Discussion Paper No. 1045

WAGE INEQUALITY DURING THE LONG-TERM STAGNATION IN JAPAN: CHANGES WITHIN AND BETWEEN ESTABLISHMENTS

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November 2018

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Wage Inequality during the Long-term Stagnation in Japan: Changes within and between Establishments

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Abstract

Wage inequality between individuals has changed little in Japan in recent times unlike in other developed countries. We examine changes in wage inequality within and between establishments during the prolonged stagnation period in Japan. Using a micro-level worker–establishment dataset from 1991 to 2012, we find changes in inequality during the 1990s. First, an increase in the variance in the establishment fixed effects expanded men's between-establishment inequality. Meanwhile, a reduction of returns to tenure decreased men's within-establishment inequality and thus suppressed rising individual wage inequality. Second, we find a different trend in women's wage inequality. Between-establishment inequality was larger than that of men in the early 1990s. However, since the structure of wage inequality in men changed significantly, the composition of inequality between men and women has become similar in recent years. Finally, the assortativeness between workers and establishment rose for both sexes.

JEL Codes: J21, J31, M52

Keywords: inequality trends, returns to tenure, within- and between-establishment inequality

1 Introduction

The significant rise in wage inequality in developed countries is associated with an expansion of wage inequality within skill groups (Katz and Murphy, 1992, Bound and Johnson, 1992). An inequality expansion within skill groups has also been found for men's wages in Japan (Kambayashi et al., 2008; Yamada and Kawaguchi, 2015). However, during this expansion, overall wage inequality between individuals has changed little unlike in other developed countries.

The Japanese labor market therefore presents an important test case for assessing changes in wage determination and inequality under a long-term recession. Since the bubble economy collapsed in 1991, the Japanese economy continued to stagnate throughout the 2000s (Japan's so-called "lost decades"). Decisions under such economic fluctuations differ among employers considerably (Fort et al., 2013). Nevertheless, most previous studies have paid limited attention to workplace differences when analyzing wages during recessions.

This study aims to clarify changes in wage inequality in Japan taking into account differing workplace effects. We examine workplace effects using a dataset with an employer/employee structure in which an establishment is the unit of employment. By pooling micro-level data from the Basic Survey on Wage Structure (BSWS) from 1991 to 2012, we can then investigate the changes in Japan's lost decades while controlling for the establishment fixed effects. The BSWS is an annual government survey that covers workers from a nationally representative sample of establishments in Japan. We analyze wages using a linear regression model for each year and capture the change in the effects of workers' heterogeneity and workplace fixed effects on wage inequality.

We make four notable findings. First, we find that wage inequality between establishments is expanding in Japan. For men, between-establishment wage inequality expanded during the study period, whereas within-establishment wage inequality shrank over a similar period. The increase in between-establishment inequality is largely due to the widening disparity in the establishment fixed effects as in other developed countries. This increase occurred more intensively in the 1990s than in the 2000s. The rise in the assortativeness between workers and establishments has also affected the expansion of inequality between establishments. This sorting occurs mainly at lower wages than at higher wages.

Second, we reveal changes in the wage structure that bring about not only between-establishment inequality but also within-establishment inequality. Most previous studies that have pointed out the expansion of inequality between workplaces have paid insufficient attention to the corresponding changes in the workplace. In Japan, during the country's long-term economic depression, wage profiles flattened owing to changes in the internal labor market (Hamaaki et al., 2012). In this study, we confirm that similar changes are observed even when considering the establishment fixed effects. Moreover, we clarify that the decrease in within-establishment wage inequality is caused by the decline in the influence of seniority on wages.

Third, we find different changes among the percentiles of between- and within-establishment inequality that cannot be observed with variance. Song et al. (2018) show that the expansion of between-firm inequality in the United States is caused by a large increase in average wages at higher percentiles. However, when we examine the change in male between-establishment inequality in Japan, the expansion was caused by a decrease (increase) in wages at low (high) percentiles.

Fourth, we shed light on the large difference in the change in inequality by sex. Previous studies such as Card et al. (2013) and Song et al. (2018) have reported the expansion of between- establishment wage inequality, suggesting few differences between sexes. However, in Japan, the establishment effect on wages was significantly different by sex in the early 1990s, and considerable differences in the trend remained thereafter. In the early 1990s, the establishment effect on wages was larger for women than for men and between-establishment inequality for men (women) expanded (shrank) during our study period. As a result, the contributions of establishment fixed effects on total wage inequality between men and women have become approximately equal in recent years.

We contribute to the literature on wage inequality between and within establishments by analyzing changes in employer-specific wage differentials in a country in which wage inequality has rarely changed. The workplace plays an important role in wage determination and provides significant employer-specific wage differentials (Abowd et al., 1999, 2002; Gruetter and Lalive, 2009). The recent literature, including Card et al. (2013), Barth et al. (2016), and Song et al. (2018), has found that the expansion of these differentials and sorting of workers to workplaces have widened wage inequality.

However, these studies have focused on countries in which wage inequality is expanding such as the United States and Germany. Thus, there still is little evidence on whether these differentials have changed in countries with stable wage inequality and on whether the workplace can help explain structural changes in wage inequality.

When we capture the change in wage inequality, considering employer-specific wage differentials is more important in Japan than in other countries, as Japanese employment practices serve as an effective way to foster the skills necessary for each workplace (Carmichae, 1983; Koike, 1988), and thus workers are influenced more strongly by their workplaces. The traditional Japanese employment based on a longer tenure and a sharper wage profile than that of the United States (Hashimoto and Raisian, 1985) declined substantially during the lost decades (Ono, 2010; Hamaaki et al., 2012; Kawaguchi and Ueno, 2013; Kambayashi and Kato, 2017). Our findings show that this decline in the internal labor market is observable even when we control for establishment fixed effects and focus on the wage system in the workplace.

The remainder of this study is organized as follows. Section 2 summarizes the macroeconomic trends and changes in the labor market in Japan. Section 3 describes the data. Section 4 presents our identification strategy. Section 5 reports our findings. Section 6 analyzes the driving factors of these changes. Section 7 concludes.

2 Macroeconomic Trends and Labor Market Changes in the Stagnation Period

This section briefly describes the macroeconomic trends before and after the bubble economy in Japan and summarizes the main changes in its labor market since the early 1990s. Then, we empirically explain the trends in the changes in workers' attributes and wage inequalities in Japan in the 1990s and 2000s.

2.1 Overview of the Macroeconomic Environment

Japan experienced a severe economic contraction in the 1990s and continued stagnation throughout

the 2000s. This period is widely referred to as Japan's lost decades. Before this depression, Japan enjoyed a bubble economy from December 1986 to February 1991, where the economy grew rapidly and the unemployment rate was low. Figure 1 plots the growth rate of GDP and the unemployment rate from 1980 to 2012. The 1980s were characterized by strong growth, with an average annual GDP growth rate of 3.7%. After the bubble burst, growth slowed and the GDP growth rate was negative in 1993, 1998, 1999, and 2009. During this period, the labor market also suffered one of the worst periods in recent Japanese history. The unemployment rate reached a historical high of 5.4% in 2002, more than 2.5 times the level in 1990.

In the 1990s, output per capita dropped to 0.5% on average, much lower than the average of the previous decade (3.2%). The decline in total factor productivity was behind the weak growth in the Japanese economy during these years (e.g., see, Hayashi and Prescott, 2002). The wage level in Japan was also sluggish. As the left-hand side of Figure A1 in Appendix A shows, while average wages in other developed countries such as the United States, the United Kingdom, and Germany rose more than 1.5 times from 1992 to 2010, the average wage in Japan changed little.

[Figure 1 about here]

2.2 Changes in Japan's Labor Market

Certain institutional changes in the 1990s affected wage determinations in Japan. First, we explain the change in Japanese employment practices. Japan has longer job tenures and larger returns to wages (Hashimoto and Rasian, 1985; Mincer and Higuchi, 1988; Clark and Ogawa, 1992). However, as the economic environment changes, such as the low growth and aging population that has characterized Japan since the collapse of the bubble economy, Japanese employment practices have altered. According to Kambayashi and Kato (2011), as far as the change in male tenure is concerned, long-term employment in Japan is not necessarily declining. On the contrary, Hamaaki et al. (2012) point out that the age/wage profile became flatter in the 1990s and 2000s, especially for employees in the middle and final phases of their careers.

Second, the Equal Employment Opportunity Law enforced in 1986 aimed to eliminate differences in

recruitment, placement, training, welfare benefits, retirement, and dismissal for men and women. The revision in 1997 subsequently prohibited sex discrimination with stiff penalties. Since the enforcement of the law in 1986, the employment rate of women aged 15–64 years in Japan has gradually risen from 57.1% to 67.7% in 2012. Further, although the gender wage gap in Japan remains the second greatest among OECD countries after South Korea, the gap between male and female wages has steadily reduced (Hara, 2018).

Third, the rise in the minimum wage has also affected wage inequality in Japan. The statutory minimum wage in Japan increased continuously throughout the 1990s and 2000s. Kambayashi et al. (2013) show that this increase reduced lower-tail inequality.

2.3 Changes in Workforce Composition

The share of educated and older workers in the Japanese labor market has risen steadily since the 1990s. Figure 2 shows the shares by the education, age, and tenure of full-time workers from 1991 to 2012 based on data from the BSWS. Between 1991 and 2012 in Japan, the two-year and four-year college graduate share rose among both men and women. The two-year college graduate share rose from 4.25% to 9.91% for men and from 17.20% to 28.41% for women. The four-year college graduate share rose from 20.64% to 36.53% for men and from 4.65% to 22.71% for women. On the contrary, the shares of junior high school and high school graduates fell. The former dropped sharply from 21.44% to 4.28% for men and from 21.02% to 3.09% for women. The latter dropped from 53.66% to 49.27% for men and from 57.12% to 47.79% for women. Such high education in Japan has spread more rapidly than in the United States (Katz and Revenga, 1989; Kawaguchi and Mori, 2016).

