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On the convergence in female participation rates

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On the convergence in female participation rates [1]

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Abstract

Large regional differences exist in female participation across regions within Japan. This paper uses two datasets to show that a significant convergence in female participation occurred from 1940 to 2010. Historically, female participation has been low in urban areas and high in non-urban areas. The participation rate steadily and significantly increased in urban areas and, to a lesser extent in non-urban areas, and thus regional differences shrank over time. Microdata from 1982 to 2012 reveal that regional dispersion is large for married women's regular full-time participation in the traditional sectors (manufacturing for the less educated and teaching for the highly educated). Compositional changes in demographics and educational attainment explain 74 percent of the convergence for those aged 25-39 years, and 40 percent of the convergence for those aged 40-54 years. An increase in non-regular employment accounts for 60 percent of the convergence for the latter group. Convergence in regular full-time participation by married women is only observed in the traditional sectors (manufacturing and teaching) and not in the new sectors (service and retail). Since the compositional change is the major source of convergence for young women's participation, their behavior across regions did not converge.

Keywords: convergence, region, female participation
JEL classification: J21, R12, R23

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[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 under 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 Information Science, University of Tokyo. I thank participants of the 7th Cliometrics World Congress, the Economic History Association's Annual Conference in Washington D.C., Giorgio Brunello, Joyce Burnette, Ann Carlos, Janet Hunter, Frederic Jouneau-Sion, Shiko Maruyama, Chiaki Moriguchi, and seminar participants at Aarhus University, GATE-Lyon St. Etienne, Hitotsubashi University, Hokkaido University, University of Helsinki, University of Padova, and University of Tokyo (Housing Policy Research Seminar) for helpful comments. Remaining errors are my own. This research is supported by the Japan Society for Promotion for Science Kakenhi (Grant Numbers 23530261, 26590045, and 15H03358).
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Introduction

How much people work differs across countries and even across regions of a single country. This fact has attracted attention for a long time. For example, Alesina et al. (2006) report that, Americans work 25.1 hours per week whereas Germans work 18.6 hours per week, on average. Significant within-country, across-region differences exist in labor market participation by women (Fogli and Veldmkamp 2011; Black et al. 2014; Abe 2013).[2] In this paper, I show that regional dispersion in female labor market participation has decreased in Japan from 1940 to present. An analysis using microdata from 1982 to 2012 reveals that a large part of the convergence is explained by compositional changes in demographics for the younger women (aged 25-39 years), and by an increase in non-regular employment for older women (aged 40-54 years).

The gender gap in Japanese society is considered one of the largest among developed countries: for instance, Japan ranks 101st among 145 countries according to the gender gap index of the World Economic Forum in 2015, and scores particularly low in “economic participation and opportunity” and “political empowerment.” Blau et al. (2014) point out that the gender wage ratio (the mean female wage divided by the mean male wage) was 0.67 in Japan in 2006, whereas it was 0.86 in Australia, 0.76 in the United Kingdom, and 0.81 in the United States.

A feature that has received little recognition so far is the regional dispersion of female

[2] In important recent studies, researchers have attempted to explain regional differences in participation using exogenous factors. Examples of such exogenous factors are: (1) availability of outsourcing household services (Cortes and Tessada 2011) or (2) peer effects operating through the sex composition of the children in the neighborhood (Maurin and Moschion 2009). Johnson (2014) examines the link between female participation and housing markets in US cities.

participation rates within Japan. For instance, areas in the Northern Coastal region of Honshu Island (Yamagata, Niigata, Toyama, Ishikawa, Fukui, Tottori, and Shimane prefectures) have very high levels of labor market participation: in 2010, the employment-to-population ratio (EPR from now on) of women aged 25-54 residing in this region was 78 percent, much higher than in Tokyo, where it was 69 percent. In 2010, the EPR 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. Therefore, the participation rate in the Northern Coastal region is comparable to, or even higher than, the rate in the countries with high participation.[3]

This paper concerns the long-term development of this regional variation in Japan. Over the 70 years from 1940 to 2010, there has been a massive reduction in regional dispersion of the female participation rate. Historically, urban areas of Japan have had low participation, whereas non-urban areas have had high participation. In 1930, the female EPR was 19 percent in Tokyo, the prefecture with the lowest participation at that time, and the average of the ten highest prefectures was 72 percent. Since then, the participation rate has risen steadily and significantly in urban areas and to a lesser extent in non-urban areas. In 2010, the EPR in the prefecture with the lowest participation (Nara) was 62.2 percent, whereas the average of the ten highest prefectures was 76.8 percent. The core question addressed here is the determinants of this massive convergence.

The census data from 1955 to 2010 show that the convergence is closely related to industry structure, most significantly to the decline in agriculture. However, the earlier aggregate data do not allow me to disentangle the roles of individual characteristics, such as

[3] Data for country-level participation rates are from statistics published by the OECD.

education, marital status, and male income. Therefore, I use microdata from the ESS, which cover the period from 1982 to 2012. In this dataset, participation measures are available for disaggregated groups in terms of education, marital status, and age ranges (25-39 and 40-54 years). Labor market participation is further disaggregated into three types: (1) regular full-time employment in the traditional sectors; (2) regular full-time employment in the "new" sectors; and (3) non-regular employment. The traditional sector comprises manufacturing for those with less-than-college education, and teaching for the highly educated. Regular full-time employment outside the traditional sectors is coded as the "new" sector; the major industries in this sector are retail and services. I show that regional convergence in participation starkly differs by sectors: regular full-time participation by married women converged only in the traditional sector; their participation in the new sector is stable or slightly diverged from 1982 to 2012. Regional dispersion in non-regular employment is small and its convergence is limited.

From the ESS data I also show that: (1) regional disparities in female participation are large only for married women; (2) compositional change in education and marital status explains 74 percent of the convergence from 1982 to 2012 for the younger group (aged 25-39 years), whereas the increase in non-regular (including part-time) employment explains 60 percent of the convergence for the older group (aged 40-54 years); and (3) for highly educated married women, there has been a remarkable decline in teaching, and a steady increase in non-teacher employment. Simple regression analysis shows that labor supply factors, such as presence of children, childcare availability, residence in three-generation households (grandparents live in households in which children are present), and husband's income, have different influences on employment in the traditional and new sectors. Among the labor supply factors considered, the proportion of three-generation households is the only one for which regional dispersion decreased. Therefore, participation in the traditional sector, for which this variable is significant, went through convergence. In contrast, the proportion of three-generation households does not affect participation in the new sector, and its regional dispersion remained constant.

A number of recent studies have taken up the issue of regional variation in female participation recently. Fogli and Veldkamp (2011) examine the spatial correlation in participation behavior in the United States and consider the role of information transmission among women; Black, Kolesnikova, and Taylor (2014) 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. Of these, Fogli and Veldkamp (2011) and Black, Kolesnikova, and Taylor (2014) focus on regional differences in labor-supply factors (i.e., information flow among mothers and commuting costs). Acemoglu, Autor, and Lyle (2004) and Goldin and Olivetti (2013) consider the role of the one-time demand shock of the war, but their primary focus is not the extent of regional dispersion. None of them consider the effects of long-term supply and demand factors on regional differences in female participation. This paper contributes to the literature by identifying the determinants of convergence in female EPR.

1. Regional variations in women's participation between 1930 and 2010: A long-term view

Trend and the relative position of prefectures

Female participation in Japan has been slowly rising since the early 1930s. As illustrated as the solid line in Figure 1, this smooth trend was interrupted in the 1970s, and resumed at a faster pace thereafter. The increase in the average participation rates has been accompanied by a decline in its regional dispersion. As shown in Figure 1 by a dashed line, the standard deviations of the EPR among 47 prefectures declined steadily: it was 0.18 in 1940 and was 0.04 in 2010. As shown below, the decline in dispersion is driven by urban areas catching up with non-urban areas.

To better document convergence, I have divided the 47 prefectures of Japan into five groups: (1) Tokyo; (2) 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). The regional classification is illustrated in Figure 2.[4] In Figure 3, the EPR of women and men aged 25−54 years are plotted, for years from 1930 to 2010. The female EPR increased most significantly in Tokyo, where it was very low in 1930. By contrast, male EPR remained at a similar level from 1930 to 2010, and the standard deviation of male EPR has been very small throughout the period.

In spite of this convergence in female participation, the relative rank of prefectures in terms of female EPR has remained surprisingly stable, with urban regions having the lowest participation rates for the entire period. Table 1A lists the 47 prefectures in Japan according to their rank in the female EPR for those aged 25-54 years, for selected years between 1930 and 2010. The actual EPRs 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 parts of Tables 1A and 1B consist of prefectures in urban areas.

Except for the urban prefectures 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

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

prefectures belonging to the Northern Coastal region (red entries) gradually emerged as the area with the highest female participation rate. I classify prefectures according to their female EPR 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 industries

In this subsection, I show that convergence in female participation from 1955 to 2010 was the result of a decline in agriculture and manufacturing. For this period, only the aggregate data are available. To show the cause of the convergence in female participation, I introduce industry participation measures as follows: (1) the fraction of agricultural workers in the population; (2) the fraction of manufacturing sector workers in the population; and (3) the fraction of workers in sectors other than the above two in the population. These measures are calculated for cells 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 the three sector participation measures equals the EPR:

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

The variance of the EPR is decomposed 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 years, 26 percent of men and 29 percent of women worked in agriculture in 1955. In 1995, the same rate was 4 percent for both men and women. However, participation in this sector was already quite low in Tokyo from as early as 1940. Agriculture declined in all regions outside Tokyo, so regional dispersion in agricultural participation decreased. This effect explains most of the convergence in female EPR from 1955 to 1985.

