 1955 to 1985, the decline in agricultural employment contributed to the convergence in female participation, whereas from the 1990s to 2010, the decline in manufacturing contributed to it.

The Northern Coastal region, the seven prefectures that have had uniquely high levels of female participation from the 1980s to 2010, emerged to that position from the 1960s. In the urban areas, the female participation rate was much lower than in other areas in 1930, but it has increased continuously thereafter.

Our data show important differences in regional dispersion in participation by marital status: large regional disparities exist for married women but not for single women. The falling marriage rates results in the convergence of the E-P ratio, because the gap in the E-P ratio between married and single women is larger in urban areas than in non-urban areas, and the overall E-P ratio is higher in non-urban areas. We find that, one-third of the convergence observed from 1982 to 2007 is due to compositional change in education, marital status, and age groups.

Using a simple supply and demand framework, we show that regional differences in supply factors have been responsible for the large regional disparities in the E-P ratios of married women. Most notable among these factors are the availability of childcare facilities and the prevalence of three-generation households, which have been consistently higher in the

Northern Coastal region and lower in the metropolitan areas. The relative scarcity of these factors has hampered participation in regular employment by married women.

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Table 1A: Ranking in women's EPR, Japan (Census data)

rank	1930	1940	1955	1965	1975	1985	1995	2000	2010
1	Ibaraki	Kagoshima	Kagoshima	Fukui	Fukui	Yamagata	Yamagata	Yamagata	Shimane
2	Kagoshima	Ibaraki	Fukui	Tottori	Tottori	Fukui	Fukui	Fukui	Yamagata
3	Chiba	Shimane	**Nagano**	Shimane	Yamagata	Tottori	Shimane	Shimane	Toyama
4	Tottori	**Nagano**	Shimane	Yamagata	Shimane	Shimane	Toyama	Toyama	Fukui
5	Tokushima	Tottori	Ibaraki	**Nagano**	Niigata	Toyama	Tottori	Tottori	Tottori
6	**Nagano**	Iwate	Tottori	Niigata	**Nagano**	**Nagano**	Niigata	Niigata	Ishikawa
7	Shimane	Oita	Iwate	Ishikawa	Toyama	Niigata	Ishikawa	Ishikawa	Niigata
8	Fukui	Tokushima	Ishikawa	Kagoshima	Iwate	Ishikawa	**Nagano**	Akita	Kochi
9	Fukushima	Miyazaki	Kagawa	Toyama	Ishikawa	Fukushima	Iwate	Iwate	Akita
10	Okinawa	Kagawa	Niigata	Kagawa	Fukushima	Iwate	Kochi	**Nagano**	Saga
11	Oita	Fukui	Shiga	Okayama	Akita	Akita	Akita	Kochi	Miyazaki
12	Shiga	Fukushima	Oita	Ibaraki	Saga	Saga	Saga	Miyazaki	Iwate
13	Yamanashi	Shiga	Yamagata	Fukushima	Kochi	Kochi	Fukushima	Fukushima	Kumamoto
14	Kagawa	Kumamoto	Kochi	Iwate	Tokushima	Miyazaki	Miyazaki	Saga	**Nagano**
15	Iwate	Chiba	Okayama	Shiga	Miyazaki	Kumamoto	Kumamoto	Kumamoto	Fukushima
16	Kumamoto	Niigata	Toyama	Kochi	Kumamoto	Gifu	Shizuoka	Shizuoka	Yamanashi
17	Yamagata	Tochigi	Aomori	Akita	Gifu	Shizuoka	Kagawa	Gifu	Gifu
18	Kochi	Okayama	Miyazaki	Tokushima	Kagawa	Tokushima	Tokushima	Aomori	Kagawa
19	Miyazaki	Yamanashi	Tokushima	Tochigi	Okayama	Tochigi	Gifu	Kagawa	Nagasaki
20	Saga	Kochi	Tochigi	Oita	Aomori	Yamanashi	Aomori	Yamanashi	Mie
21	Tochigi	Aomori	Akita	Miyazaki	Tochigi	Kagawa	Yamanashi	Tokushima	Tokushima
22	Okayama	Gifu	Fukushima	Saga	Yamanashi	Okayama	Okayama	Okayama	Aomori
23	Aomori	Yamagata	Chiba	Gifu	Kagoshima	Mie	Mie	Tochigi	Shizuoka
24	Saitama	Ishikawa	Yamanashi	Gumma	Gumma	Gumma	Tochigi	Oita	Gumma
25	Niigata	Saitama	Gifu	Yamanashi	Ibaraki	Aomori	Yamaguchi	Mie	Kagoshima
26	Toyama	Saga	Gumma	Aomori	Shiga	Miyagi	Nagasaki	Kagoshima	Oita
27	Mie	Gumma	Kumamoto	Kumamoto	Oita	Ehime	Oita	Nagasaki	Yamaguchi
28	Ishikawa	Mie	Mie	Hiroshima	Shizuoka	Ibaraki	Gumma	Gumma	Hiroshima
29	Gifu	Akita	Saga	Miyagi	Miyagi	Hiroshima	Miyagi	Yamaguchi	Okayama
30	Yamaguchi	Toyama	Hiroshima	Mie	Mie	Yamaguchi	Kagoshima	Miyagi	Tochigi
31	Miyagi	Miyagi	Ehime	Ehime	Yamaguchi	**Aichi**	Hiroshima	Hiroshima	Ehime
32	Hiroshima	Ehime	Miyagi	Yamaguchi	Ehime	Shiga	Ehime	Ehime	Tokyo
33	Ehime	Shizuoka	Yamaguchi	Shizuoka	Hiroshima	Oita	Shiga	Shiga	Shiga
34	Nagasaki	Hiroshima	Saitama	Chiba	**Aichi**	Kagoshima	**Aichi**	Ibaraki	Miyagi
35	Shizuoka	Nagasaki	Shizuoka	Nagasaki	Nagasaki	Nagasaki	Ibaraki	**Aichi**	Kyoto
36	Akita	Yamaguchi	Nagasaki	**Aichi**	Kyoto	Tokyo	Tokyo	Fukuoka	Ibaraki
37	Gumma	**Aichi**	**Aichi**	Kyoto	Wakayama	Kyoto	Fukuoka	Tokyo	Fukuoka
38	**Aichi**	Wakayama	Wakayama	Wakayama	Fukuoka	Wakayama	Kyoto	Hokkaido	**Aichi**
39	Hokkaido	Hokkaido	Nara	Saitama	Tokyo	Fukuoka	Hokkaido	Kyoto	Okinawa
40	Fukuoka	Nara	Hokkaido	Nara	Hokkaido	Saitama	Wakayama	Okinawa	Wakayama
41	Hyogo	Fukuoka	Kyoto	Fukuoka	Okinawa	Okinawa	Okinawa	Wakayama	Hokkaido
42	Wakayama	Kyoto	Hyogo	Hyogo	Chiba	Chiba	Chiba	Chiba	Saitama
43	Kyoto	Hyogo	Fukuoka	Hokkaido	Hyogo	Hokkaido	Saitama	Saitama	Chiba
44	Nara	Kanagawa	Osaka	Tokyo	Saitama	Hyogo	Kanagawa	Hyogo	Hyogo
45	Kanagawa	Tokyo	Kanagawa	Osaka	Osaka	Osaka	Hyogo	Kanagawa	Kanagawa
46	Osaka	Osaka	Tokyo	Kanagawa	Nara	Kanagawa	Osaka	Osaka	Osaka
47	Tokyo				Kanagawa	Nara	Nara	Nara	Nara