There are three noticeable changes in the share of workers' age. First, the number of young people entering the labor market declined due to the fall in the birthrate and extension of schooling. Second, first-generation Baby Boomers after World War II began to retire and second-generation Baby Boomers reached middle age. Third, the share of women in their thirties and forties in the workforce increased above that for men, as more women continued to work after marriage and childbirth. Tenure among women also lengthened, consistent with the findings of Kambayashi and Kato (2011), whereas the job

tenure of men hardly changed. On the contrary, the share of workers with fewer than 10 years of tenure declined significantly among full-time female workers. Long-term employment is also becoming common for women, although the extent remains less than that for men.

[Figure 2 about here]

2.4 Trends in wage inequality in the 1990s and 2000s

Here, we define a skill group by education, experience, and tenure. Figure 3 illustrates the trends in total, between-group, and within-group wage inequality.[1] Although total wage inequality has hardly changed for either men or women, there is a large difference in their structures. For men, between-group inequality declined in the 1990s and then fluctuated after 2000, while within-group inequality stayed nearly constant in the early 1990s and increased after the mid-1990s. Women showed lower between-group inequality and higher within-group inequality than men. This did not change in the 1990s and 2000s.

Several studies have discussed the trends in Japan's inequality. For example, Tachibanaki (2005) reports that income inequality widened during the 1980s and 1990s. By contrast, Ohtake (2005) claims that the increase in income inequality is partly due to the aging population because the degree of income inequality is intrinsically high among elderly people and the aging population mechanically widens income inequality. Kambayashi et al. (2008) find that the aging population and other changes in the labor force cannot explain the increase in within-group wage inequality among male workers. They also find that the declining between-group wage inequality is largely due to the fall in the returns to education and job tenure. Yamada and Kawaguchi (2015) point out that the decreased return to tenure is a key factor preventing a rise in wage inequality. However, it remains unclear whether the declining between-group wage inequality for men observed in Kambayashi et al. (2008) and Yamada and Kawaguchi (2015) can be observed robustly when we control for the establishment fixed effects. It is also worth verifying whether the increase in within-group inequality among male workers is linked to the

[1] On the right-hand side of Figure A1, while the wage inequality is at a similar level, that in other developed countries expanded after the 1990s. Japan's slight increase in 2005 is assumed to be due to the change in the survey structure.

expansion of inequality between workplaces.

[Figure 3 about here]

3 Data

3.1 BSWS Data

This study uses repeated cross-sectional data from the BSWS from 1991 to 2012, which is collected every year in June by the Ministry of Health, Labor and Welfare in Japan. The BSWS is conducted to explain the wage structure of Japan's main industries by surveying both establishments and their workers. It is the most appropriate and reliable data on the trend of wage inequality in Japan.

The BSWS adopts a two-stage random sampling procedure. In the first stage, establishments are randomly chosen from most regions and industries except the agriculture, forestry, and fishery sector in Japan. The sample includes establishments with 10 or more employees in both the private and the public sectors as well as private establishments with five to nine employees. In the second stage, workers are selected from the payroll records of the selected establishments, following the uniform sampling method.[2] Therefore, it is possible for us to identify to which establishment each worker belongs and control for the workplace fixed effects in our estimation.

The survey consists of an establishment form and an employee form. The former provides information about establishments' location, industry, and number of regular workers (workers with non-terminated contracts or contracts of at least one month). The latter provides individuals' sex, contract type (non-terminated or terminated, full-time or part-time), educational background, age, tenure, and earnings. In addition, we can see their working hours, cash earnings for June including overtime allowance and commuter allowance, and bonus in the last year.

The BSWS changed the category name to identify the working hours of workers on the survey form in 2005 (i.e., during our observation period). Until 2004, the BSWS classified workers into full-time and part-time. Since 2005, the BSWS has called part-time workers short-time workers without changing its definition. As a result, despite the absence of a definition change, the ratio of full-time to part-time

[2] Board members are not included in this sample, but there is neither top- nor bottom-coding instead.

(i.e., short-time) workers has significantly increased since 2005.[3] There might be inconsistency between the 2004 and 2005 surveys because our sample excludes part-time and short-time workers. Therefore, when comparing the periods before 2004 and after 2005, we need to pay attention to this point.

3.2. What is an Establishment?

Following Card et al. (2013) and Barth et al. (2016), this study focuses on an establishment as the unit of analysis. An establishment is defined as a place of business in which a firm conducts a type of economic activity. It is an important unit because several taxes and local regulations affect a firm based on its location. In the dataset, we are unable to identify to which firm each establishment belongs.

Although human resources are managed at the firm level, using an establishment as the unit of analysis is not thought to be a serious concern for the following reason. Since all establishments within a firm strictly adhere to the rules determined by their group, the heterogeneity between establishments is similar to that between firms. From the results verified by Song et al. (2018) using US data, we can thus confirm that rising inequality among establishments is closely mirrored in rising inequality among firms. Indeed, they show that 84% of the increase in cross-establishment inequality can be accounted for by firms.

3.3 Sample and variables

We focus on full-time male and female workers aged 15 to 59. We restrict employees to full-time workers because the BSWS does not provide the educational background for part-time workers. In addition, we exclude those aged 60 and older because the mandatory retirement age is typically 60. Further, we use the log hourly wage as the main dependent variable. Using the information on monthly earnings and monthly working hours, the hourly wage is calculated as follows:

[3] In Japan, some people call those who do not work in permanent positions part-time workers even if they are working full-time. Shinozaki (2008) points out that a some full-time workers were misclassified as part-time workers until 2004.

hourly wage = (monthly earnings×12+bonus) / ((scheduled working hours + overtime worked)×12).

As the bonus in Japan is decided systematically and usually considered to be part of one's wage, we should include it in our measure of hourly wages. This bonus does not necessarily reflect individual performance and is regarded as a kind of profit sharing (Freeman and Weitzman, 1987) and/or a return to job-specific tenure (Hashimoto, 1979).

To capture the trend of wage inequality, our dataset starts from 1992 even though data from 1991 are available. The bonus of the previous year (total amount paid from January to December in the previous year) is reported to the BSWS. Because Japan experienced the bubble economy from December 1986 to February 1991, the bonus in 1991 may have been strongly affected. Hence, we start our dataset in 1992 to avoid these bubble effects and use the wages in the other years converted into 1992 real values based on the consumption price index.

We control for tenure, potential experience (age − educational years − 6), and four categories of educational attainment (junior high school, high school, two-year college, and university or more) to represent workers' characteristics. We use dummy variables for firm size (5–29, 30–99, 100–299, 300–999, 1,000–4,999, and 5000 or more workers), industrial categories (Group 1: Secondary Industry; Group 2: Infrastructure, Transport, and Retail; Group 3: Finance and Real Estate and Group 4: Services), office categories (independent office, head office, branch office), and the 47 prefectures as the variables to represent establishments' characteristics.[4]

3.4 Descriptive Statistics

Table 1 shows the number of employees and establishments in the sample. The yearly sample size ranges between 534,454 and 830,297. There is no notable change in the number of establishments from 1992 to 2012; however, there is a relatively large decline in the average number of female and male workers per establishment. Consequently, the number of workers during the study period decreases by

[4] The Japan standard industrial classification changed three times during our analysis period. We thus construct consistent industrial groups for all periods from the detailed industrial classifications (see Appendix B for more details).

about 200,000 for men and 80,000 for women.[5]

[Table 1 about here]

Table 2 presents the summary statistics for average hourly wages for an employee and an establishment. Hourly wages are adjusted for inflation using the Consumer Price Index in 2010 to allow a comparison among the years. Average wage levels rose from 1992 to 2002 and fell from 2002 and 2012 both for individual workers and for establishments. The average wage between 1992 and 2012 stayed almost the same for men, whereas it rose for women.

[Table 2 about here]

Table 3 reports workers' characteristics in 1992, 2002, and 2012. The changes in workers' characteristics generally correspond with those in Figure 2. We can find a large increase in educational levels for both men and women. Tenure for men hardly changed, whereas that for women lengthened during the study period.

[Table 3 about here]

Table 4 shows the estimates of the Mincer-type wage equation (equation (3)) using 1992, 2002, and 2012 surveys. Columns (1), (4), and (7) report the ordinary least squares (OLS) estimates without controlling for the information on establishments. Columns (2), (5), and (8) control for the establishment characteristics such as firm size and industrial group dummies. Columns (3), (6), and (9) show the estimates with the establishment fixed effects. Returns to education and tenure change largely if we control for the establishment fixed effects. This finding implies a correlation between education/tenure and the establishment fixed effects. An F-test with the null hypothesis of a constant establishment effect is rejected for both men and women in all sample years.

[Table 4 about here]

[5] The decrease in the number of workers at each establishment is assumed to be caused by a decline in the workforce since the peak in 1997, an increase in workers aged 60 and over, and an increase in the ratio of part-time workers.

4 Econometric Framework

4.1 Simple Variance Decomposition

Our first approach is to decompose the variance in log hourly wages into the within- and between-establishment components. Let $y_t^{i,j}$ be the log hourly wages of worker i employed by establishment j in year t. We assume that $y_t^{i,j}$ can be decomposed into two parts, namely the average establishment wage ($\bar{y}_t^j$) and the difference in the average establishment wage ($y_t^{i,j} - \bar{y}_t^j$):

$$y_t^{i,j} \equiv \bar{y}_t^j + \left[y_t^{i,j} - \bar{y}_t^j\right]. \quad (1)$$

Then, we can decompose the variance in individual wages as follows:

$$Var\left(y_t^{i,j}\right) = Var\left(\bar{y}_t^j\right) + Var\left(y_t^{i,j} - \bar{y}_t^j\right), \quad (2)$$

where $Var\left(\bar{y}_t^j\right)$ is between-establishment inequality. Between-establishment wages are weighted to place greater weight on establishments with more workers. $Var\left(y_t^{i,j} - \bar{y}_t^j\right)$ is within-establishment inequality. Using this method, we decompose wage inequality for each year and show the trends.