Since the 1990s, the impact of agriculture on convergence has been small; instead, a decline in manufacturing contributed to the decrease in dispersion.

Table 2 lists the standard deviations of the EPR and sector participation rates, as well as the covariances of sector participation rates (i.e., each term in Eq.(2)). There is large regional dispersion for agriculture and manufacturing participation. In the United States in the 1980s, manufacturing created regional disparities in labor demand for men (Bound and Holzer 2000). According to historical data of Japan, agriculture, in addition to manufacturing, was the sector that caused large regional disparities in female EPR.

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

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

Covariances between agriculture and the two other sectors diminished over time because agriculture participation declined everywhere; since the lower-bound for the agricultural participation rate is zero, the overall decline in agriculture makes regional dispersion small.

After the 1990s, manufacturing participation also started to decrease, so the regional dispersion for manufacturing became smaller than in the 1980s. These patterns are evident in Figure 4, in which sector participation in five regions is plotted for women and men for the period from 1955 to 2010. Regional dispersion in sector participation is large for agriculture and manufacturing, and small for the other sector. For women, regions with high agricultural participation also have high manufacturing participation, and the Northern Coastal region is the most prominent example. For men, by contrast, the regions with high manufacturing participation have low participation in the other sector.

2. EPR by marital status and education: 1982‒2012

Dispersion and convergence by marital status, education, and age groups

As shown in Figures 1 and 3, female EPR across regions converged significantly from 1940 to 2010. Even so, the regional dispersion in EPR in 2010 was still much larger for women than for men. Moreover, I show in this section that the dominant source of regional disparity in female EPR since the 1980s is the regular full-time employment ratio of married women. Convergence has been slow for this employment type by married women (except for highly educated young women: see Section 4). To demonstrate this point, the ESS micro data from 1982 to 2012 are used. In this section, I apply a series of disaggregations by individual characteristics (marital status and education) and employment type (regular full-time workers, or non-regular workers that include part-time and casual workers), in order to identify the education and demographic groups and employment type for which the regional dispersion is large.[5] I find that dispersion is large only for regular full-time employment of married women.

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

To illustrate the convergence pattern, Figure 5 plots the EPRs (Figure 5.A), regular full-time employment ratios (Figure 5.B), and non-regular employment ratios (Figure 5.C) of married and single women, for the two education groups, in five macro regions. The left part of Table 3 lists means and standard deviations of the EPR and the regular employment ratios of married women over time. Four notable patterns are evident. First, regional differences in the EPR are much greater for married than for single women (Figure 5.A). Therefore, the large regional disparities in EPR documented by the Census data in Section 1 are mainly driven by differences for married women. The regional dispersion in the regular full-time participation rate is also greater for married than for single women. Regional dispersion in non-regular employment is generally small for all education and marital status groups, although urban areas have relatively high ratios (Figure 5.C). For regular full-time employment, the convergence is modest for married women with less-than-college education, but is large for college-educated, married women (the left part of Table 3 and Figure 5.B).

Second, the regional EPR ranking is similar for college-educated and for less-educated, married women: the Northern Coastal region has the highest EPR, Tokyo and other urban regions have the lowest EPR, and the two non-urban regions have intermediate EPR. As shown in Figure 2, the female EPR in Tokyo is higher than that in the urban region and is almost the same as the non-urban-low region in 2010. Nonetheless, Tokyo’s rate for married women is still lower than the rate in the 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.

Third, unlike in the last section, convergence is modest when we disaggregate by education and marital status. We observe EPR convergence for married women but not for single women. Even among married women, EPR convergence did not occur for regular full-time employment by the less educated; but did for those with a college education (the left part of Table 3).

Finally, it is important to distinguish between regular full-time and non-regular employment. The EPRs suggest that among married women, those with a college education are no more likely to work than those with less education. It has been pointed out that one of the problems with female participation in Japan is low participation among the highly educated (OECD 2002). Figure 5.A shows that this is especially the case for married women residing in urban areas.[6]

Convergence of participation in regular employment

As shown above, regular full-time employment of married women is the major source of regional dispersion in EPR. Below, I examine this pattern in further detail by considering separate age ranges of younger and older groups (age 25-39 and 40-54 years), and by regular full-time employment into two sectors (traditional and new). For the latter, I divide the regular full-time participation into the following two categories for each education: (1) manufacturing and (2) other regular employment for those with less-than-college education, and (1) teaching and (2) other regular employment for those with a college education. Hereafter, I call regular full-time employment in manufacturing for the less educated and in teaching for the highly educated as the "traditional sector," regular full-time employment in other sectors as the "new sector" The new sector includes service, retail, and clerical occupations. The right part of Table 3 lists means and standard deviations of regular employment participation in the traditional and new sectors.

Figure 6.A plots the regular full-time employment ratio for married women in the two

[6] For participation in regular full-time employment by married women, however, college graduate married women have higher rates than those with less education. This difference cannot be discerned from the EPR.

age groups. Unlike Figure 5.B in which the age groups are combined, the pattern for those with a college education is quite different between the age groups: the dispersion is relatively stable for the older group, whereas the rate in Tokyo rapidly increased for the younger group. In the reminder of the paper, the analysis is performed separately for the younger (25-39 years) and older (40-54 years) groups because, their convergence patterns differ significantly.

Figure 6 shows the regular full-time participation rate in the traditional sector and the new sector. The convergence in regular employment for married women arises from manufacturing and teaching (Figure 6.B), just as agriculture was the major source of convergence at an earlier time (Section 1). In the new sector (Figure 6.C), no convergence is observed. A remarkable change occurred in highly educated married women aged 25-39 years in teaching. Participation in teaching accounted for more than half of regular full-time participation in 1982, but that share declined to 15 percent in 2012. In addition, participation in the traditional sector has large regional dispersion, whereas that in the new sector does not. Time-series changes for other age and education groups are not as dramatic but are qualitatively the same: participation in the traditional sector declined and its dispersion decreased, whereas participation in the new sector increased and its dispersion has been stable.

3. Sources of convergence: composition and changes in sector participation

Regional dispersion in female EPR has compressed over time (Figures 1 and 3). When data are disaggregated by education and marital status, regional dispersion has been stable after 1982, except for participation in regular full-time employment in the traditional sector. Therefore, part of the convergence in regional variation is a consequence of compositional changes, for instance because of declining marriage rates and improvements in educational attainment.[7] [8] Moreover, as shown below, the reminder of the convergence arises from another source: participation in particular types of employment.

To quantify the roles of composition and employment type, I compare the standard deviations of the actual EPR with those of counterfactual measures. I consider three counterfactuals: (1) the composition-constant counterfactual, (2) the counterfactual that replaces married women's regular full-time employment in the traditional sector (this measure is used only for those aged 25-39 years), and (3) the counterfactual that replaces non-regular employment participation (this measure is used only for those aged 40-54 years).

The first counterfactual is the EPR that keeps the composition constant at its distribution in 1982. Specifically, I use the EPR for each cell (defined for each the age group, marital status, and education combination) in 1982 and then weight them with the age-education-marital status share of women in 2012, as follows:

$$\widehat{EPR_{cf}} = \sum_{e,m} \theta_{em,2012} EPR_{em,1982} \tag{3}$$

where EPR stands for the EPR, θ_{emy} is the population share for the education group e and the marital status group m (married or single) in year y.

[7] To see why compositional changes lead to convergence, consider a decline in the marriage rate. This decrease results in EPR convergence across regions via the following mechanism. The EPR difference between married and single women is greater in urban than in non-urban areas (Figure 5). Let m_r represent the marriage rate in region r, and let EPR_{jr} represent the EPR for the marital status j (j=m,s) in region r. Then, the overall EPR in region r is $EPR_r = m_r \cdot EPR_{mr} + (1-m_r)\cdot EPR_{sr}$. Differentiating this equation by m_r gives $\partial EPR_r / \partial m_r = EPR_{mr} - EPR_{sr}$, which is negative and has the absolute value that is greater for urban than for non-urban areas. Therefore, for the same decline in marriage rate, the overall EPR increases more in urban than in non-urban areas. Since the overall EPR is lower in urban than in non-urban areas, the decline in the marriage rate reduces regional EPR disparities, even though the EPR by marital status (EPR_{mr} and EPR_{sr}) remains constant.

[8] According to the census data, marriage rates were much lower in Tokyo than elsewhere from 1955 to 2010, for both education groups. The Northern Coastal region had the highest marriage rates for the entire period.

The second counterfactual, used only for those aged 25-39 years, is defined as follows:

$$\begin{aligned}\widehat{EPR_{cf2}} = &\sum_e \theta_{e1,2012}(FT\_new_{e1,1982} + FT\_trad_{e1,2012} + Nonreg_{e1,1982}) + \\ &\sum_e \theta_{e0,2012}(FT\_new_{e0,1982} + FT\_trad_{e0,1982} + Nonreg_{e0,1982}).\end{aligned} \tag{4}$$

In Eq.(4), values for regular employment of married women in the traditional sector ($FT\_trad_{e1,y}$) are set to the 2012 value, whereas other components of married women ($FT\_new_{e1,y}$ and $Non\_reg_{e1,y}$) and all components of single women ($FT\_trad_{e0,y}$, $FT\_new_{e0,y}$, and $Non\_reg_{e0,y}$) are kept at the 1982 values. The idea here is to gauge the impact of convergence in participation in the traditional sector by married women on overall convergence. As shown in Section 4, there was dramatic convergence participation in the traditional sector by married women.