Note: Green prefectures are the low-participation prefectures, blue prefectures are suburban prefectures and Okinawa, and red entries are prefectures included in the Northern Coastal region.

Table 1B: EPR levels of women, Japan (Census data)

rank	1930	1940	1955	1965	1975	1985	1995	2000	2010
1	0.785	0.754	0.737	0.740	0.714	0.754	0.777	0.776	0.798
2	0.756	0.742	0.697	0.731	0.712	0.745	0.762	0.759	0.787
3	0.729	0.727	**0.694**	0.720	0.705	0.724	0.757	0.756	0.786
4	0.717	**0.726**	0.687	0.710	0.703	0.724	0.755	0.754	0.786
5	0.698	0.714	0.684	**0.707**	0.688	0.723	0.749	0.749	0.777
6	**0.695**	0.700	0.674	0.701	**0.671**	**0.712**	0.743	0.740	0.776
7	0.681	0.699	0.670	0.695	0.664	0.711	0.736	0.737	0.774
8	0.681	0.695	0.659	0.686	0.663	0.709	**0.719**	0.725	0.765
9	0.681	0.691	0.658	0.685	0.659	0.689	0.716	0.722	0.756
10	0.672	0.684	0.655	0.681	0.658	0.686	0.710	**0.720**	0.744
11	0.670	0.683	0.652	0.680	0.642	0.667	0.710	0.716	0.743
12	0.663	0.681	0.648	0.675	0.638	0.664	0.710	0.708	0.742
13	0.656	0.677	0.644	0.673	0.631	0.658	0.706	0.708	0.742
14	0.640	0.675	0.644	0.672	0.620	0.650	0.701	0.708	**0.738**
15	0.640	0.673	0.641	0.672	0.618	0.644	0.694	0.707	0.724
16	0.629	0.669	0.640	0.657	0.613	0.643	0.677	0.684	0.721
17	0.624	0.666	0.638	0.656	0.602	0.640	0.668	0.677	0.718
18	0.623	0.665	0.636	0.652	0.598	0.636	0.663	0.675	0.717
19	0.609	0.656	0.635	0.651	0.598	0.635	0.661	0.673	0.715
20	0.605	0.655	0.632	0.649	0.595	0.630	0.658	0.673	0.714
21	0.602	0.655	0.622	0.646	0.595	0.629	0.655	0.667	0.714
22	0.600	0.652	0.620	0.644	0.593	0.618	0.655	0.665	0.713
23	0.599	0.650	0.613	0.634	0.588	0.616	0.653	0.665	0.712
24	0.577	0.639	0.595	0.632	0.580	0.615	0.652	0.663	0.710
25	0.576	0.638	0.593	0.632	0.574	0.603	0.648	0.663	0.710
26	0.576	0.631	0.593	0.629	0.572	0.597	0.648	0.663	0.708
27	0.568	0.622	0.583	0.624	0.568	0.593	0.647	0.661	0.701
28	0.568	0.618	0.578	0.594	0.565	0.589	0.646	0.660	0.700
29	0.566	0.606	0.574	0.593	0.551	0.588	0.643	0.659	0.700
30	0.558	0.605	0.568	0.590	0.551	0.585	0.638	0.653	0.697
31	0.542	0.581	0.563	0.588	0.546	**0.585**	0.637	0.649	0.690
32	0.534	0.575	0.557	0.567	0.542	0.583	0.629	0.638	0.688
33	0.522	0.567	0.541	0.562	0.534	0.583	0.621	0.636	0.688
34	0.516	0.545	0.533	0.548	**0.510**	0.579	**0.617**	0.633	0.685
35	0.515	0.537	0.515	0.534	0.509	0.564	0.614	**0.631**	0.683
36	0.514	0.537	0.504	**0.527**	0.502	0.554	0.608	0.626	0.682
37	0.501	**0.487**	**0.499**	0.524	0.484	0.552	0.607	0.622	0.680
38	**0.458**	0.471	0.491	0.519	0.480	0.544	0.599	0.612	**0.678**
39	0.440	0.464	0.452	0.493	0.461	0.531	0.592	0.611	0.677
40	0.425	0.427	0.433	0.486	0.454	0.525	0.586	0.610	0.675
41	0.400	0.415	0.432	0.470	0.445	0.524	0.581	0.602	0.670
42	0.386	0.401	0.426	0.453	0.439	0.518	0.575	0.595	0.661
43	0.367	0.386	0.416	0.446	0.425	0.512	0.569	0.591	0.660
44	0.338	0.280	0.311	0.410	0.424	0.500	0.550	0.575	0.651
45	0.251	0.234	0.306	0.394	0.400	0.498	0.548	0.570	0.643
46	0.218	0.222	0.299	0.360	0.394	0.487	0.543	0.556	0.643
47	0.192				0.376	0.449	0.504	0.532	0.622