4.2 Simple Decomposition across Percentiles

Under our second approach, we decompose individual wages by percentile. While the variance decomposition presented in Section 4.1 is a useful and easy method, it can mask trends in inequality across the wage distribution. In this section, we compare the wage distribution in 1992 with that in 2012. First, we categorize individuals in 1992 into percentile bins based on their wages. Second, we estimate the average wages for each percentile bin. Let $Px\left(y_{1992}^{i,j}\right)$ indicate the average log wages at the x-percentile bin in 1992. We apply the same procedure to the wage in 2012 and calculate $Px\left(y_{2012}^{i,j}\right) - Px\left(y_{1992}^{i,j}\right)$. The same calculations are repeated for all the percentiles.

The variance in individual wages comprises the average wage of the establishment ($\bar{y}_t^j$) and the difference in establishments' average wage ($y_t^{i,j} - \bar{y}_t^j$), as in equation (2). $\bar{y}_t^j$ and $y_t^{i,j} - \bar{y}_t^j$ are based on the percentile of individual wages (x). That is, at each *x*-percentile bin of individual wages, we calculate the average establishment wage and its difference for each year. Then, we take their difference between years for the same percentages; hence, the between-establishment change is $Px(\bar{y}_{2012}^j) - Px(\bar{y}_{1992}^j)$ and the within-establishment change is $Px(y_{2012}^{i,j} - \bar{y}_{2012}^j) - Px(y_{1992}^{i,j} - \bar{y}_{1992}^j)$.

4.3 Detailed Variance Decomposition

We next investigate the sources of those changes in within- and between-establishment inequality that appeared in the simple decomposition. Specifically, we estimate a Mincer-type wage equation with the establishment fixed effects and then decompose the variance in the predicted wages. Although Card et al. (2013) and Song et al. (2016) use establishment–worker matched panel data and identify both establishment and employee fixed effects using Abowd et al.'s (1999) approach, we employ repeated cross-sectional data and thus cannot apply their approach.

Under the assumption that the wage determination process is common across establishments, after we control for the establishment fixed effects, we can write the Mincer-type wage equation for each year as in equation (3):

$$y_t^{i,j} = \varphi_t^j + \beta_t X_t^{i,j} + u_t^{i,j}, \quad (3)$$

where φ_t^j denotes the establishment fixed effects, while $X_t^{i,j}$ denotes the workers' characteristics composed of dummy variables of educational attainment, tenure and its squared term, potential experience and its squared term, and the interaction term of tenure and potential experience. $u_t^{i,j}$ denotes an idiosyncratic shock. We define workers' observable characteristic effects as $X_t^{i,j}\hat{\beta}_t$ (hereafter worker effects).

For OLS to identify the parameters of interest, we need the following conditions to hold:

$$E\left(\varphi_t^j u_t^{i,j}\right) = 0 \ \forall j, \ E\left(X_t^{i,j} u_t^{i,j}\right) = 0 \ \forall i. \ (4)$$

The assumption that the residuals ($u_t^{i,j}$) are orthogonal to covariates ($X_t^{i,j}$) is standard. However, the assumption that residuals are orthogonal to establishment identifiers (φ_t^j) depends on the condition that the assignment of workers to establishments is strict exogeneity conditional on the covariates ($X_t^{i,j}$).

Substituting the establishment effects and worker effects into equation (1), we obtain equation (5):

$$y_t^{i,j} \equiv \varphi_t^j + \hat{\beta}_t \bar{X}_t^j + [\hat{\beta}_t (X_t^{i,j} - \bar{X}_t^j) + u_t^{i,j}]. \ (5)$$

$$Var\left(y_t^{i,j}\right) =$$

$$Var\left(\varphi_t^j\right) + Var\left(\hat{\beta}_t \bar{X}_t^j\right) + 2Cov\left(\varphi_t^j, \hat{\beta}_t \bar{X}_t^j\right) + Var\left(\hat{\beta}_t (X_t^{i,j} - \bar{X}_t^j)\right) + Var\left(u_t^{i,j}\right). \ (6)$$

Taking the variance in equation (5), we decompose the variance in log wages into five parts as shown in equation (6): variance in the establishment fixed effects, variance in the predicted wage from the average worker effect at each establishment, their covariance, variance in relative worker effects (i.e. workers' relative wage at their establishment expected from their observable attributes), and variance in the residual.[6]

4.4 Detailed Decomposition across Percentiles

Finally, we consider a decomposition across percentiles corresponding to the detailed variance decomposition. In the detailed variance decomposition, we decomposed individual wages into five

[6] In our approach, an unobserved individual effect that workers at the same establishment hold commonly is included as part of the establishment fixed effects. Therefore, if there is sorting between an establishment and workers, the variance in the establishment fixed effects will be overestimated compared with using the estimation method of Abowd et al. (1999).

parts: the establishment fixed effects (φ_t^j), average workers' characteristics at establishments ($\hat{\beta}_t \bar{X}_t^j$), the combination of establishment fixed effects and average workers' characteristics ($\varphi_t^j, \hat{\beta}_t \bar{X}_t^j$), relative worker effects ($\hat{\beta}_t (X_t^{i,j} - \bar{X}_t^j)$), and residual ($u_t^{i,j}$). We observe the change in each part based on the percentiles of individual wages (x). We then calculate their average at each x-percentile bin of individual wages for each year. However, we use $\sqrt{\varphi_t^j, \hat{\beta}_t \bar{X}_t^j}$ to index the extent of the combination and take the differences in the five components between years at the same percentages.

5 Results

5.1 Simple Variance Decomposition

We conduct the model (2) decomposition using data from 1991 to 2012 by sex. Figure 4 reports the trends in the share of within- and between-establishment inequality in total individual wage inequality. For men, within- and between-establishment wage inequality in the early 1990s were similar. Between-establishment inequality expanded and within-establishment inequality shrunk in the late 1990s. However, for women, the share of between-establishment inequality was much larger in the early 1990s than that of within-establishment inequality. Between-establishment inequality in the early 1990s was larger for women than for men. However, between- and within-establishment inequality for women did not change (both in its share and in its level) unlike those of men. Consequently, the shares of between- and within-establishment inequality in individual wage inequality are similar for men and women.

Kambayashi et al. (2008) investigate the increase in wage inequality within skill groups from 1989 to 2003 in Japan, finding a difference in the changes for men and women over time. They suggest that the change in the composition of worker characteristics explains the expansion of women's wage inequality within the same skill groups. However, the expansion for men did not offer a similar explanation. Our results suggest that an increase in between-establishment inequality for men does explain the expansion in wage inequality among men within the same skill groups.

[Figure 4 about here]

5.2 Simple Decomposition across Percentiles

Figure 5 reports the wage changes for each percentile in the individual wage distribution. The horizontal axis indicates the percentiles of an individual worker's wage and the vertical axis shows changes in wages from 1992 to 2012. The line labeled "total" reports the change in the individual wage distribution from 1992 to 2012, "between" denotes the change in the average establishment wage, and "within" denotes the changes in the deviation of the individual wage from the average wage of the establishment to which the worker belongs.

Figure 5 shows that men's inequality in individual wages is slightly increasing and that between-establishment wage inequality is widening more than that of individual wages. Not only the increase at higher percentiles but also the decline at lower percentiles in the average establishment wage contribute to the increase in between-establishment inequality. Men's "within" line shows a rise (fall) in the deviation of the individual wage from the average establishment wage at lower (higher) percentiles.

The difference with the United States (see Song et al., 2018) appears more clearly in the wage distribution than in the variance. In Japan, there is no jump in the average establishment wage at higher percentiles as seen in the United States. The significant changes in within-establishment inequality for men are also unique to Japan. Within-establishment inequality remains almost constant in the United States. The change in the wage distribution of women is considerably different to that of men. In the distribution of individual wages, the wage level is rising overall. However, the rise in wages is limited at a particularly high levels (i.e., above the 90^{th} percentile). The rises in individual wages reflect the rise in the average establishment wage. There is no remarkable change in within-establishment inequality as for men.

[Figure 5 about here]

5.3 Detailed Variance Decomposition

To quantify the contributions of changing wage inequality in the worker and establishment effects, and assortative matching, we conduct a detailed variance decomposition based on equation (6). Table

5 reports the variance and their share of each component for 1992, 2002, and 2012. Figure 6 shows the trends from 1991 to 2012.

The male result in Table 6 shows that the variance in the worker effects declined from an average of 0.030 in 1992 to 0.024 in 2012, whereas the variance in the establishment fixed effects increased from 0.085 in 1992 to 0.103 in 2012. The share of the variance in the establishment fixed effects in overall wage inequality increased from 33.7% in 1992 to 39.5% in 2012. This finding implies that one's place of work explains a larger part of the wage determination in recent years. The covariance between the worker and establishment effects also increases from 0.020 in 1992 to 0.032 in 2002. This finding implies that the rise in assortativeness between workers and establishment contributes to the increase in between-establishment wage inequality. On the contrary, the variance in the relative worker effect for each establishment significantly decreased from 0.079 in 1992 to 0.059 in 2012. The variance in the residual seems to be increasing, but the rise occurred in 2005 and thus it cannot be distinguished from the influence of the change in the survey form.