The final counterfactual, used only for those aged 40-54 years, sets the non-regular employment rate to the 2012 value, keeping participation rates for married women in other sectors and those for single women in all sectors as in 1982, as follows:

$$\begin{aligned}\widehat{EPR_{cf3}} = &\sum_e \theta_{e1,2012}(FT\_new_{e1,1982} + FT\_trad_{e1,1982} + Nonreg_{e1,2012}) + \\ &\sum_e \theta_{e0,2012}(FT\_new_{e0,1982} + FT\_trad_{e0,1982} + Nonreg_{e0,1982}).\end{aligned} \tag{5}$$

Standard deviations of the actual EPRs in 1982 and 2012, $\widehat{EPR_{cf}}$, $\widehat{EPR_{cf2}}$, and $\widehat{EPR_{cf3}}$ are reported in Table 4.[9]

Changes in the demographic composition played a significant role in reducing regional dispersion in EPR. For the younger age group, the standard deviation of the EPR decreased from

[9] The replacement in Eqs.(4) and (5) does not take into account the effect of changes in the replaced value on other components (i.e., covariances).

0.079 in 1982 to 0.040 in 2012. According to the dispersion in $\widehat{EPR_{cf}}$, 74 percent of the total decline ((0.079-0.050) / 0.039 = 0.74) arises from compositional changes in education and marital status. For the older group, composition accounts for 40 percent ((0.077-0.065) / 0.030 = 0.40) of the overall decline. The composition effect is much smaller for the older than for the younger group. The reason why composition has such a large effect for the younger group is evident from Figure 7, in which the composition by marital status and education in 1982 and 2012 is plotted for the two age groups. In 1982, regional differences in composition in marital status and education were small, but they increased by 2012. Regional differences in composition are much greater for the younger than for the older group. The proportion of highly educated women is higher, and the proportion of married women is lower, in urban than in non-urban areas. Previous studies reported that a decline in the marriage rate was a major immediate change in behavior by young women after enactment of the Equal Employment Opportunity Act in 1986 (Edwards et al. 2015; Abe 2011). The decrease in the proportion of married women, especially for the younger age group, is a reflection of this phenomenon, but its regional patterns have not been considered in previous research.

Next, I examine whether the remaining part of the convergence is explained by the sources posited in Eqs. (4) and (5). For the younger age group, setting regular employment in the traditional sector for the married women to the 2012 value (as in Eq.(4)) brings the standard deviation to 0.044, close to its 2012 value of 0.040. For the older age group, replacing the participation in non-regular employment (as in Eq.(5)) brings the standard deviation to 0.047, very close to its 2012 value of 0.046. Thus, the causes of convergence differ between the younger and older groups. For the former, (1) compositional changes in education and marital status (74 percent), and (2) convergence in regular full-time employment in the traditional sector by married women (20 percent) explain 90 percent of the overall convergence. For the latter, (1) compositional changes explain 40 percent of the convergence, and (2) the rest is explained by the increase in non-regular employment. Large effects of compositional changes mean that conditional on education and marital status, participation behavior did not become similar across regions. Convergence arose not because female labor supply converged across regions, but because of changes in women's choices regarding education and marital status.

4. Supply factors and convergence in regular full-time participation by young married women

Regression analysis of supply variables

As shown in Section 3, much of the convergence after 1982 was due to compositional changes in marital status and education, a decrease in the marriage rate, and an increase in the college education among women. However, changes in non-regular employment of the older group and in regular employment of the younger group still contributed to convergence. Of these, non-regular employment exhibits small regional dispersion (Figure 5.C); its increase led to convergence because the non-regular participation rate is higher in urban than in non-urban areas, offsetting the large regional disparities in regular employment rates. In contrast, the regular employment rate by young married women had large dispersion, but it converged between 1982 and 2012, accounting for 20 percent of the convergence for this age group.

Table 3 lists standard deviations of participation measures among married women. It is evident that there has been notable convergence in regular full-time participation in the traditional sector, whereas there has been virtually no convergence in the new sector. For instance, among married college graduates aged 25-39 years, the standard deviation of the traditional sector participation fell from 0.076 in 1982 to 0.024 in 2012, whereas that in the new sector participation increased from 0.046 in 1982 to 0.054 in 2012. In this section, I examine whether changes in regular full-time participation by young married women arose from changes in labor supply factors, such as children, childcare availability, residence in three-generation households (grandparents live in households in which children are present), and husband's income.

Motivations for examining labor supply factors are twofold. First, supply factors are the typical set of variables that affect married women's participation, and has been widely used in previous research in Japan (e.g., Sasaki 2002; Nawata and Ii 2004; Asai et al. 2015). These studies have found that supply factors significantly affect women's labor force participation.[10] For instance, difficulty in securing formal or informal childcare is considered a major obstacle to maternal employment (Asai et al. 2015).

The second reason for focusing on supply factors is that the patterns for regional ranking of participation rates is consistent with the supply story. As in Figures 5 and 6, the regions that have high participation rates are the same, regardless of education levels—the Northern Coastal region has the highest participation, whereas urban regions have low participation. Moreover, Table 1 shows that the regional rankings have been stable since the 1980s. This stability across education level and time suggests that supply factors are the main reason why women of all education levels have high EPR in certain areas.[11] In the reminder of this section, I confine attention to regular full-time employment of married women aged 25-39 years; this is the group for which regional dispersion decreased over time, and the age ranges for

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[10] It is well known that there is large regional dispersion in childcare availability in a cross section (Unayama 2012; Abe 2013).

[11] The implicit assumption for this argument is that labor demand factors differ across education levels, whereas supply factors (e.g., the ease of obtaining childcare) depends little on the mother's education.

which supply constraints have the greatest effect.[12]

To identify possible impacts of supply variables, I estimate regression equations using data for married women aged 25-39 years, aggregated to the prefectural level. Specifically, the following simple model is estimated, separately for the two education groups:

$$Logit[E(LF_{rt})] = \beta_0 + \beta_1 X_{rt}\,, \tag{6}$$

where LF_{rt} is the mean participation measure (the regular employment ratio in the traditional and new sectors) in year t in prefecture r, and X_{rt} is the set of prefectural supply factors. Because the LF_{rt} could take a value of 0 or 1, I use the quasi-maximum likelihood procedure of Papke and Wooldridge (1996). Note that the X_{rt} variables are the same for the two regressions that take traditional and new sector participation rates as dependent variables.

To gauge the role of supply factors in regional dispersion, the variance in LF_t at time t is decomposed into the part predicted by the supply variables and the remaining part, as follows:

$$Var(LF_t) = Var(\widehat{LF}(\beta_t, X_t)) + \sigma_t^{\,2}, \tag{7}$$

where $\widehat{LF}(\beta, X)$ is the predicted value of LF when the vector of supply variables are X and the coefficients of them are β, and σ_t is the difference between the actual variance of LF_t and the variance of its predicted value.[13]

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[12] Furthermore, supply variables are clearly defined for married women. It is impossible to estimate the effect of husband's income in a sample that includes single women.

[13] Since Eq. (6) is non-linear, the variance of the dependent variable does not add up to the variance of the predicted value and the residual variance. Therefore, the $\sigma_t^{\,2}$ in Eq. (7) is not the variance of residuals, but is defined as the difference in the variance of LF_t and the variance of the predicted value, $\widehat{LF_t}$.

Using Eq. (7), the change from 1982 to 2012 is written as:

$$
\begin{aligned}
& Var(LF_{2012}) - Var(LF_{1982}) \\
&= [Var(\widehat{LF}(\beta_{2012}, X_{2012})) - Var(\widehat{LF}(\beta_{1982}, X_{1982}))] + [\sigma_{2012}{}^2 - \sigma_{1982}{}^2] \\
&= [Var(\widehat{LF}(\beta_{1982}, X_{2012})) - Var(\widehat{LF}(\beta_{1982}, X_{1982}))] \\
&\quad + [Var(\widehat{LF}(\beta_{2012}, X_{2012})) - Var(\widehat{LF}(\beta_{1982}, X_{2012}))] \\
&\quad + [\sigma_{2012}{}^2 - \sigma_{1982}{}^2].
\end{aligned}
\tag{8}
$$

The final expression in Eq. (8) reveals how much of the LF_t convergence is caused by changes in Xs (the first term), by changes in β (the second term), or by changes in σ_t^2 (the third term).

Summary statistics of the sample are shown in Table 5.A. Standard deviations in Table 5.A indicate that, among the four supply variables considered, the proportion of three-generation households is the only one that experienced convergence across regions during the sample period. Standard deviations of other three variables either remained stable or slightly diverged. Therefore, if convergence in the dependent variable occurs because of convergence in X, then it must come from the participation measures or groups for which the coefficient of three-generation households is large.

Regression estimates of Eq. (6) are reported in Table 5.B, and the convergence/divergence patterns and their relationship with supply factors (Xs) are reported in Table 5.C. Results in Table 5.B indicate that the impacts of supply-related factors starkly differ by sector. Since I use prefecture-level cell averages, the coefficients reflect the impact of *across*-prefecture differences in supply factors.[14] Husband's income has a strong negative effect on regular full-time participation by college graduates in the new sector, but not in teaching

[14] When I estimate similar regression equations using microdata, the effects of coefficients differ by employment type, as for the regressions based on cell data reported here.