Note: The figures are the E-P ratios of prefecture-year combinations that appear in Table 1A. The green figures are low-participation prefectures; red figures with shade are Northern Coastal prefectures. The painted cells (around 34th) correspond to the national average of the E-P ratio.

Table 2
Dispersion in the E-P ratio and sector participation rates, 1955-2010

		EPR-level	Standard deviations				Covariances		
	year		EPR	Agriculture	Manufacturing	Other	manuf_agri	manuf_other	agri_other
Women	1955	0.520	0.134	0.156	0.025	0.022	-0.00154	0.00008	-0.00230
	1965	0.544	0.113	0.135	0.038	0.029	-0.00187	-0.00002	-0.00189
	1975	0.515	0.094	0.077	0.043	0.034	0.00037	-0.00015	-0.00026
	1985	0.574	0.071	0.038	0.053	0.033	0.00044	-0.00051	-0.00012
	1995	0.619	0.060	0.017	0.045	0.035	0.00023	-0.00024	0.00010
	2010	0.688	0.037	0.009	0.030	0.030	0.00005	-0.00034	0.00003
Men	1955	0.949	0.013	0.135	0.084	0.068	-0.00963	0.00218	-0.00737
	1965	0.968	0.010	0.107	0.095	0.058	-0.00832	-0.00047	-0.00306
	1975	0.964	0.011	0.061	0.081	0.052	-0.00350	-0.00262	-0.00034
	1985	0.955	0.015	0.034	0.074	0.051	-0.00151	-0.00322	0.00019
	1995	0.949	0.013	0.017	0.065	0.052	-0.00048	-0.00326	0.00017
	2010	0.907	0.015	0.012	0.069	0.062	-0.00014	-0.00400	-0.00009

Source: Authors' calculation from Census (1955-2010)

Table 3
Dispersion in the E-P ratio and sector participation rates of married women, 1982-2007

Married women

	Standard Deviation				Covariances		
year	EPR	Agriculture	Manufacturing	Other	manuf_agri	manuf_other	agri_other
1982	0.097	0.050	0.063	0.033	0.00043	0.00012	0.00043
1987	0.087	0.035	0.062	0.029	0.00042	0.00023	0.00020
1992	0.082	0.026	0.059	0.033	0.00038	0.00016	0.00023
1997	0.080	0.018	0.048	0.040	0.00018	0.00057	0.00030
2002	0.071	0.014	0.040	0.039	0.00020	0.00041	0.00026
2007	0.066	0.013	0.037	0.036	0.00014	0.00044	0.00019

Single women

	Standard Deviation				Covariances		
year	EPR	Agriculture	Manufacturing	Other	manuf_agri	manuf_other	agri_other
1982	0.029	0.020	0.048	0.053	0.00003	-0.00190	-0.00046
1987	0.037	0.013	0.043	0.042	-0.00006	-0.00101	-0.00013
1992	0.024	0.007	0.041	0.036	-0.00001	-0.00120	-0.00003
1997	0.023	0.005	0.036	0.034	0.00000	-0.00094	-0.00003
2002	0.021	0.005	0.032	0.033	-0.00001	-0.00085	-0.00001
2007	0.025	0.004	0.038	0.034	0.00001	-0.00100	-0.00004

Source: Authors' calculation from the Employment Status Survey (1982-2007)

Table 4

A. Standard deviations of labor force measures and counterfactual measures

Labor force measure	1982, actual SD	2007, actual SD	SD, 2007 participation$_r$ with 1982 composition
E-P ratio (EPR)	0.081	0.045	0.057
Agriculture	0.046	0.010	0.011
Manufacturing	0.059	0.035	0.038
Other	0.035	0.031	0.034

B. Variance-covariance decomposition

Labor force measure and the dispersion measures	1982, actual	2007, actual	2007 participation$_r$ with 1982 composition
var(EPR)	0.0066	0.0020	0.0033
var(Agri)	0.0021	0.0001	0.0001
var(Manuf)	0.0035	0.0012	0.0014
var(Other)	0.0012	0.0009	0.0012
cov (Manuf, Agri)	0.0004	0.0001	0.0001
cov (Manuf, Other)	-0.0006	-0.0003	0.0000
cov (Agri, Other)	0.0001	0.0000	0.0001

Note: The red entries indicate the parts for which participation changes are large. The shaded entries are the ones for which compositional effects are large.