For women, the variance in the establishment fixed effects accounts for the vast majority of overall variance, which was 56.4% in 1992 but decreased to 44.7% in 2012. The variance in the relative worker effect in their establishment among women is lower than that among men. It was 0.032 in 1992, representing only 17% of overall wage inequality. Moreover, there was no significant change in the variance in the predicted relative wage from 1992 to 2012. The degree of assortative matching is rising for women like men. However, as shown in Figure 6, the covariance in the early 1990s for women was much lower than that for men.

[Table 5 and Figure 6 about here]

5.4 Detailed Decomposition across Percentiles

To assess how each part of workers' wages in each percentile of the wage distribution has changed, we use the method described in Section 4.4. Figure 7 reports the changes in the five parts of wages for each percentile of the individual wage distribution. The horizontal axis indicates the percentiles of an individual worker's wage.

[Figure 7 about here]

The most noticeable changes in the male graph are the changes in the establishment fixed effects and worker effect. Neither changes markedly in a specific wage distribution, whereas the establishment fixed effects increase more and the worker effect decreases more as wages rise. However, the interaction of the establishment fixed effects and worker effects, which represents the change in assortativeness between workers and establishments, suggests a change in a particular wage distribution. The downward shift at the lower tail of the wage distribution is larger than the upward shift at the higher tail.

For women, the establishment fixed effects decrease more as wages rise, probably because wages were raised at low-paying establishments in response to the revision of the Equal Employment Act and rises in the minimum wage. The average worker effect and the interaction of the establishment fixed effects and average worker effect peak around the 75th percentile, and thereafter their degree of change is smaller for higher percentiles. The widening variance of these parts is assumed to be caused by the extension of female tenure; however, why the effect is weakened at high percentiles (e.g., above the 75th percentile) is unclear.

6 Worker and Establishment Fixed Effects, and Assortative Matching

6.1 Accounting for Within-establishment Inequality

To examine the source of the decreasing within-establishment inequality, we estimate counterfactual wage inequality using the coefficient of workers' characteristics in 1992, $Var\left(\hat{\beta}_t(X_t^{i,j} - \bar{X}_t^j)\right)$. By comparing them with actual establishment inequality in the worker effects, we can learn how changes in the coefficient affect changes in within-establishment inequality.

Figure 8 shows counterfactual wage inequality. In this figure, we fix the coefficient of the observables at 1992 for experience, tenure, and experience × tenure.[7] For men (see the left-hand panel), the line of

[7] We do not report the counterfactual variance with the coefficient of education in 1992 because it is similar to the actual variance.

the counterfactual coefficient of tenure follows a different trend to actual wage inequality. This finding suggests that a decrease in the coefficient of tenure affected the decline in within-establishment inequality in the 1990s. Further, the contributions of the change in the coefficient of experience increase in the late 2000s. This change implies that wages have been influenced by raising the mandatory retirement age and the change in the survey form.

As pointed out by Hamaaki et al. (2012), we confirm that there was a decrease in returns to tenure implied by the flattening of the wage profile even if we control for the establishment fixed effects. Yamada and Kawaguchi (2015) argue that changes in the coefficients of tenure and experience explain the decrease in overall individual wage inequality in the 1990s. In our results, the change in the coefficient of experience hardly affects the variance in wages, whereas tenure's effects are similar to their results. As shown in the right-hand panel of Figure 8, counterfactual wage inequality with tenure's coefficient in 1992 is rapidly increasing in the 1990s for women, driven by women's tenure increasing significantly. On the contrary, the change in the coefficient of experience hardly affects the variance in wages as for men. The gender differences in within-establishment inequality are considered to be caused by the different maturity levels of the internal labor market.

[Figure 8 about here]

6.2 Accounting for Between-establishment Inequality

The results in Sections 5.3 and 5.4 show that a large part of the rise in between-establishment inequality for men is associated with the rise in the variance in the establishment fixed effects. To investigate the source of this disparity increase, we decompose the variance in the establishment fixed effects by their characteristics. We assume that the establishment fixed effects φ_t^j in equation (3) consist of three components: firm size, prefecture (47 administrative regional units), and industry. The error term (ν_{jt}) represents the difference in productivity and allowance that the three factors cannot explain, and we suppose $\mathrm{E}\left(\nu_{jt} \middle| Firsize_j,\ Prefecture_j,\ Industry_j\right) = 0$. Then, the variance in the establishment fixed effects is decomposed as in equation (8).

$$\varphi_t^j = \delta_{0,t} + \delta_{1,t} Firm\_Size_j + \delta_{2,t} Prefecture_j + \delta_{2,t} Industry_j + \nu_{jt}, \quad (7)$$

$$Var(\varphi_t^j) = Var\left(\delta_{1,t} Firm_{Size_j}\right) + Var(\delta_{2,t} Prefecture_j) + Var(\delta_{2,t} Industry_j) + Var(\nu_{jt}). \quad (8)$$

Table 6 and Figure 9 report the results of this establishment fixed effects decomposition. The ratios of the parts that are not explained by firm size, region, and industry in the establishment fixed effects increase each year. Further, there is almost no common point, such as the breakdown in variance in the early 1990s and the transition between men and women. For men, about one-quarter of the variance in the establishment fixed effects is explained by the wage difference according to firm size, while wage inequality derived from the differences in firm size increased from the late 1990s. For women, the variance in the establishment fixed effects declined, largely due to the falling variance among firm sizes and industries.

The existence of a firm size/wage premium has long been studied (Brown and Medoff, 1989; Troske, 1999). However, some studies have recently pointed out the relationship between productivity and wage inequality (Berlingieri et al., 2018). They show that the link between wages and productivity is strong, especially in the service sector. Unfortunately, no productivity information on each establishment is available. Hence, the question of whether the increase in the productivity gap caused the increase in the variance in the establishment fixed effects is beyond the scope of our study and remains an avenue for future research.

In Germany, the variance in the establishment fixed effects has doubled over about 30 years (Card et al., 2013), whereas the change in Japan over 20 years has not been as large. In addition to shrinking wage inequality in the workplace, this different trend in establishment fixed effects is one of the reasons why Japan's wage inequality has expanded little. To clarify the reasons behind this, an analysis using more information at the establishment level would be necessary.

[Table 6 and Figure 9 about here]

6.3 Change in the Assignment of Workers to Establishments

To reveal more about the rise in the covariance in the worker effects ($X_t^{i,j}\hat{\beta}_t$) and establishment fixed effects (φ_t^j), Figure 10 displays the joint distribution among the deciles of worker and establishment fixed effects in 1992 and 2012, while the third panel shows the difference between them. There is a rise in assortative matching: workers who may receive high (low) wages are concentrated in an establishment that may pay high (low) wages, which increases the wage differential.

However, the change in matching in Japan is moderate. Using our definitions of worker and establishment fixed effects, assortativeness does not rise intensively among the very high wage groups as seen in the United States (Song et al., 2016). This is more remarkable at lower deciles than at higher deciles, where the middle- and lower-decile workers have substantially shifted to lower-decile establishments. Larger Japanese firms, which often pay higher wages, tend to have employees with longer tenures and their employment is less mobile (see Hamaaki et al., 2012). Executives are often chosen from among career employees.[8] Therefore, it is unlikely that assortativeness will rise intensively in the high wage distribution. This limited change in matching is one of the reasons why wage inequality has not increased significantly in Japan.

[Figure 10 about here]

7 Conclusion

This study investigates within- and between-establishment wage inequality from 1991 to 2012 using Japanese employer/employee data. We find the following three main results. First, the results of the detailed decomposition of within- and between-establishment wage inequality suggest an expansion of the latter for men during the study period, while this expansion is offset by the contraction of the former. The increase in between-establishment inequality stems from the expanding establishment fixed effects. The decrease in within-establishment inequality is caused by a reduction in returns to tenure estimated in the wage equation. This decrease is a key factor preventing a rise in wage inequality in Japan.

[8] Only managers lower than directors are included in the BSWS sample.

Second, we find a different trend in women's wage inequality. This finding suggests that men and women faced different labor markets. The establishment effect on wages was significantly different for men and women in the early 1990s and there were also considerable differences in the trend thereafter. In the early 1990s, the establishment effect on wages was larger for women than for men and between-establishment inequality shrunk. As a result, the impact of establishments on wages between men and women has become similar in recent years.

Third, we find that a rise in assortative matching between workers and establishments increases between-establishment inequality. The rise in assortativeness is larger for women than for men. It is because women are more likely to find it easier to change jobs than men. In addition, the share of so-called lifetime employment remains large and retention rates are low for men in Japan compared with in other developed countries. Thus, the impact of assortative matching on wage inequality in Japan is not as large as other countries.

We acknowledge the several limitations of the present study. First, our analysis cannot exclude the effect of unobserved worker heterogeneity by controlling for the fixed effects because we employ repeated cross-sectional data. Second, we cannot clarify in detail the factors that changed the variance in the establishment fixed effects because of the limited information at the establishment level. In particular, the heterogeneous effects of productivity, profitability, and labor's share of revenue would be a fruitful topic for future research.

Acknowledgement

This study is based on the second chapter of the Ph.D. dissertation of Akesaka at Osaka University. This was originally published as ISER DP No. 985, entitled "Trends in Wage Inequality Within and Between Establishments: Evidence from Japanese Employer–Employee Matched Data," (in Japanese: 『事業所内・事業所間賃金格差の変遷日本の事業所―労働者結合データによる考察』) October 2016. We are grateful to Junichiro Ishida, Ryo Kambayashi, Nobuyoshi Kikuchi, Miki Kohara, Fumio Ohtake, Ryosuke Okazawa, Hideo Owan, Masaru Sasaki, Katsuya Takii, Junichi Yamasaki, and Kazufumi Yugami for their helpful comments and suggestions. We also would like to thank the seminar

participants of the 2015 Japanese Economic Association Spring Meeting at Niigata University, 18th Labor Economics Conference at Hitotsubashi University, RIEB Seminar at Kobe University, and Economic Workshop at Osaka City University for their useful discussions. Any remaining errors are our own. Akesaka was financially supported by the Grant-in-Aid for JSPS Fellows DC2 (14J07655) and the Grant-in-Aid for Scientific Research S (15H05728) from the Japan Society for the Promotion of Science. This research was also financially supported by the Grant-in-Aid for Scientific Research (24330074). We use the BSWS based on permission from the Ministry of Health, Labor and Welfare (MHLW). The views expressed are those of the authors and do not necessarily reflect those of the MHLW.