(traditional sector).[15] In contrast, husband's income is negatively related to participation in the new sector for those with less-than-college education. Presence of children negatively affects participation in regular employment by married women in the new sector, but not in the traditional sector, suggesting that traditional sector employment has allowed married women to combine work and family. The prevalence of three-generation households in a region is associated with higher participation in the traditional sector, but not much in the new sector.

The coefficient of the proportion of three-generation households decreases from 1982 to 2012 for participation in the new sector by those with less than college education, and for teacher participation by the highly educated (Table 5.B). The other variables and sectors for which the absolute value of β changes between 1982 and 2012 are the children variable for the less educated (the absolute value decreases for manufacturing and increases for the new sector), and the husband's income for teaching for the highly educated.

In contrast, for participation in the new sector, the effect of three-generation households is small, whereas those of the children and childcare availability are large. Because the fraction of three-generation households converged and children and childcare availability did not, the new sector participation rate did not converge.

Convergence and the role of supply variables

Rows (a) and (b) of Table 5.C show the variances of participation rates in the traditional and new sectors in 1982 and 2012, for the two education groups. It is evident from Figure 6.A and Table 3 that the decrease in dispersion is most dramatic for married college graduate women

[15] Teacher participation is low in urban areas owing to low fertility rates and a greater supply of college graduates. Becoming a teacher requires a college degree, so the number of college graduates in the region is a proxy for supply of teachers. The ratio of the number of young children to the number of college graduates shows that urban areas have a much lower net demand for teachers.

in the traditional sector (teaching). For the new sector, a small *divergence*, rather than convergence, occurred for both education groups.

Next, I decompose changes in the dispersion into the proportion explained by supply factors and residuduals, as in Eq. (8). Rows (d) to (f) of Table 5.C list changes due to: (1) changes in X ($Var(\widehat{LF}(\beta_{1982}, X_{2012})) - Var(\widehat{LF}(\beta_{1982}, X_{1982}))$, row (d)), (2) changes in β setting the X at the 2012 values ($Var(\widehat{LF}(\beta_{2012}, X_{2012})) - Var(\widehat{LF}(\beta_{1982}, X_{2012}))$, row (e)), and (3) changes in unexplained part ($\sigma_{2012}{}^{2} - \sigma_{1982}{}^{2}$, row (f)). In all cases, the supply factors determine the direction of convergence. That is, in all four cases in Table 5.C, the sign for *X*'s effect (row (d)) is the same as that for the overall effect (row (c)). Except for teaching among the highly educated, the *X*'s effect (row (d)) and $\beta' s$ effect (row (e)) have opposite signs. Thus, changes in β have a countervailing effect that mitigates changes in *X*s. The changes in σ_t^2 (row (f)) are large for the highly educated but are small for the less educated. For the highly educated, the size of this last effect has the same sign as the overall effect, but the absolute values are smaller than the effect from changes in *X*.

Taken together, even though the values of X are the same for the traditional and new sectors, the same Xs led to convergence in the traditional sector but divergence in the new sector. The convergence occurred in the traditional sector because the proportion of three-generation households is important; convergence did not occur in the new sector because three-generation household is unimportant. Therefore, labor supply factors commonly used in the literature have very different effects depending on the sector, resulting in different convergence patterns across sectors. Another issue that warrants attention is regular employment participation in the new sector by married women in Tokyo (Figure 6.C). For most of the other figures, participation rates for Tokyo are the lowest among the five macro regions; however, for regular employment by married women in the new sector, Tokyo has the highest rate for the younger group, and it ranked intermediate for the older group. Supply factors cannot explain why Tokyo's rate is high only in the new sector for the highly educated, and not high for the other sector or education group.

In sum, the effects of supply factors have been different by employment type. In particular, supply factors contributed to convergence in the traditional sector, but to divergence in the new sector, largely because supply factors have different effects (i.e., have different βs) on the traditional and new sectors.

5. Conclusions

It is known that female participation rates differ significantly across regions in contemporary Japan. Yet regional disparities in the EPR were much larger in 1930 than in 2010. During the 20th century, a significant convergence in female EPR occurred. According to census data, a decline in agricultural employment contributed to the convergence from 1955 to 1985, whereas the decline in manufacturing contributed to convergence from the 1990s to 2010. In metropolitan areas, the female EPR was much lower than in other areas in 1930 but increased continuously thereafter.

Data from 1982 to 2012 reveal that regional disparity in EPR is large for married women, but small for single women. Female EPR converged from 1982 to 2012. Compositional changes in demographics and educational attainment explain 74 percent of the convergence for those aged 25-39 years, and 40 percent of it for those aged 40-54 years. Since 74 percent of convergence of young married women came from compositional changes in marital status and education, changes in labor supply behavior are not the main source of convergence. In contrast, increases in older women's non-regular employment explain 60 percent of the convergence. Disaggregation by education, marital status, employment type, and sectors reveals that convergence occurred in married women's regular full-time participation in the traditional sector, but not in regular employment in the new sector, or in non-regular employment.

Data Appendix

Census Data

The aggregate data of Census from 1930 to 2010 are used in this study. The Census was conducted around the time of WWII (1940 and 1947), but I did not use the data from 1947 because detailed labor force statistics by prefecture are not available. The region variable used is the region of residence and not the region of employment. The data used in this paper are restricted to people aged 25-54 years. The concept of labor force participants differed before and after the War. Before WWII, (1) those who only occasionally helped on a family farm or in a family business are not included as labor force participants; (2) unemployed people who did not have a previous job were not included in the labor force; and (3) the working population included workers under age 15 years. Therefore, the convergence we observe before WWII (from 1940 to 1955 in Figures 2 and 3) may be partly due to these changes in definitions. However, it is also true that convergence took place after WWII.

ESS data

The ESS is a large scale cross-sectional survey conducted every 5 years; I use data from 1982 to 2012 for the analysis. Because the ESS does not collect information on region of employment, the region variable used is the region of residence and not that of employment. To confine attention to those who have finished schooling and are below the mandatory retirement age, the analysis here mostly uses a sample of women aged 25-54 years. I also include executives of private corporations in the set of regular employees because many of them are promoted to executive positions from regular employee positions. The ESS data contain a variable that classifies household type into five categories: (1) a couple only; (2) a couple and their parent(s); (3) a couple with child(ren); (4) a couple, the couple's child(ren), and the couple's parent(s); and (5) other. In this terminology, "couple" means the youngest couple in the household, and "children" are the children of the youngest couple. Husband's income consists of earnings from the main job, and is surveyed using a set of income ranges. I assign the midpoint of the range in calculating average income.

Data for the childcare availability index

Data on childcare center enrollment are obtained from the Statistics of Social Welfare Facilities (Shakai Fukushi Shisetsu Chosa). Data on the female population aged 25–34 years for each prefecture are obtained from the Census in years close to the survey years of ESS.

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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 EPRs 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 EPR.

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

		E-P Ratio: level	Standard deviations				Covariances		
	year		E-P ratio	Agriculture	Manufacturing	Other	manufacturing & agriculture	manufacturing & other	agriculture & 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: Author's calculation from Census (1955-2010).

Table 3
Dispersion in the E-P ratio and sector participation rates by married women, 1982-2012

Less than college education

	Age 25-54			
	Mean		Standard Deviation	
year	E-P ratio	Regular FT	E-P ratio	Regular FT
1982	0.556	0.198	0.098	0.059
1987	0.575	0.205	0.087	0.068
1992	0.621	0.234	0.081	0.075
1997	0.607	0.228	0.081	0.072
2002	0.598	0.204	0.072	0.060
2007	0.631	0.215	0.068	0.057
2012	0.654	0.218	0.063	0.056

	Age 25-39				Age 40-54			
	Mean		Standard Deviation		Mean		Standard Deviation	
year	Regular FT, traditional	Regular FT, new	Regular FT, traditional	Regular FT, new	Regular FT, traditional	Regular FT, new	Regular FT, traditional	Regular FT, new
1982	0.050	0.129	0.039	0.038	0.081	0.136	0.039	0.022
1987	0.050	0.139	0.045	0.040	0.076	0.143	0.042	0.028
1992	0.050	0.159	0.045	0.046	0.080	0.172	0.044	0.035
1997	0.042	0.155	0.032	0.045	0.066	0.183	0.041	0.039
2002	0.033	0.147	0.023	0.037	0.046	0.175	0.029	0.041
2007	0.033	0.159	0.019	0.038	0.038	0.193	0.026	0.043
2012	0.031	0.178	0.017	0.043	0.035	0.190	0.020	0.046

College or over

	Age 25-54			
	Mean		Standard Deviation	
year	E-P ratio	Regular FT	E-P ratio	Regular FT
1982	0.476	0.296	0.092	0.096
1987	0.494	0.302	0.089	0.093
1992	0.546	0.323	0.084	0.086
1997	0.569	0.324	0.071	0.078
2002	0.572	0.309	0.073	0.081
2007	0.608	0.327	0.055	0.066
2012	0.631	0.345	0.056	0.059

	Age 25-39				Age 40-54			
	Mean		Standard Deviation		Mean		Standard Deviation	
year	Regular FT, traditional	Regular FT, new	Regular FT, traditional	Regular FT, new	Regular FT, traditional	Regular FT, new	Regular FT, traditional	Regular FT, new
1982	0.171	0.113	0.076	0.046	0.222	0.109	0.132	0.044
1987	0.164	0.137	0.079	0.040	0.176	0.129	0.116	0.052
1992	0.161	0.167	0.083	0.039	0.155	0.162	0.082	0.043
1997	0.119	0.195	0.088	0.037	0.161	0.175	0.060	0.042
2002	0.085	0.218	0.067	0.055	0.143	0.173	0.076	0.038
2007	0.058	0.263	0.042	0.052	0.125	0.209	0.086	0.034
2012	0.054	0.309	0.024	0.054	0.104	0.221	0.076	0.048

Source: Author's calculation from the Employment Status Survey (1982-2012).