Table 5
Summary Statistics

A. First stage regression samples

Education	LT college				College			
Age group	25-39		40-54		25-39		40-54	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
E-P ratio	0.538	0.096	0.715	0.075	0.541	0.091	0.679	0.098
Childcare (lagged, dev. from prefecture mean)	0.000	0.013	0.000	0.013	0.000	0.013	-0.002	0.013
three-generation hh (lagged, dev. from prefecture mean)	0.009	0.053	0.000	0.012	-0.002	0.056	-0.007	0.047
Demand index (lagged , dev. From prefecture mean)	0.006	0.057	-0.001	0.053	0.048	0.571	0.223	0.446
log husband's income (lagged, dev. from prefecture mean)	-0.022	0.166	-0.003	0.209	0.007	0.136	0.030	0.118

B. Second stage regression samples

Education	LT college				College			
Age group	25-39		40-54		25-39		40-54	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Prefecture fixed effects (dependent var.)	0.466	0.088	0.714	0.068	0.597	0.081	0.683	0.068
Childcare	0.133	0.056	0.130	0.051	0.129	0.052	0.132	0.051
three-generation hh	0.288	0.104	0.244	0.068	0.210	0.114	0.237	0.141
Demand index	-1.387	0.034	-1.388	0.036	-5.454	0.054	-5.454	0.060
log husband's income	6.221	0.163	6.045	0.196	6.503	0.131	6.774	0.178
Density	0.340	0.618	0.321	0.608	0.335	0.620	0.292	0.549
Climate	16.557	2.380	16.295	2.784	16.562	2.234	16.128	2.653
Ruggedness	0.623	0.197	0.612	0.194	0.616	0.173	0.622	0.174

Source: Authors' calculation from the ESS, 1982-2007.

Table 6
First-stage regression results (1982-2007)

	(1)	(2)	(3)	(4)
Education	LT college	LT college	College	College
Age	25-39	40-54	25-39	40-54
Childcare	0.450***	0.264***	0.187	0.361**
	(0.0770)	(0.0824)	(0.154)	(0.141)
Three-generation households	0.298***	-0.366***	0.0916*	0.0798*
	(0.0370)	(0.103)	(0.0510)	(0.0414)
Demand index	-0.00640	-0.203***	0.0650***	0.0305***
	(0.0355)	(0.0297)	(0.00896)	(0.0105)
Log husband's income	-0.140***	-0.0320***	-0.0899***	-0.0405*
	(0.0108)	(0.00923)	(0.0210)	(0.0219)
trend	0.00591***	0.000515	-0.00180**	0.00232***
	(0.000471)	(0.000321)	(0.000836)	(0.000773)
Constant	0.352***	0.617***	0.502***	0.540***
	(0.00953)	(0.0126)	(0.0174)	(0.0201)
Observations	235	235	235	235
Number of prefectures	47	47	47	47
Goodness of fit				
RV1	0.957	0.908	0.697	0.623
RV2	0.968	0.923	0.734	0.708

Note: Standard errors in parentheses.

* Statistically significant at the 10% level; ** at the 5% level (two-tailed tests);
***at the 1% level (two-tailed tests)

Source: Authors' calculation from the ESS, 1982-2007.

Table 7
Second-stage regression results (Married women with less-than-college education)

	(1)	(2)	(3)	(4)	(5)	(6)
Education	LT college	LT college	LT college	LT college	LT college	LT college
Age	25-39	25-39	25-39	40-54	40-54	40-54
log husband's income	-0.254***			-0.0905		
	(0.0495)			(0.0625)		
Childcare	0.559***			0.492***		
	(0.0958)			(0.113)		
Three-generation hh	0.482***			0.350***		
	(0.0668)			(0.108)		
Demand	0.377**	0.192		0.682**	0.720***	
	(0.164)	(0.373)		(0.290)	(0.214)	
Density	0.00597	-0.0469***	-0.0429***	-0.00764	-0.0389***	-0.0216***
	(0.00710)	(0.0162)	(0.0139)	(0.00603)	(0.00841)	(0.00698)
Climate	-0.00470**	-0.0104*	-0.0106*	-0.00703*	-0.00697*	-0.00616
	(0.00226)	(0.00601)	(0.00594)	(0.00375)	(0.00347)	(0.00465)
Ruggedness	-0.0700**	0.0995	0.103	0.0221	0.114***	0.149***
	(0.0313)	(0.0618)	(0.0619)	(0.0444)	(0.0335)	(0.0461)
Constant	2.472***	0.859*	0.592***	2.163**	1.770***	0.731***
	(0.509)	(0.499)	(0.123)	(0.835)	(0.260)	(0.0978)
Observations	47	47	47	47	47	47
R-squared	0.912	0.329	0.324	0.812	0.498	0.381

Note: Robust standard errors are in parentheses.

* Statistically significant at the 10% level; ** at the 5% level (two-tailed tests);
***at the 1% level (two-tailed tests)

Source: Authors' calculation from the ESS, 1982-2007.