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Table 1: Sample Structure of Full-time Men and Women

	Number of observations		Number of workers in an Establishment			
	Workers	Establishments	Mean	Std.Dev	Min	Max
Male						
1992	765,677	52,611	14.55	14.11	1	316
2002	736,390	49,749	14.80	13.84	1	351
2012	565,926	52,006	10.88	11.24	1	279
Female						
1992	338,797	49,044	6.91	7.06	1	122
2002	269,312	45,091	5.97	6.51	1	103
2012	265,948	46,546	5.71	6.17	1	134

Notes: Sample includes employees in Japan aged 15–59 working full-time in establishments that hire 10 or more employees (full- and part-time workers combined) or in single establishments of firms that hire five to nine employees.

Table 2: Summary Statistics for Wages

		Log hourly wage				Average of log hourly wage in establishments			
		Mean	Std.Dev	Min	Max	Mean	Std.Dev	Min	Max
Male									
	1992	7.71	0.50	4.22	11.89	7.59	0.39	5.76	10.39
	2002	7.80	0.50	4.05	13.22	7.68	0.41	5.72	10.06
	2012	7.71	0.51	2.90	11.96	7.59	0.42	5.79	9.76
Female									
	1992	7.18	0.47	4.02	11.51	7.14	0.39	5.67	10.99
	2002	7.37	0.46	3.59	12.78	7.32	0.40	4.62	10.59
	2012	7.32	0.45	4.22	11.85	7.27	0.37	5.48	10.64

Notes: Hourly wages are adjusted for inflation using the Consumer Price Index in 2010.

Table 3: Basic Statistics of Full-Time Workers

	Male			Female		
Sample year	1992	2002	2012	1992	2002	2012
Education						
Junior High School	0.21	0.09	0.04	0.16	0.06	0.02
High School	0.54	0.52	0.47	0.63	0.56	0.51
Two year college	0.05	0.10	0.11	0.16	0.25	0.26
University or over	0.20	0.29	0.38	0.05	0.13	0.21
Experience	20.16	19.73	19.53	17.47	17.41	18.37
	(11.94)	(11.59)	(10.93)	(13.31)	(12.46)	(11.69)
Tenure	11.53	12.34	11.47	7.75	9.41	9.15
	(9.95)	(10.38)	(10.11)	(7.96)	(8.50)	(8.66)
Industry						
Group 1 (Secondary industry)	0.47	0.40	0.23	0.47	0.40	0.23
Group 2 (Infrastructure, Transport, Retail)	0.26	0.27	0.22	0.22	0.25	0.21
Group 3 (Finance and Real Estate)	0.09	0.08	0.13	0.10	0.09	0.15
Group 4 (Service)	0.18	0.24	0.41	0.20	0.26	0.41
Firm size						
5-29	0.36	0.31	0.27	0.36	0.29	0.27
30-99	0.19	0.19	0.16	0.20	0.20	0.17
100-299	0.13	0.14	0.14	0.14	0.15	0.15
300-999	0.10	0.12	0.12	0.10	0.13	0.12
1000-4999	0.10	0.12	0.14	0.10	0.12	0.14
5000 or over	0.12	0.12	0.16	0.10	0.11	0.14

Notes: Standard deviations are in parentheses. Although observations are available for every year between 1991 and 2012, the descriptive statistics are reported for three years.

Table 4: Estimation Results of the OLS and Establishment Fixed Effects Model

Male	1992			2002			2012		
	(1) Base	(2) + Establ. characteristics	(3) + Establ. Fixed Effect	(4) Base	(5) + Establ. characteristics	(6) + Establ. Fixed Effect	(7) Base	(8) + Establ. characteristics	(9) + Establ. Fixed Effect
Junior high school	-0.182	-0.144	-0.112	-0.168	-0.131	-0.093	-0.140	-0.109	-0.066
Two year collage	0.118	0.111	0.075	0.108	0.093	0.073	0.087	0.083	0.060
University or over	0.368	0.277	0.203	0.356	0.268	0.184	0.361	0.275	0.169
Experience	0.026	0.040	0.043	0.026	0.035	0.038	0.022	0.028	0.030
$\text{Experience}^2/100$	-0.042	-0.072	-0.075	-0.037	-0.061	-0.062	-0.036	-0.053	-0.052
Tenure	0.040	0.025	0.023	0.039	0.025	0.020	0.039	0.030	0.028
$\text{Tenure}^2/100$	0.010	-0.011	-0.017	0.023	-0.009	-0.017	0.010	-0.025	-0.039
Experience * Tenure	-0.054	-0.006	0.002	-0.069	-0.009	0.003	-0.054	-0.001	0.010
Constant	6.983	6.738	6.976	7.008	6.790	7.078	6.959	6.763	7.028
adj. R-sq	0.575	0.675	0.649	0.541	0.642	0.613	0.508	0.606	0.534
Obs.		765,677			736390			565926	
H_0 : Fixed effects are homogeneous									
F-value(p-value)			24.31(0.00)			30.65(0.00)			19.55 (0.00)

Female	1992			2002			2012		
	(1) Base	(2) + Estab. characteristics	(3) + Estab. Fixed Effect	(4) Base	(5) + Estab. characteristics	(6) + Estab. Fixed Effect	(7) Base	(8) + Estab. characteristics	(9) + Estab. Fixed Effect
Junior high school	-0.211	-0.130	-0.077	-0.170	-0.116	-0.063	-0.144	-0.102	-0.032
Two year collage	0.199	0.113	0.069	0.272	0.170	0.080	0.212	0.181	0.071
University or over	0.422	0.276	0.179	0.441	0.304	0.170	0.435	0.371	0.170
Experience	-0.003	0.010	0.010	0.007	0.012	0.013	0.009	0.012	0.007
$\text{Experience}^2/100$	0.011	-0.019	-0.015	-0.010	-0.026	-0.024	-0.016	-0.026	-0.014
Tenure	0.064	0.053	0.053	0.051	0.044	0.037	0.042	0.039	0.039
$\text{Tenure}^2/100$	0.027	-0.009	-0.037	0.030	-0.002	-0.026	0.034	0.012	-0.019
Experience * Tenure	-0.134	-0.079	-0.061	-0.101	-0.054	-0.027	-0.085	-0.055	-0.035
Constant	6.885	6.509	6.829	6.878	6.608	6.969	6.832	6.635	6.953
adj. R-sq	0.362	0.569	0.349	0.410	0.557	0.336	0.415	0.475	0.276
Obs.		338797			269312			265948	
H_0 : Fixed effects are homogeneous									
F-value(p-value)			14.33(0.00)			12.95(0.00)			8.56(0.00)

Notes: Robust standard errors are in parentheses. Columns (1), (4), and (7) report the OLS estimates without controlling for the establishment variables. Columns (2), (5), and (8) control for the establishment characteristics such as firm size, industrial group, and prefecture dummies. Columns (3), (6), and (9) show the estimates with the establishment fixed effects. An F-test is for the null hypothesis of a constant establishment effect.

Table 5: Decomposition of the Change in Wage Inequality

Male	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	in 1992		in 2002		in 2012		Diff. 2002-1992	Diff. 2012-2002	Diff. 2012-1992
Between Establishment									
A. Var(Est. Fixed Effect)	0.085	33.7%	0.099	39.3%	0.103	39.5%	0.014	0.004	0.018
B. Var(Average Worker Effect)	0.030	11.9%	0.024	9.4%	0.024	9.3%	-0.006	0.001	-0.006
C. 2×Covariance(AB)	0.020	7.7%	0.030	11.8%	0.032	12.2%	0.010	0.002	0.012
	0.135	53.4%	0.152	60.5%	0.160	60.9%	0.018	0.007	0.025
Within Establishment									
D. Var(Worker Effect)	0.079	31.4%	0.064	25.3%	0.059	22.5%	-0.016	-0.005	-0.020
E. Var(Residual)	0.038	15.2%	0.036	14.3%	0.043	16.5%	-0.002	0.007	0.005
	0.118	46.6%	0.100	39.5%	0.102	39.1%	-0.018	0.003	-0.015
Total	0.252		0.252		0.262		0.000	0.010	0.010

Female	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	in 1992		in 2002		in 2012		Diff. 2002-1992	Diff. 2012-2002	Diff. 2012-1992
Between Establishment									
A. Var(Est. Fixed Effect)	0.123	56.4%	0.116	53.9%	0.103	44.7%	-0.007	-0.012	-0.020
B. Var(Average Worker Effect)	0.020	9.2%	0.019	8.7%	0.024	10.5%	-0.001	0.006	0.004
C. 2×Covariance(AB)	0.002	0.9%	0.017	7.8%	0.032	13.8%	0.015	0.015	0.030
	0.145	66.5%	0.151	70.4%	0.160	68.9%	0.006	0.008	0.014
Within Establishment									
D. Var(Worker Effect)	0.032	14.9%	0.028	13.3%	0.029	12.5%	-0.004	0.000	-0.003
E. Var(Residual)	0.041	18.6%	0.035	16.4%	0.043	18.6%	-0.005	0.008	0.002
	0.073	33.5%	0.064	29.6%	0.072	31.1%	-0.009	0.008	-0.001
Total	0.218		0.215		0.232		-0.004	0.017	0.013

Notes: See the notes of Table 3 for the sample composition. Calculation based on the estimated fixed establishment effects models summarized in Table 4. Entries in columns (1), (3) and (5) are the variance components in 1992, 2002, and 2012. Entries in columns (2), (4) and (6) are the ratio of the variance components to the total variance (as a percentage). Entries in columns (7), (8) and (9) are the change in the variance components from 1992 to 2002, from 2002 to 2012, and from 1992 to 2012.