Table 4
Standard deviations of E-P ratio and counterfactual measures

Age group	Age 25-39		Age 40-54	
		Fraction by		Fraction by
1982 Actual SD	0.079		0.077	
2012 Actual SD	0.040		0.047	
SD in Counterfactual 1 (Eq. (3) in the text)	0.050	<composition> 0.741	0.065	<composition> 0.398
SD in Counterfactual 2 (Eq. (4) in the text)	0.042	<Traditional sector> 0.197	–	–
SD in Counterfactual 3 (Eq. (5) in the text)	–	–	0.047	<Non-regular employment> 0.595

Source: Author's calculation from the ESS, 1982-2012 (microdata).

Table 5.A. Means and standard deviations of supply variables

Less than college

year	mean log(husband income)	three generation households	presence of children	childcare resources
1982	6.465	0.214	0.898	0.098
	(0.129)	**(0.100)**	(0.025)	(0.049)
2012	6.698	0.081	0.761	0.111
	(0.131)	**(0.049)**	(0.038)	(0.056)

College or over

year	mean log(husband income)	three generation households	presence of children	childcare resources
1982	6.651	0.126	0.798	0.089
	(0.107)	**(0.081)**	(0.044)	(0.044)
2012	6.912	0.035	0.671	0.102
	(0.119)	**(0.028)**	(0.054)	(0.051)

Note: Means are in the upper row, and the standard deviations are in parentheses.

Table 5.B. Regression analysis of supply factors on regular full-time employment among married women aged 25-39 (Marginal effects)

Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Less than college				College or over			
	Traditional <Manufacturing>		New		Traditional <teaching>		New	
	1982	2012	1982	2012	1982	2012	1982	2012
mean of log(husband's earnings)	0.023	0.035*	-0.130**	-0.158***	-0.341***	-0.108***	-0.018	0.100
	(0.012)	(0.014)	(0.042)	(0.029)	(0.084)	(0.029)	(0.086)	(0.103)
Proportion of three-generation household	0.221***	0.297***	0.177**	-0.064	0.271**	-0.018	-0.090	-0.186
	(0.017)	(0.042)	(0.057)	(0.102)	(0.088)	(0.081)	(0.121)	(0.257)
Children present in the household	-0.072	0.072*	-0.455**	-0.538***	0.039	0.011	-0.358*	-0.451**
	(0.079)	(0.032)	(0.145)	(0.081)	(0.187)	(0.043)	(0.176)	(0.162)
Childcare resource index	0.012	0.020	0.192*	0.299***	-0.036	0.140**	0.441	0.432**
	(0.028)	(0.022)	(0.091)	(0.057)	(0.225)	(0.053)	(0.234)	(0.160)

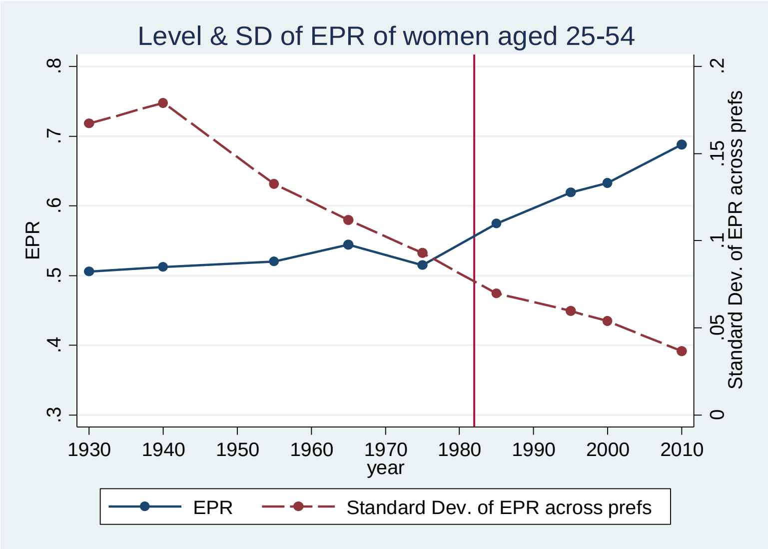
Notes:
There are 47 observations. Robust standard errors in parentheses.
A constant is included in all regressions.
* Statistically significant at the 5% level; ** at the 1% level (two-tailed tests); ***at the 0.1% level (two-tailed tests)

Table 5.C. Contributons from residual, beta, and supply factors on convergence
Regular full-time participation in traditional and new sectors, aged 25-39

	LT college		College or over	
	Traditional <Manufacturing>	New	Traditional <Teaching>	New
(a) Var_1982 (x100)	0.0733	0.1858	0.5413	0.2102
(b) Var_2012 (x100)	0.0296	0.2071	0.0581	0.3060
(c) Difference (x100)	-0.0437	0.0214	-0.4830	0.0958
Changes from 1982 to 2012				
(d) Difference in Variances of X (x100)	-0.0554	0.0688	-0.2982	0.1510
(e) Difference due to changes in β (x100)	0.0141	-0.0393	-0.0187	-0.0883
(f) Difference in σ_t^2 (x100)	-0.0023	-0.0081	-0.1663	0.0331

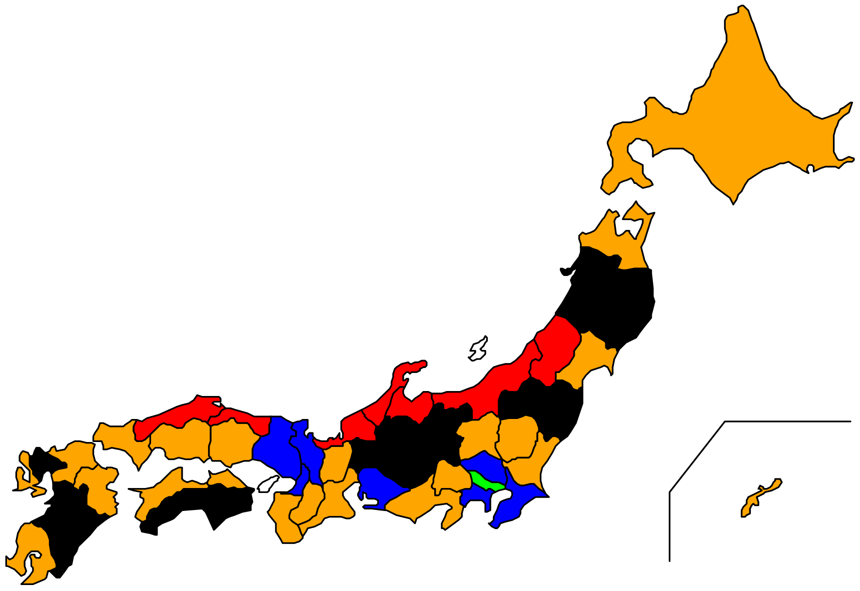
Source: Author's calculation from the ESS, 1982-2012 (microdata).

Figure 1
Level and the standard deviation of the E-P ratio of women aged 25-54



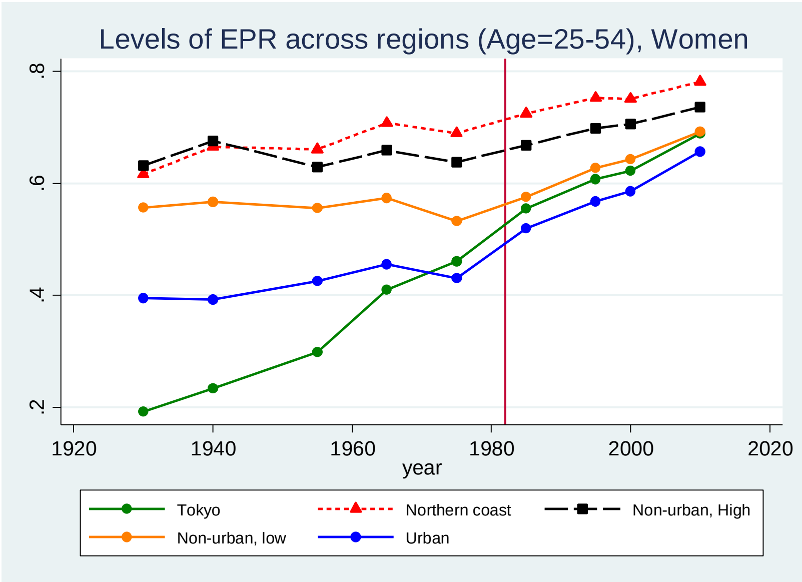
Note: The red vertical line corresponds to year 1982, the earliest year of the ESS data.
Note: Authors' calculation from Census (1930-2010)