Table 8
Second-stage regression results (Married women with college education)

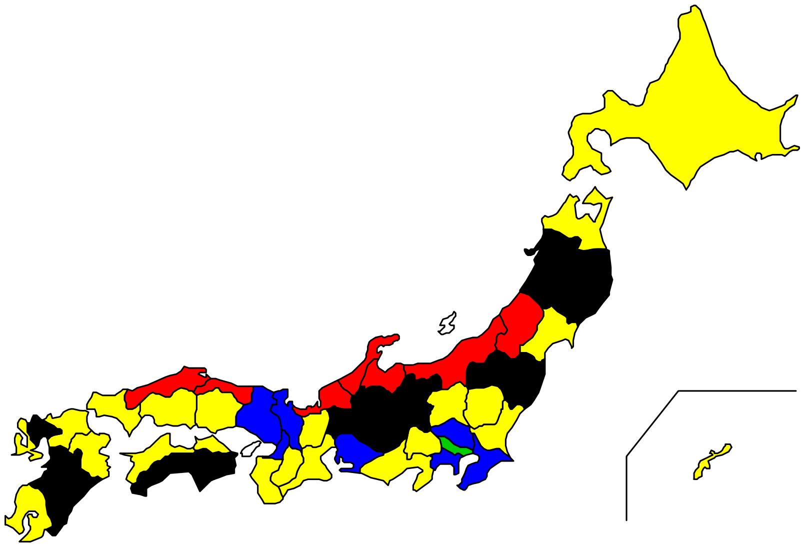
	(1)	(2)	(3)	(4)	(5)	(6)
Education	College	College	College	College	College	College
Age	25-39	25-39	25-39	40-54	40-54	40-54
log husband's income	-0.149			-0.0748		
	(0.134)			(0.0453)		
Childcare	0.333			0.672***		
	(0.237)			(0.200)		
Three-generation	0.315**			0.137**		
	(0.118)			(0.0520)		
Demand	0.275	0.351		-0.00192	0.0751	
	(0.180)	(0.229)		(0.145)	(0.170)	
Density	-0.00635	-0.0340***	-0.0340**	-0.0307***	-0.0518***	-0.0530***
	(0.00853)	(0.0108)	(0.0140)	(0.00886)	(0.0103)	(0.0119)
Climate	-0.00507	-0.0147**	-0.0125*	-0.00247	-0.00206	-0.00163
	(0.00576)	(0.00715)	(0.00654)	(0.00329)	(0.00487)	(0.00449)
Ruggedness	-0.0148	0.0734	0.0682	0.0248	0.0883*	0.0833
	(0.0624)	(0.0673)	(0.0718)	(0.0597)	(0.0501)	(0.0549)
Constant	3.047***	2.724**	0.773***	1.091	1.086	0.673***
	(0.915)	(1.320)	(0.117)	(0.763)	(0.973)	(0.0878)
Observations	47	47	47	47	47	47
R-squared	0.639	0.330	0.278	0.614	0.324	0.320

Note: Robust standard errors are in parentheses.

* Statistically significant at the 10% level; ** at the 5% level (two-tailed tests);
***at the 1% level (two-tailed tests)

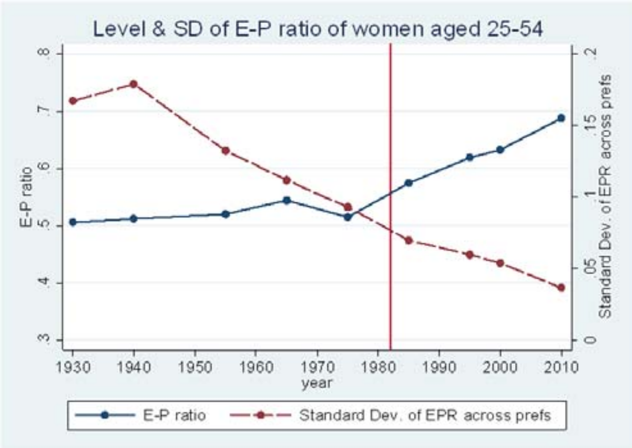
Source: Authors' calculation from the ESS, 1982-2007.

Figure 1
Five regions



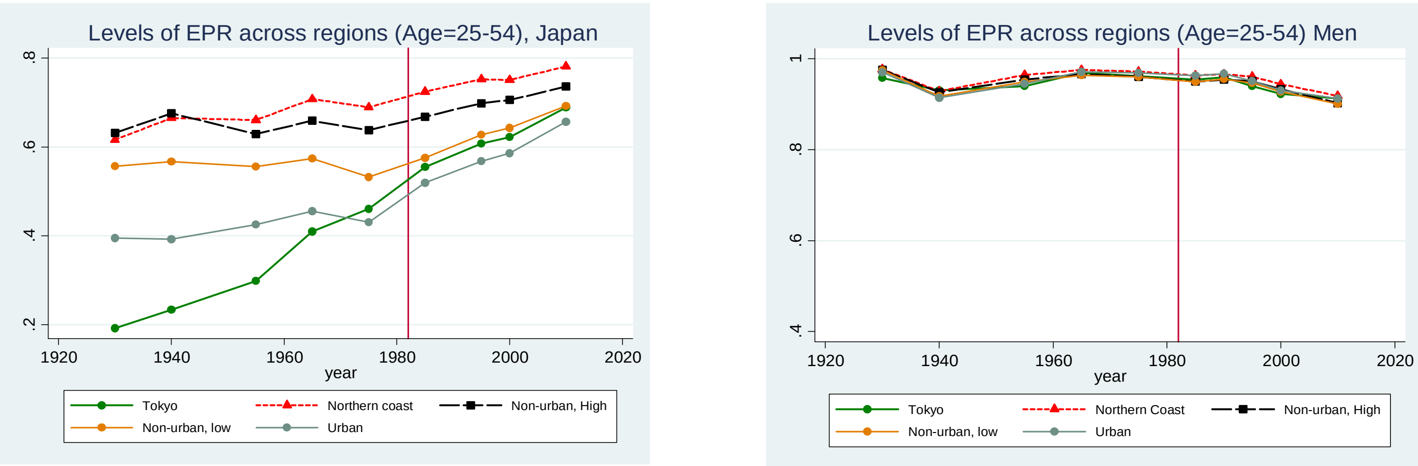
Red: Northern Coast
Green: Tokyo
Blue: Urban
Black: non-urban-high
Yellow: non-urban-low