Table 6: Variance Decomposition of the Establishment Fixed Effects

Male	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	in 1992		in 2002		in 2012		Diff. 2002-1992	Diff. 2012-2002	Diff. 2012-1992
Var(Est. Fixed Effect)	0.085		0.099		0.103		0.014	0.004	0.018
Explained									
Var(Firm Size)	0.022	25.4%	0.027	27.1%	0.030	28.8%	0.005	0.003	0.008
Var(Prefecture)	0.011	12.9%	0.007	7.0%	0.008	7.4%	-0.004	0.001	-0.003
Var(Industry)	0.003	3.6%	0.003	3.1%	0.003	2.8%	0.000	0.000	0.000
Unexplained									
Var(v)	0.049	58.1%	0.062	62.9%	0.063	61.0%	0.013	0.001	0.014

Female	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	in 1992		in 2002		in 2012		Diff. 2002-1992	Diff. 2012-2002	Diff. 2012-1992
Var(Est. Fixed Effect)	0.123		0.116		0.094		-0.007	-0.022	-0.029
Explained									
Var(Firm Size)	0.023	18.4%	0.016	13.9%	0.009	9.6%	-0.007	-0.007	-0.014
Var(Prefecture)	0.016	12.6%	0.012	10.6%	0.012	12.3%	-0.003	-0.001	-0.004
Var(Industry)	0.012	9.5%	0.013	10.9%	0.004	4.0%	0.001	-0.009	-0.008
Unexplained									
Var(v :unexplained)	0.073	59.5%	0.075	64.6%	0.070	74.1%	0.002	-0.005	-0.004

Figure legends

Figure 1: Macroeconomic Indicators in Japan, 1980–2012

Figure 2: Trends in Workforce Share by Education, Age, and Tenure

Figure 3: Trends in the Variance in the Within- and Between-Skill Groups

Figure 4: Simple Variance Decomposition in Wages

Figure 5: Simple Decomposition across Percentiles from 1992 to 2012

Figure 6: Detailed Variance Decomposition in Wages

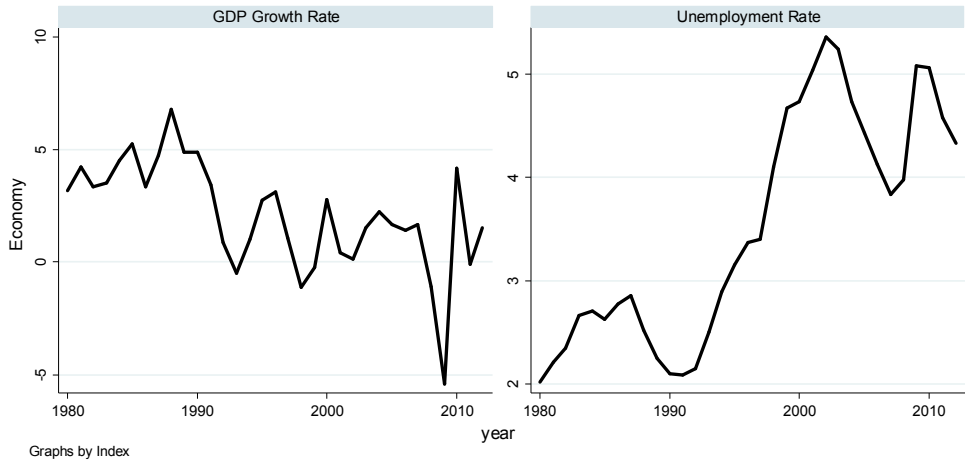
Figure 7: Detailed Decomposition across Percentiles

Figure 8: Counterfactual Trends in Within-Establishment Inequality

Figure 9: Decomposition of Establishment Fixed Effects

Figure 10: Change in the Joint Distribution of the Worker and Establishment Fixed Effects

Figure 1



Notes: The GDP growth rate is based on the annual report of the national accounts calculation by the Cabinet Office. The unemployment rate is based on the Labor Force Survey conducted by the Statistics Bureau, Ministry of Internal Affairs and Communications.

Figure 2

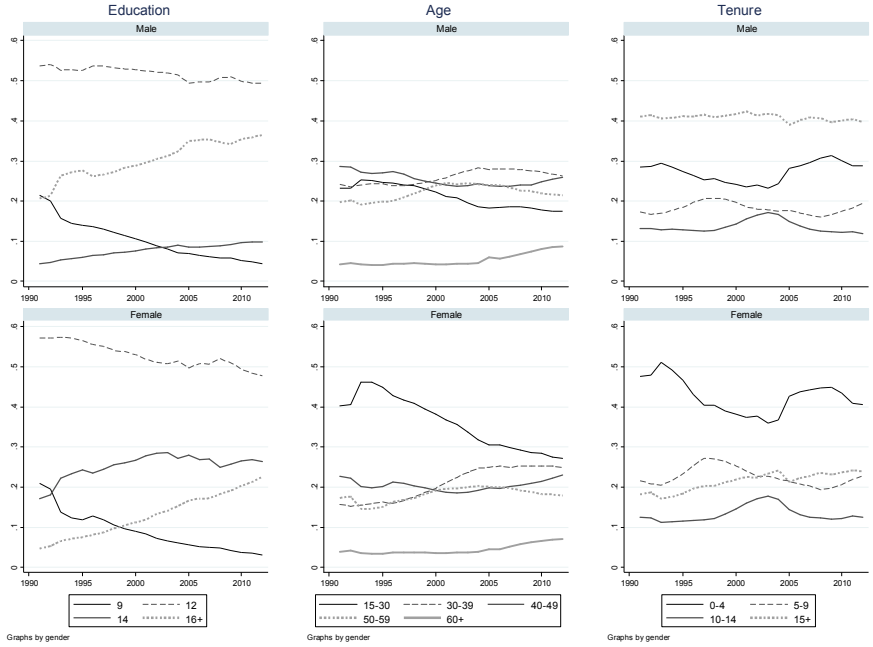
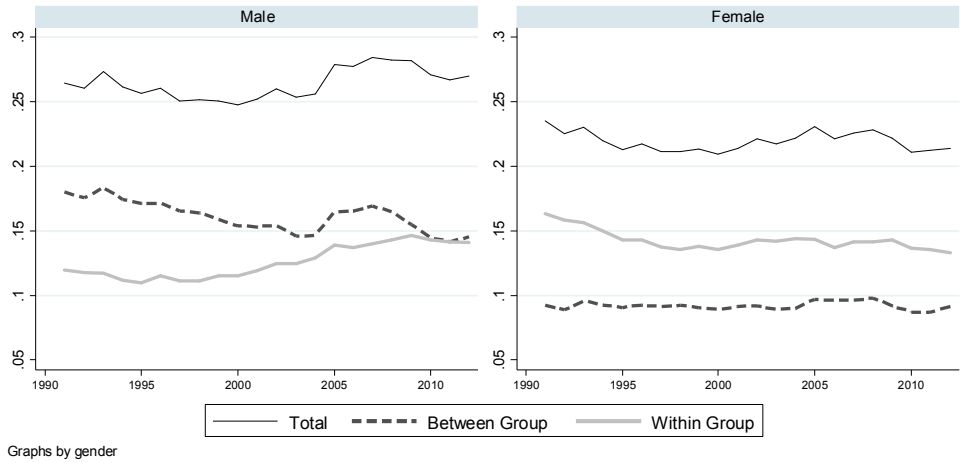
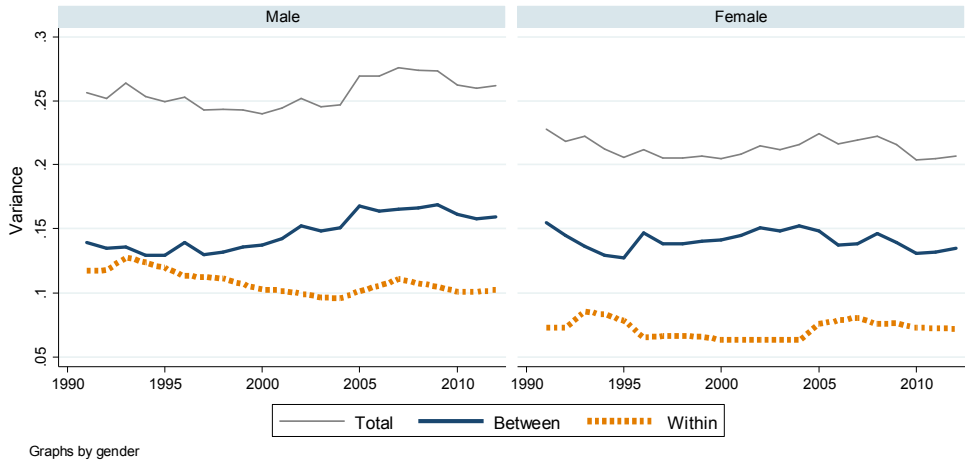

Education
Age
Tenure
Male
Female
1990
1995
2000
2005
2010
9
12
14
16+
15-30
30-39
40-49
50-59
60+
0-4
5-9
10-14
15+
Graphs by gender