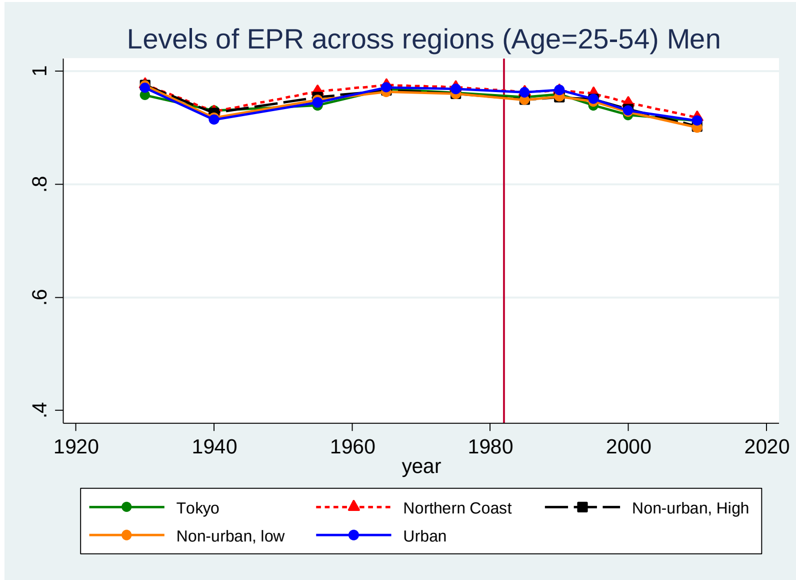
Figure 2
Five regions



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

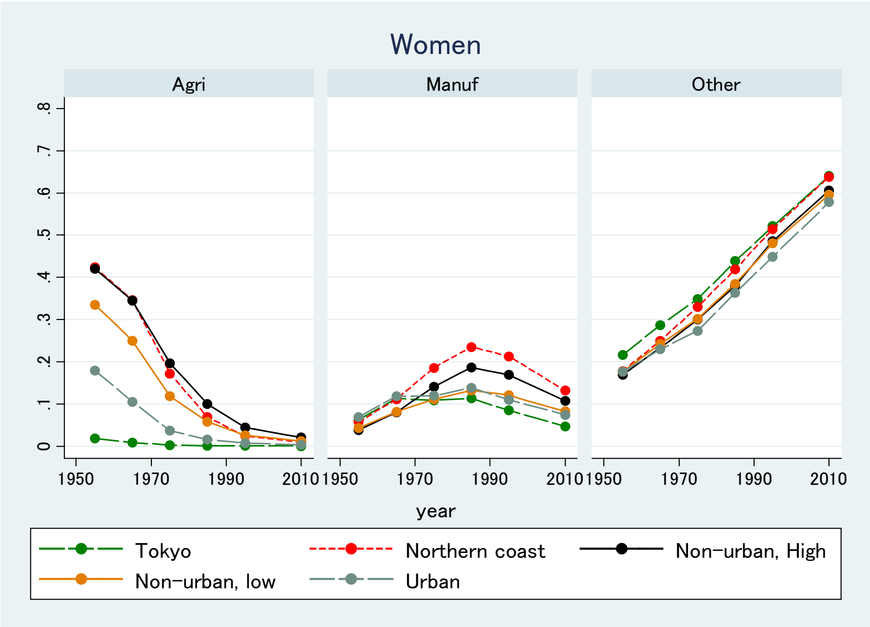
Figure 3 Levels of EPR across five regions

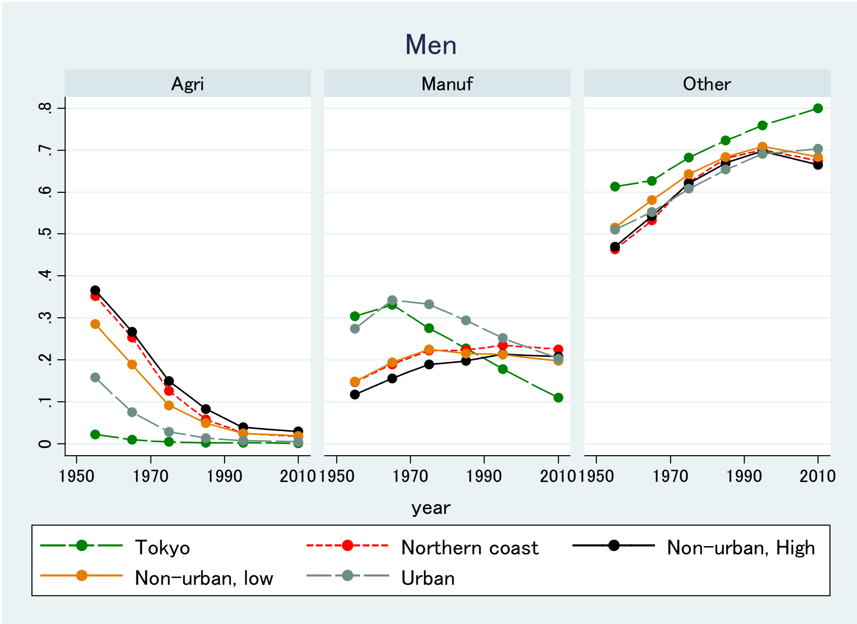




Note: The red vertical line corresponds to year 1982, the earliest year of the ESS data.
Source: Author's calculation from Census (1930-2010)

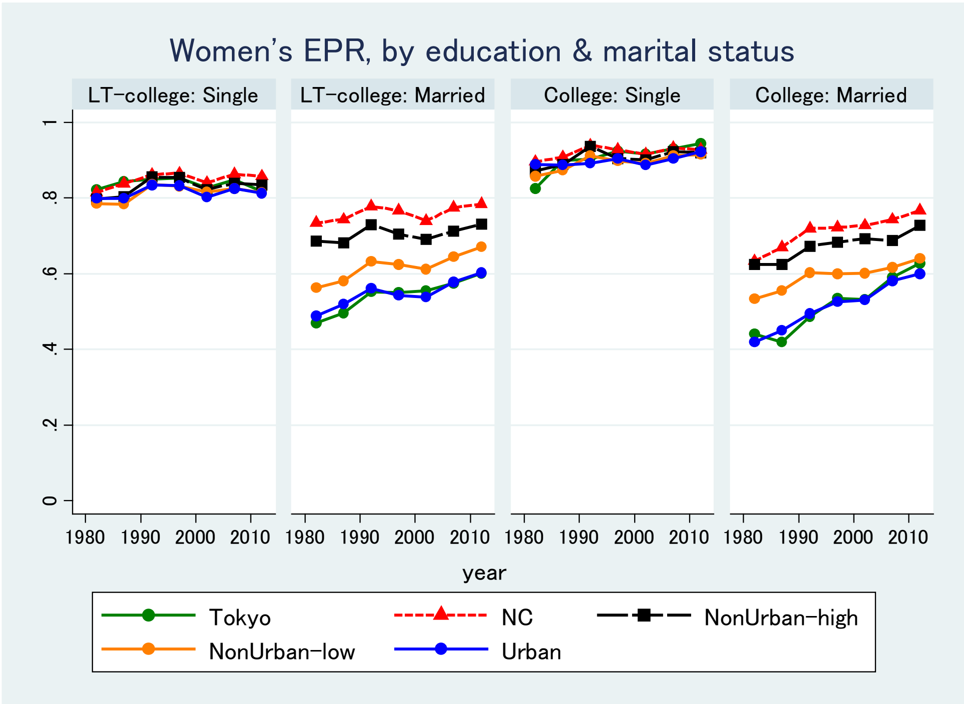
Figure 4
Sector Participation by gender and region: 1955-2010



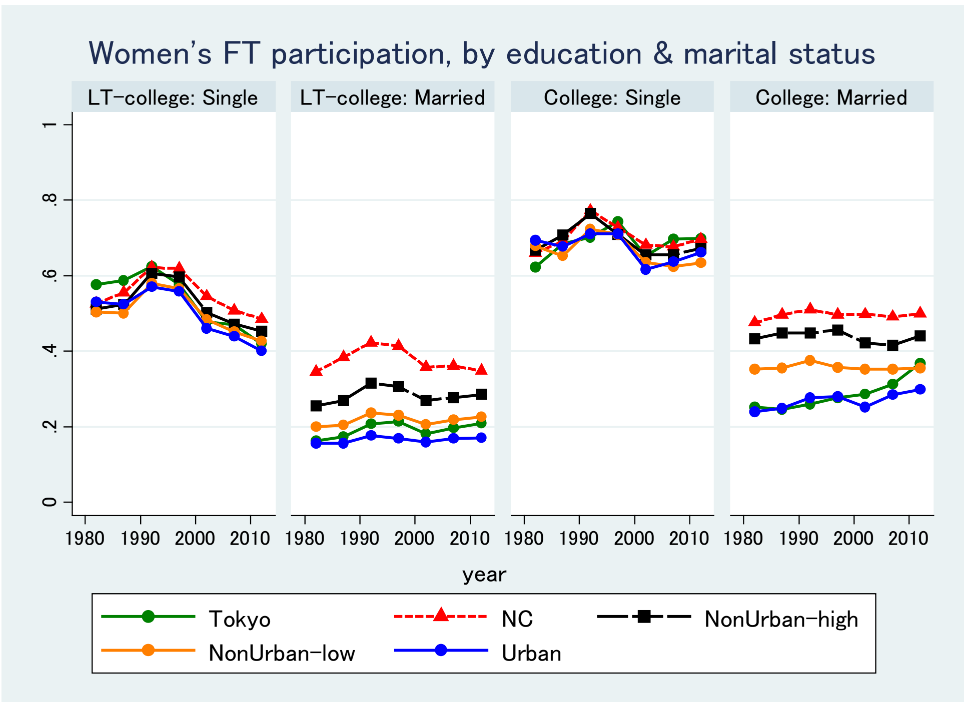


Source: Author's calculation from the Census (1955-2010).