Figure 2
Level and the standard deviation of the E-P ratio of women aged 25-54



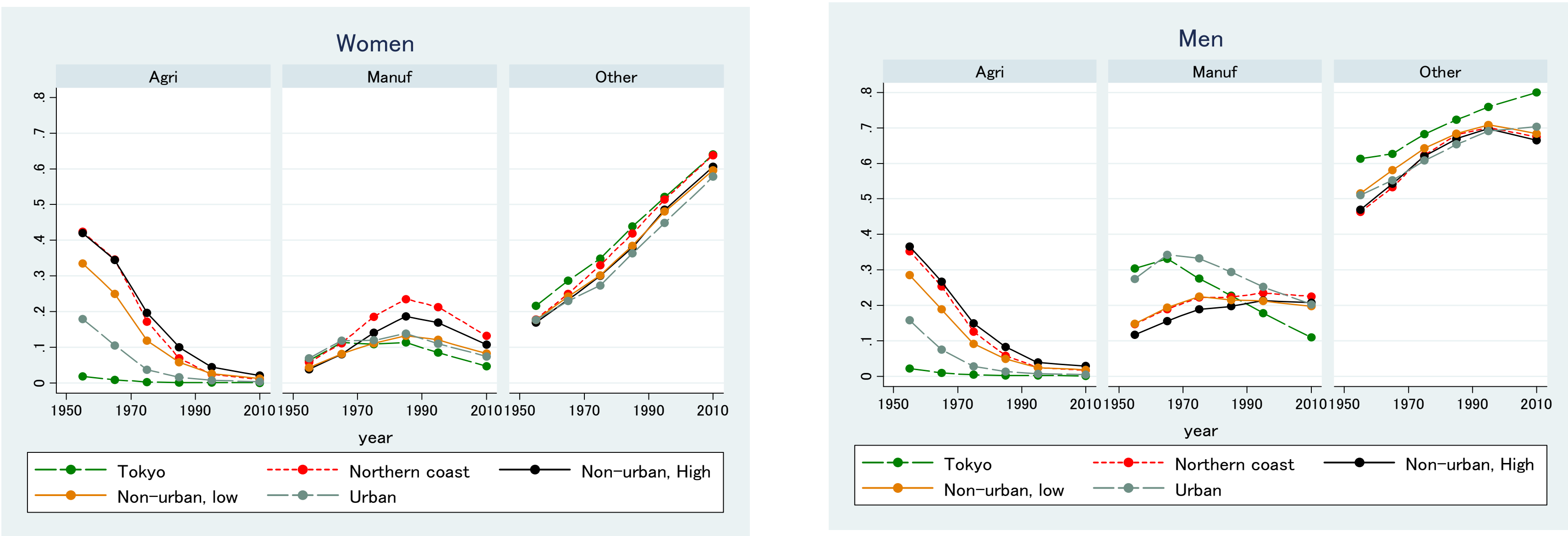
Note: The red vertical line corresponds to year 1982, the earliest year of the ESS data.
Note: Authors' calculation from Census (1930-2010)

Figure 3



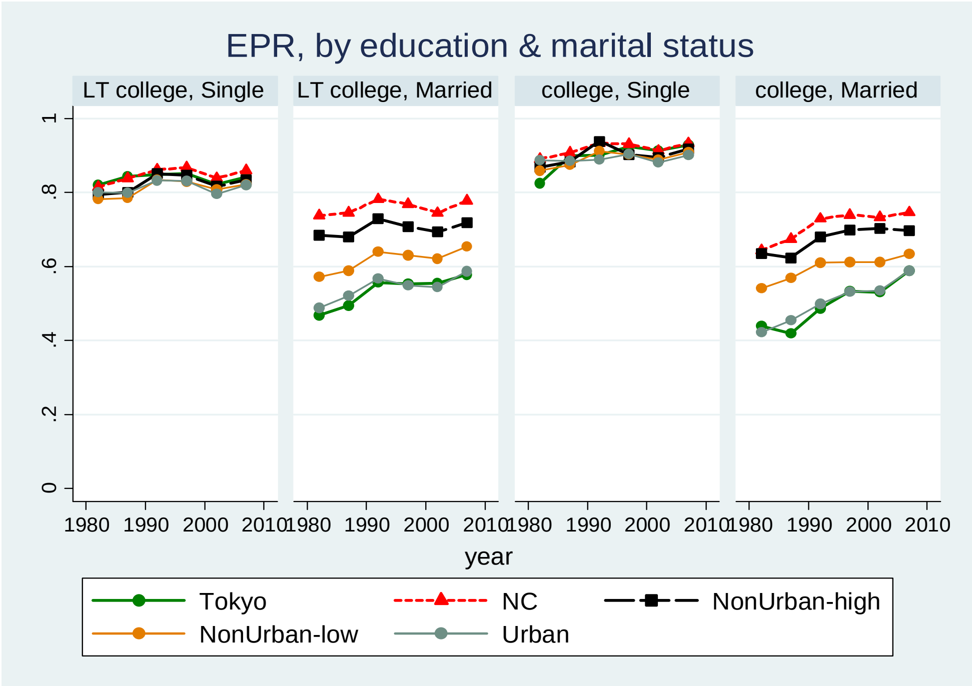
Note: The red vertical line corresponds to year 1982, the earliest year of the ESS data.
Source: Authors' calculation from Census (1930-2010)

Figure 4
Sector Participation by gender and region: 1955-2010



Source: Authors' calculation from the Census (1955-2010).