Figure 3



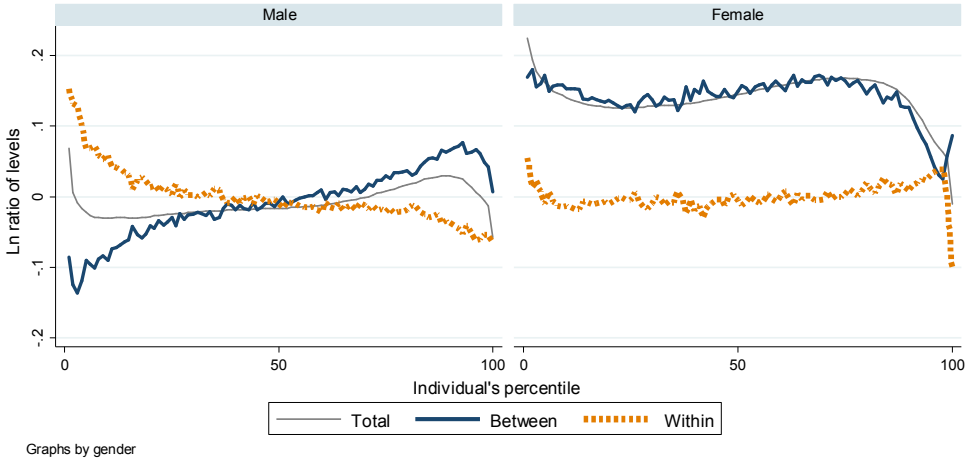
Notes: This figure reports the trends in wage inequality calculated for the datasets of workers classified as regular and permanent employees aged 15 or over. Skill groups are defined by education, experience, and job tenure.

Figure 4



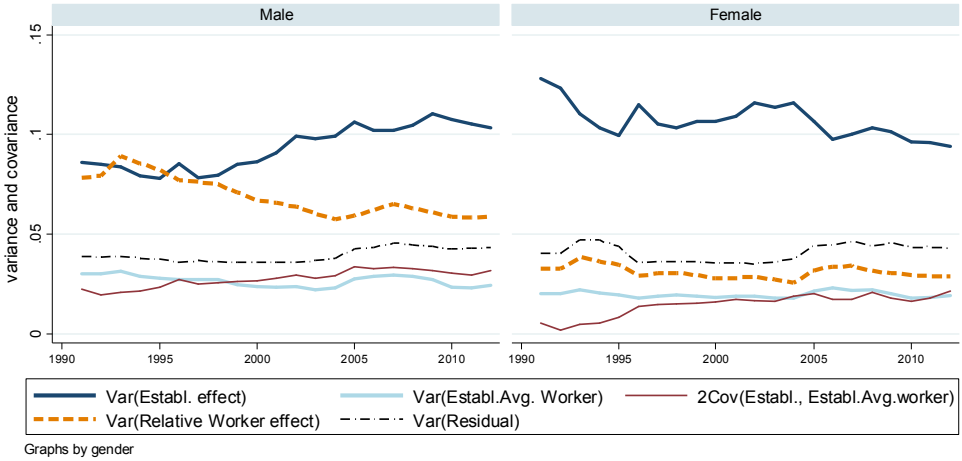
Notes: See the variance decomposition in equation (2). Between-establishment variance is calculated using the mean log hourly wage and weighted by the number of employers. Within-establishment inequality is calculated based on the difference between individual log wages and establishment mean log hourly wages.

Figure 5



Notes: Between-establishment statistics are based on the average of mean log wages at establishments for individuals in that percentile of wages in each year. Within-establishment statistics are based on individual log wages minus establishment mean log wages for individuals in that percentile of wages in each year. All values are adjusted for inflation using the consumer price index.

Figure 6



Notes: See the variance decomposition in equation (6). The simple decomposition in Figure 4 is further decomposed into five parts: variance in the establishment fixed effects, variance in the predicted wage of the average observable workers' characteristics for each establishment, their covariance, variance in workers' relative wage expected from their observable attributes at their establishment, and variance in the residual.

Figure 7

Notes: Establishment unit statistics such as the establishment fixed effects, establishment average worker effect, and their interaction are based on the average of each estimated value at establishments for individuals in that percentile of wages in each year. Data on the worker effects and residual are based on the average of each estimated value for individuals in that percentile of wages in each year.

Figure 8

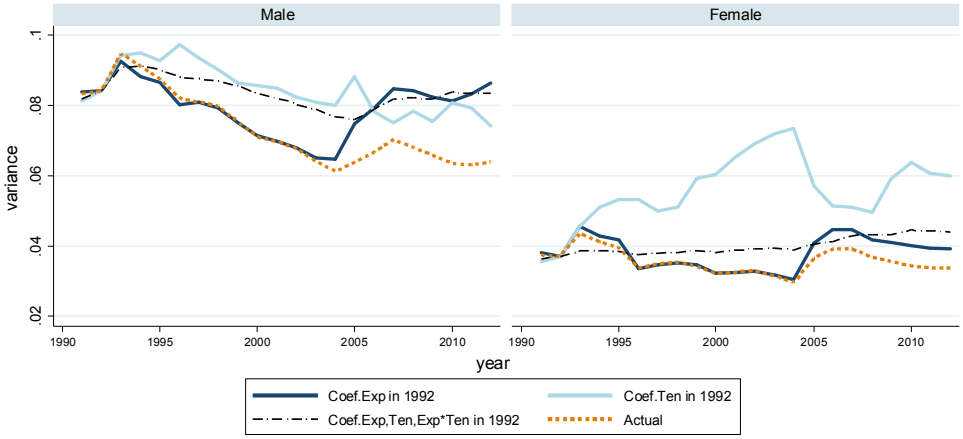

Male
Female
variance
.02
.04
.06
.08
.1
1990
1995
2000
2005
2010
year
Coef.Exp in 1992
Coef.Ten in 1992
Coef.Exp,Ten,Exp*Ten in 1992
Actual
Graphs by gender

Figure 9

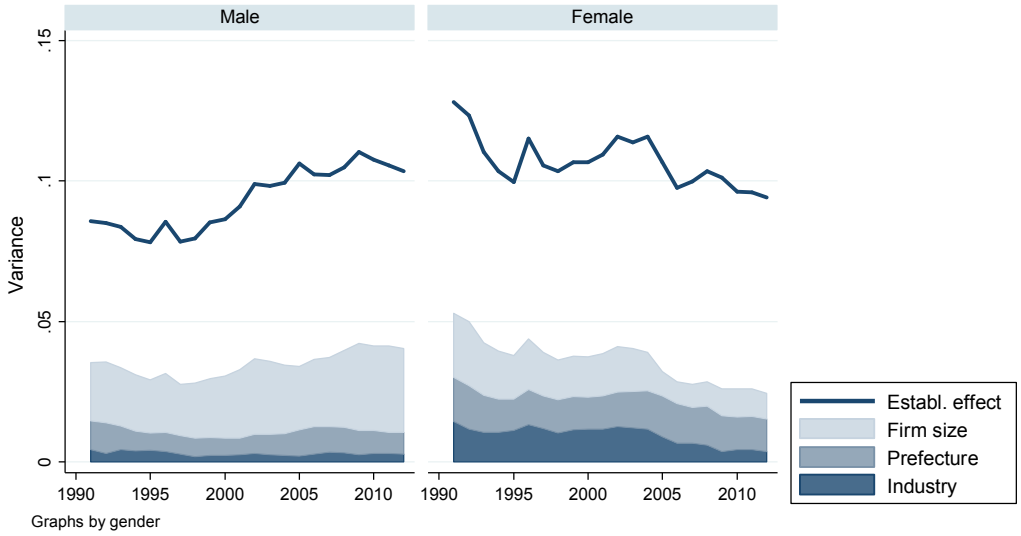
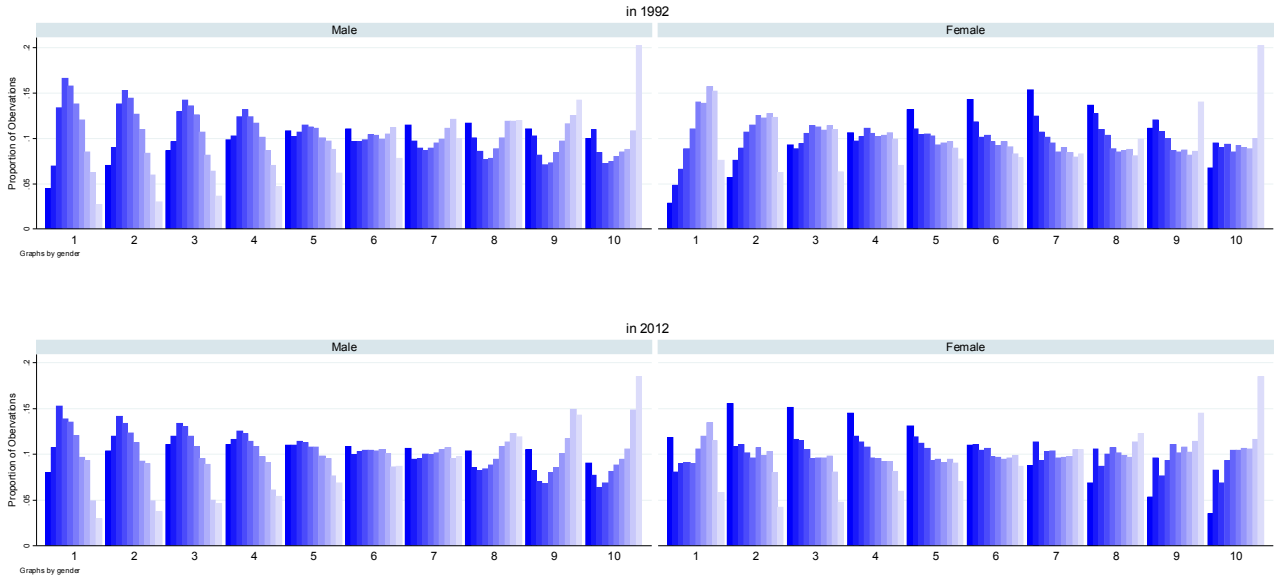
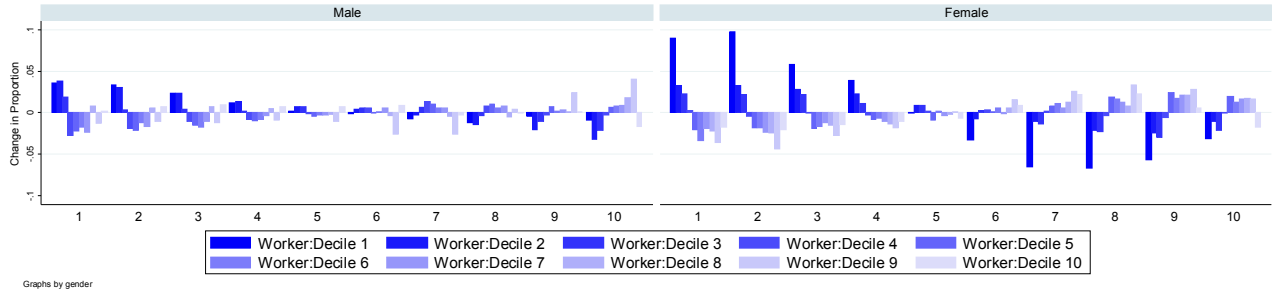