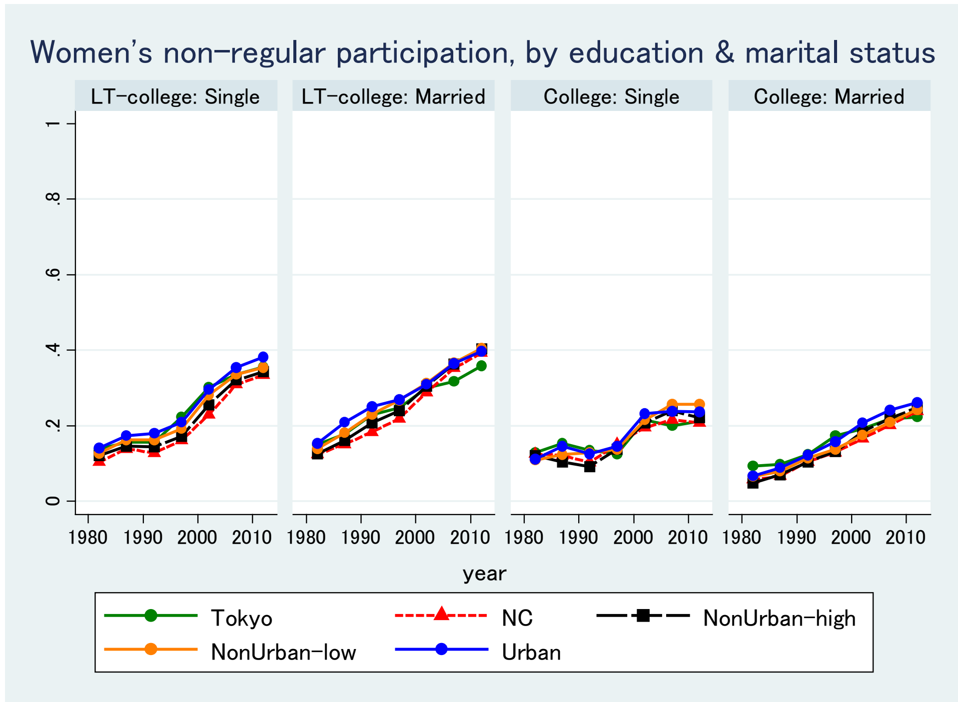
Figure 5
A. EPR by education and marital status



B. Regular FT by education and marital status



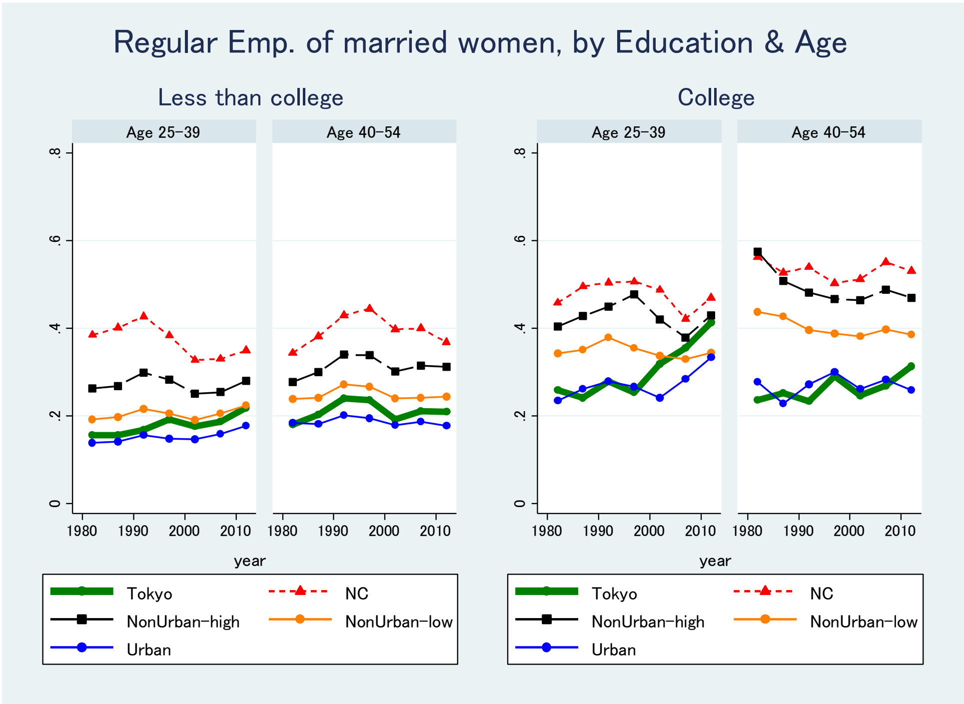
C. Non-regular employment by education and marital status



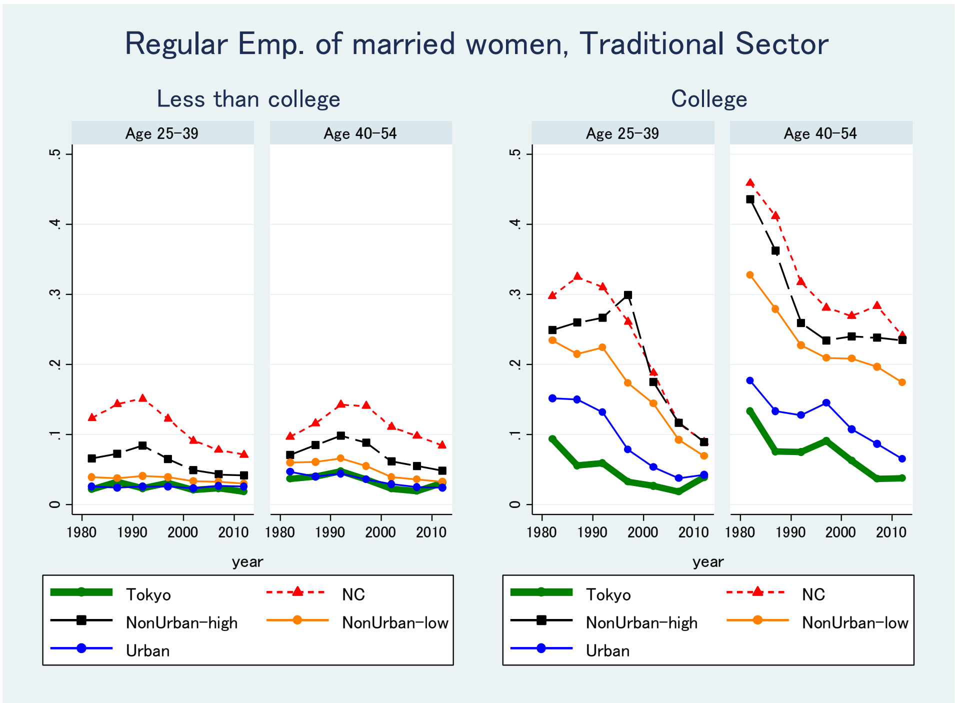
Source: Author's calculation from the ESS (1982-2012).

Figure 6

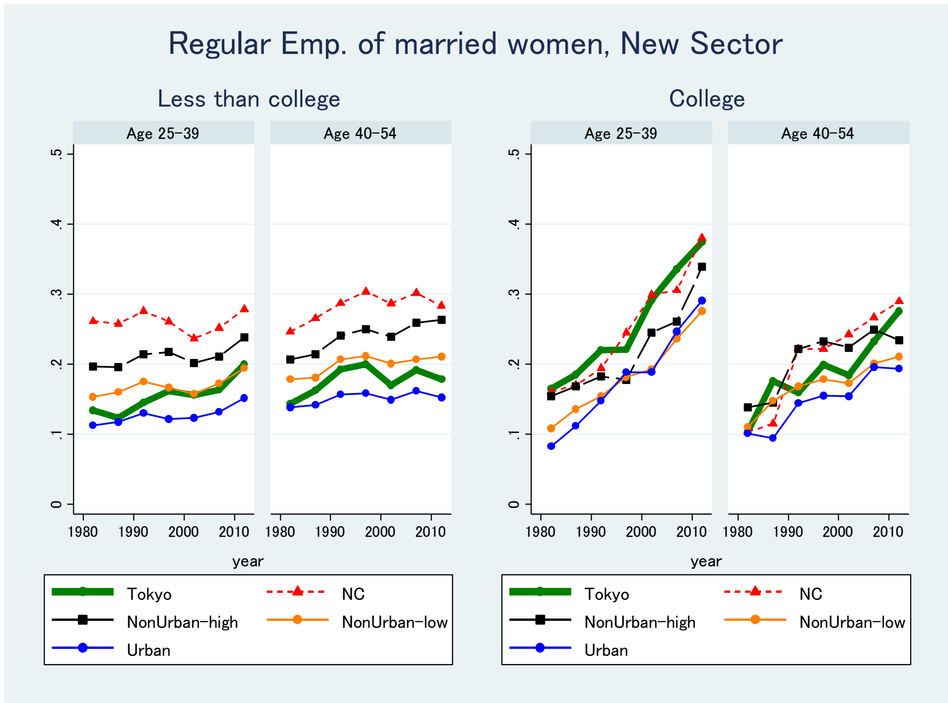
A. Regular full-time employment by married women, by education and age