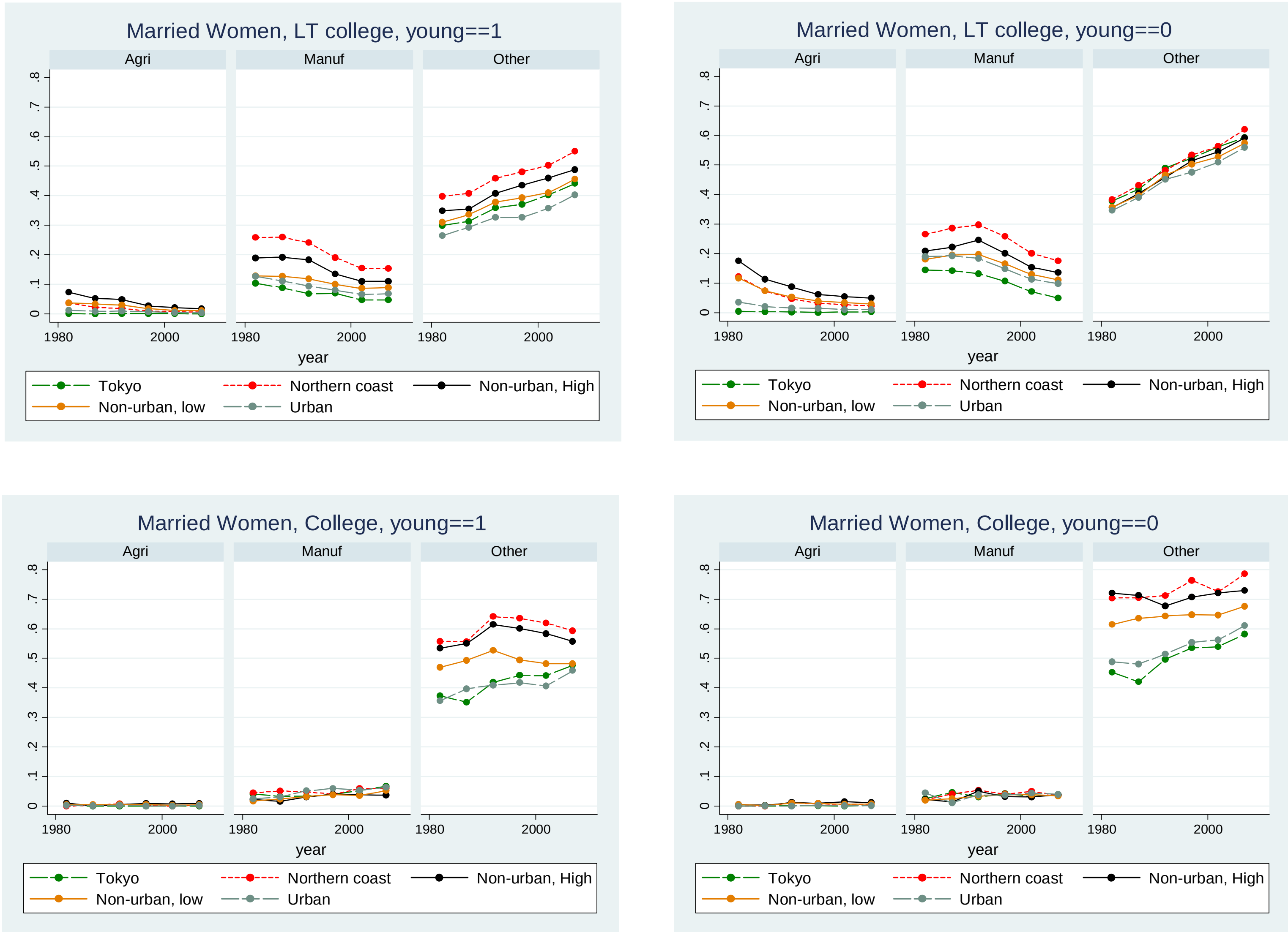
Figure 5
E-P ratio by education and marital status



Source: Authors' calculation from the Employment Status Survey (1982-2007)