B. Regular full-time employment by married women in the traditional sector



C. Regular full-time employment by married women in the new sector

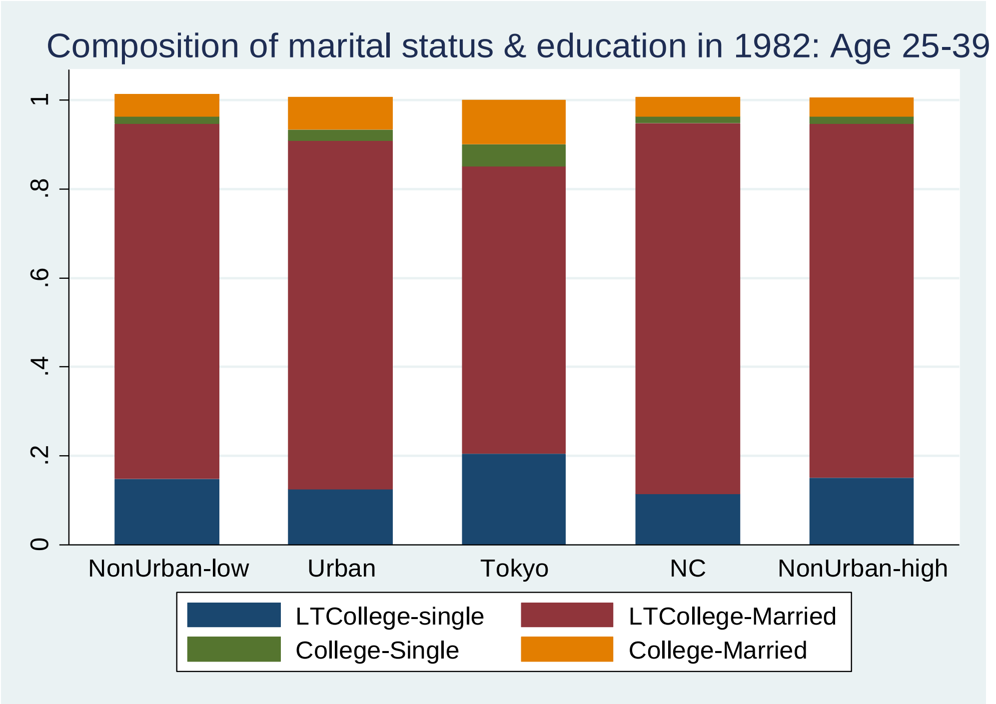


Source: Author's calculation from the ESS (1982-2012).

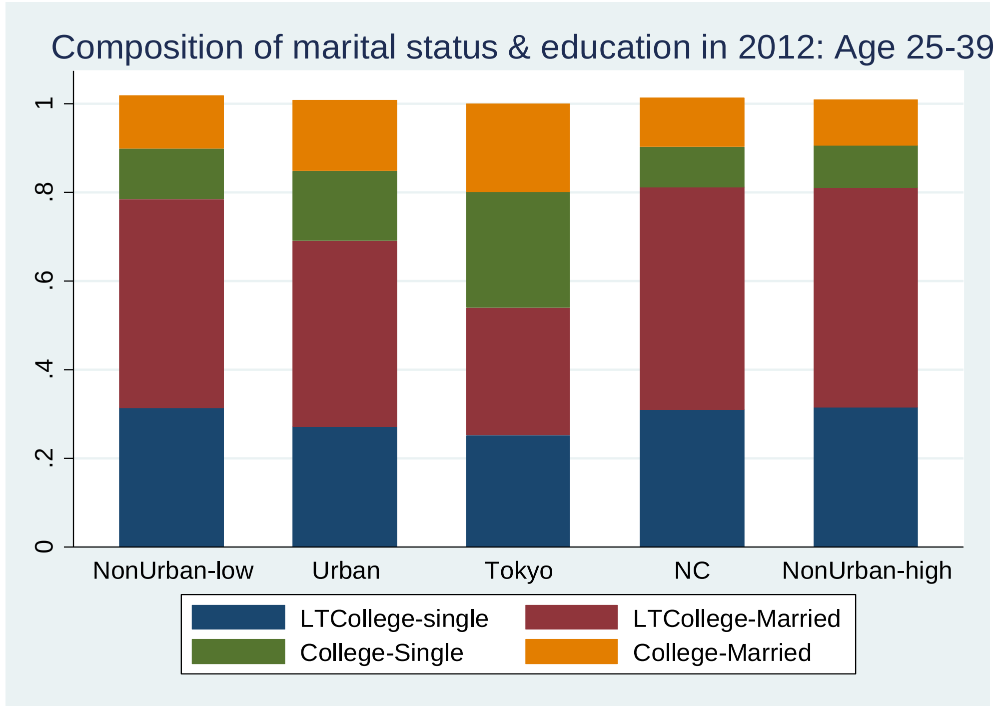
Figure 7 Composition of marital status and education in 1982 and 2012, by age group

Age 25-39

1982

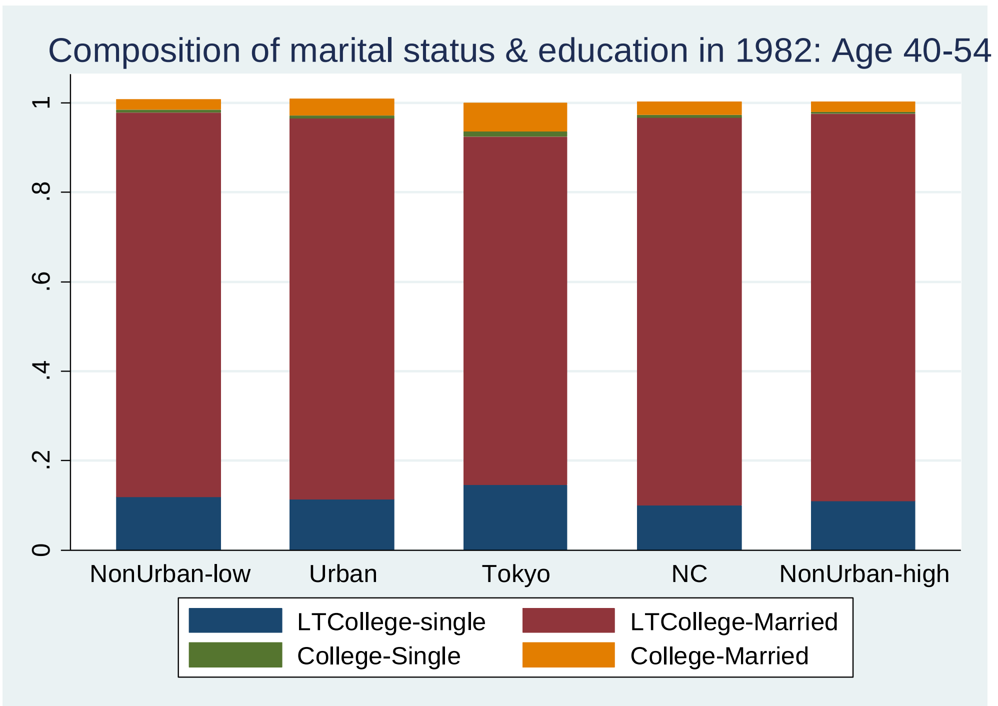


2012

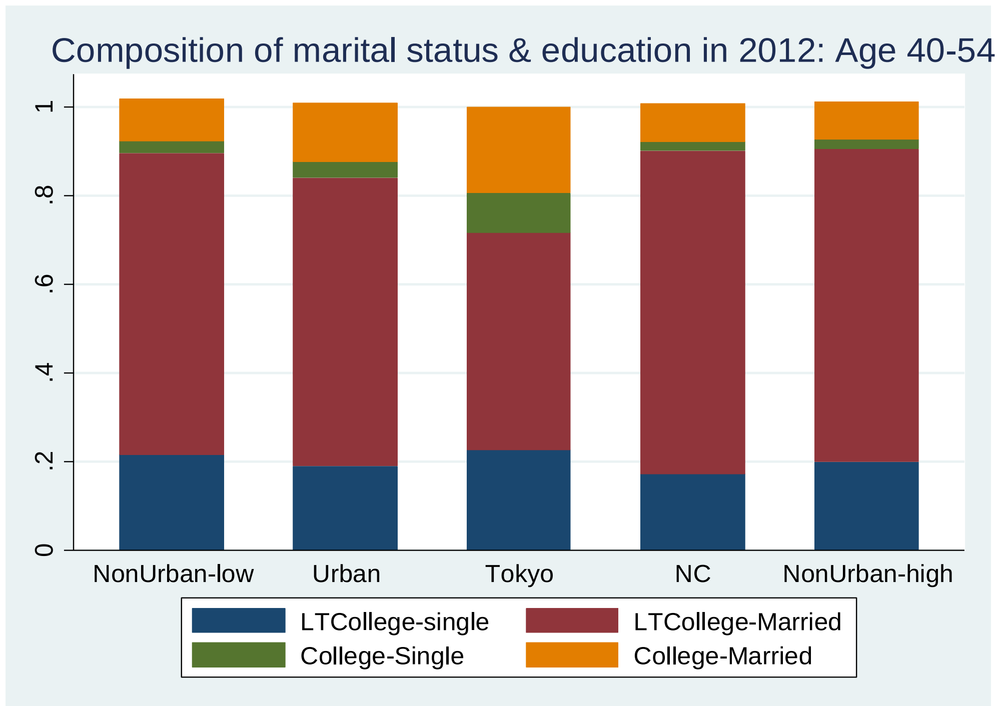


Age 40-54

1982



2012



Source: Author's calculation from the ESS (1982-2012).