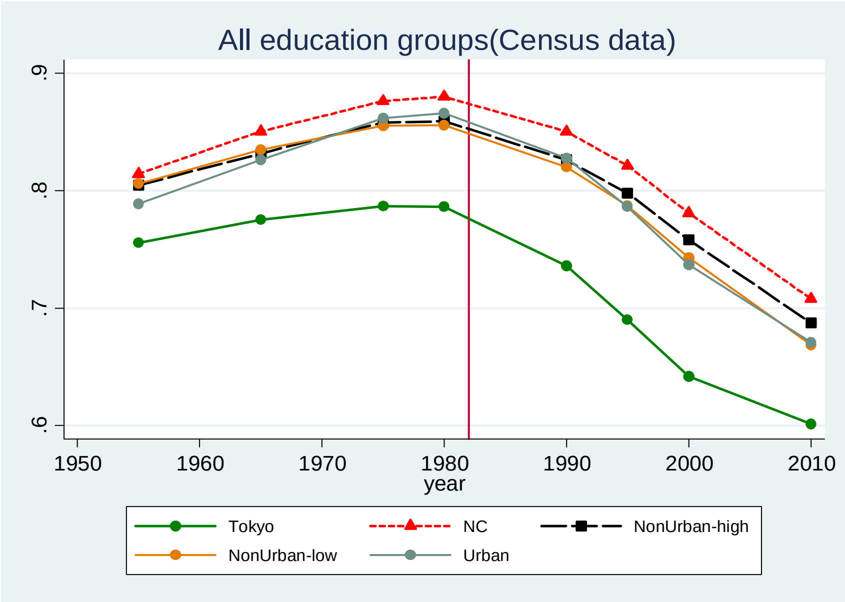
Figure 6

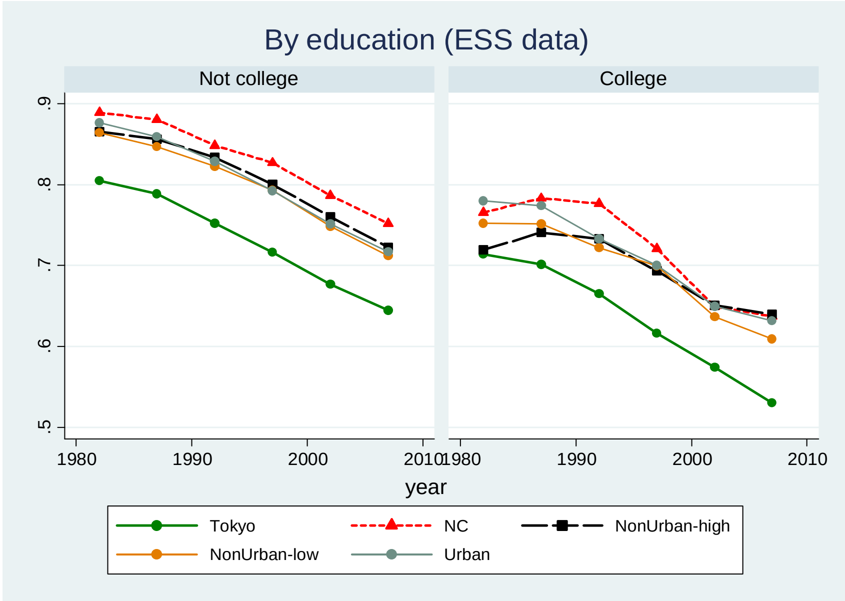
Sector participation by education and age group, 1982-2007: Married women



Source: Authors' calculation from the Employment Status Survey (1982-2007)

Figure 7 Marriage rates of women aged 25-54





Note: The red vertical line in the census graph corresponds to year 1982, the earliest year of the ESS data.
Source: Authors' calculation from the Census (1955-2010) and the Employment Status Survey (1982-2007)

Appendix

Table A1
Standard deviation and covariances of sector participation from the ESS data

Women

Standard Deviation					Covariances		
year	EPR	Agriculture	Manufacturing	Other	manuf_agri	manuf_other	agri_other
1982	0.082	0.046	0.060	0.035	0.00036	-0.00055	0.00010
1987	0.071	0.031	0.058	0.029	0.00032	-0.00040	0.00001
1992	0.065	0.022	0.054	0.033	0.00029	-0.00048	0.00008
1997	0.060	0.015	0.044	0.036	0.00013	-0.00015	0.00013
2002	0.051	0.012	0.036	0.035	0.00012	-0.00024	0.00010
2007	0.045	0.010	0.035	0.031	0.00009	-0.00027	0.00004

Men

Standard Deviation					Covariances		
year	EPR	Agriculture	Manufacturing	Other	manuf_agri	manuf_other	agri_other
1982	0.010	0.038	0.079	0.057	-0.00191	-0.00391	0.00042
1987	0.012	0.028	0.074	0.054	-0.00126	-0.00362	0.00041
1992	0.008	0.020	0.068	0.054	-0.00074	-0.00347	0.00027
1997	0.009	0.015	0.065	0.053	-0.00050	-0.00332	0.00024
2002	0.013	0.012	0.064	0.056	-0.00020	-0.00347	0.00004
2007	0.014	0.011	0.071	0.061	-0.00016	-0.00417	-0.00003

Note: Authors' calculation from the Employment Status Survey (1982-2007)

Table A2
Role of compositional change in regular, non-regular, and self-employment

Standard deviations of labor force measures and counterfactual measures

Labor force measure	1982, actual	2007, actual	2007 LF_r with 1982 composition
E-P ratio (EPR)	0.081	0.045	0.057
Regular Emp. (RER)	0.048	0.043	0.048
Non-regular Emp. (NRER)	0.020	0.025	0.024
Self-employed etc. (SELF)	0.053	0.010	0.012

Variance-covariance decomposition

Labor force measure	1982, actual	2007, actual	2007 LF_r with 1982 composition
var(EPR)	0.0066	0.0020	0.0033
var(RER)	0.0023	0.0018	0.0023
var(NRER)	0.0004	0.0006	0.0006
var(SELF)	0.0028	0.0001	0.0001
cov (RER, NRER)	-0.0004	-0.0004	-0.0002
cov (RER, SELF)	0.0013	0.0002	0.0003
cov (NRER, SELF)	-0.0004	-0.0001	-0.0001

RER: Regular Employment Ratio (the number of regular employees/population)
NRER: Non-Regular Employment Ratio (the number of non-regular employees/population)
SELF: Employment other than regular employment or non-regular employment (=EPR-RER-NRER)

Note: The red entries indicate the parts for which participation changes are large.
The shaded entries are the ones for which compositional effects are large.

Figurer A1
Sector participation by education and age group, 1982-2007: Men

Source: Authors' calculation from the Employment Status Survey (1982-2007)

Figure A2 Childcare over time, by region