Male
Female
Variance
0
.05
.1
.15
1990
1995
2000
2005
2010
Graphs by gender
Establ. effect
Firm size
Prefecture
Industry

Figure 10

(A) Joint Distribution in 1992 and 2012



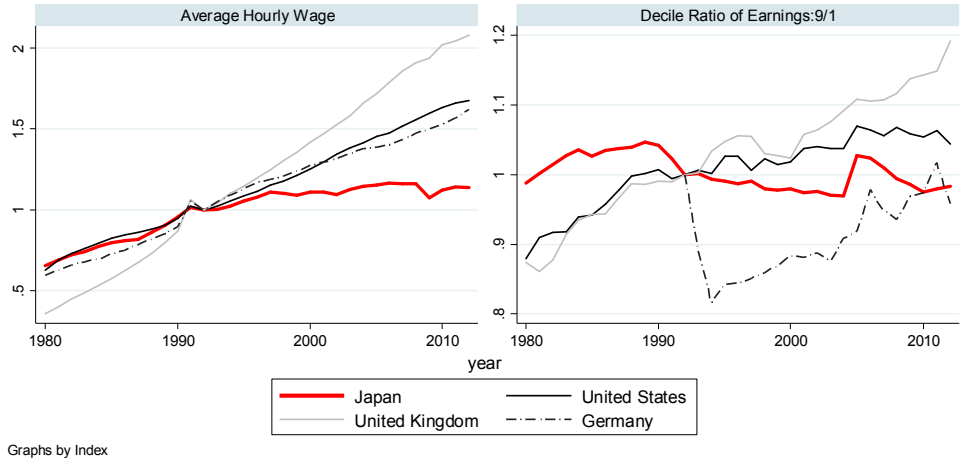
(B) Change in the Joint Distribution from 1992 to 2012



Notes: This figure shows the joint distribution of the worker and establishment fixed effects estimated from equation (5). Higher fixed effects deciles are computed with respect to the distribution of establishments. Since higher fixed effects establishments are usually larger, there are more employees in the higher establishment fixed effects deciles. Establishment fixed effects deciles are ordered from left to right from 1 to 10. Within each establishment fixed effects decile group, worker effect deciles are ordered from left to right from 1 to 10.

Appendix A

Figure A1: Trends in Average Wages and Inequality across Four Countries



Notes: Both figures are based on OECD statistics. Average wages are obtained by dividing the national accounts-based total wage by the average number of employees in the total economy, which is then multiplied by the ratio of the average usual weekly hours per full-time employee to the average usually weekly hours for all employees. The index of earnings inequality is defined by the ratio of the ninth decile to the first decile in the monthly earnings of full-time dependent employees.

Appendix B: Additional Information for the Sample

Table B1: Groups for the Industrial Classification

Group 1	**Group 3**
Secondary industry	Finance, Real Estate
C. Mining and Quarrying of Stone and Gravel	J. Finance and Insurance
D. Construction	K. Real Estate ,Goods Rental and Leasing
E. Manufacture	
Group 2	**Group 4**
Infrastructure, Transport and Retail	Service
F.Electricity, Gas, Heat Supply and Water	L. Scientific Research, Professional and Technical Services
G. Information and Communication	M. Eating and Drinking services, Accommodations
H. Transport and Postal Activities	N. Living-Related and Personal Services and Amusement Services
I.Wholesale and Retail Trade	O. Education, Learning Support
	P. Imedical Services, Public Health and Hygiene
	Q. Compound Services
	R. Miscellaneous Services. N.E.C.
Exception from the BSWS	
A. Agriculture, Forestry	
B. Fisheries	
S. Government Seriveses(Except elsewhere classified)	
T. Industries unable to classify	

Table B2: Changes in the Industrial Category

9th revision January, 1984	10th revision October, 1993	11th revision March, 2002	12th revision November, 2007
A. Agriculture	A. Agriculture	A. Agriculture	A. Agriculture, Forestry
B. Forestry	B. Forestry	B. Forestry	B. Fisheries
C. Fisheries	C. Fisheries	C. Fisheries	C. Mining and Quarrying of Stone and Gravel
D. Mining	D. Mining	D. Mining	D. Construction
E. Construction	E. Construction	E. Construction	E. Manufacture
F. Manufacture	F. Manufacture	F. Manufacture	F.Electricity, Gas, Heat Supply and Water
G. Electricity, Gas, Heat Supply and Water	G. Electricity, Gas, Heat Supply and Water	G. Electricity, Gas, Heat Supply and Water	G. Information and Communication
H. Transport and Communications	H. Transport and Communications	H. Information and Communication	H. Transport and Postal Activities
I. Holesale and Retail Trade, Eating and Drinking Survice	I. Holesale and Retail Trade, Eating and Drinking Survice	I. Transport	I.Wholesale and Retail Trade
J. Finance and Insurance	J. Finance and Insurance	J. Wholesale and Retail Trade	J. Finance and Insurance
K. Real Estate	K. Real Estate	K. Finance and Insurance	K. Real Estate ,Goods Reantal and Leasing
L. Services	L. Services	L. Real Estate	L. Scientific Research, Professional and Technical Services
M. Government Seriveses(Except elsewhere classified)	M. Government Seriveses(Except elsewhere classified)	M. Eating and Drinking services, Accommodations	M. Eating and Drinking services, Accommodations
N. Industries unable to classify	N. Industries unable to classify	N. Imedical Services, Public Health and Hygiene	N. Living-Related and Personal Services and Amusement Services
		O. Education, Learning Support	O. Education, Learning Support
		P. Compound Services	P. Imedical Services, Public Health and Hygiene
		Q. Miscellaneous Services. N.E.C.	Q. Compound Services
		R. Government Seriveses(Except elsewhere classified)	R. Miscellaneous Services. N.E.C.
		S. Industries unable to classify	S. Government Seriveses(Except elsewhere classified)
			T. Industries unable to classify
Survey Year			
1991	1996	2004	2009
1992	1997	2005	2010
1993	1998	2006	2011
1994	1999	2007	2012
1995	2000	2008	
	2001		
	2002		
	2003		

Table B3: Sample structure for all observation year

	Number of observations		Number of Individuals in Establishments			
	Indiviudals	Establishments	Mean	Std.Dev	Min	Max
a. Male						
1991	766,497	52,706	14.54	14.08	1	304
1992	765,677	52,611	14.55	14.11	1	316
1993	809,831	54,672	14.81	14.33	1	403
1994	775,280	52,263	14.83	14.34	1	360
1995	813,186	55,336	14.70	13.91	1	322
1996	824,047	54,426	15.14	13.86	1	315
1997	830,297	54,778	15.16	13.84	1	262
1998	811,170	53,833	15.07	13.82	1	352
1999	803,240	52,898	15.18	13.89	1	457
2000	767,468	50,640	15.16	13.87	1	344
2001	753,869	49,081	15.36	14.05	1	358
2002	736,390	49,749	14.80	13.84	1	351
2003	726,287	49,002	14.82	13.83	1	365
2004	727,242	49,430	14.71	12.99	1	361
2005	591,421	47,812	12.37	11.80	1	217
2006	617,946	50,695	12.19	11.74	1	251
2007	564,255	48,349	11.67	11.61	1	241
2008	564,300	48,800	11.56	11.64	1	232
2009	552,391	50,221	11.00	11.26	1	207
2010	548,687	49,875	11.00	11.17	1	202
2011	534,454	49,326	10.84	11.06	1	290
2012	565,926	52,006	10.88	11.24	1	279
b. Female						
1991	340,671	49,384	6.90	7.13	1	125
1992	338,797	49,044	6.91	7.06	1	122
1993	384,180	51,846	7.41	7.33	1	123
1994	363,897	49,585	7.34	7.32	1	115
1995	375,240	52,403	7.16	7.19	1	111
1996	341,451	51,080	6.68	6.76	1	106
1997	339,072	51,398	6.60	6.69	1	96
1998	318,781	50,167	6.35	6.61	1	126
1999	309,961	49,274	6.29	6.55	1	108
2000	288,908	46,805	6.17	6.54	1	114
2001	275,197	45,231	6.08	6.49	1	152
2002	269,312	45,091	5.97	6.51	1	103
2003	262,913	44,151	5.95	6.51	1	117
2004	274,200	45,121	6.08	6.34	1	92
2005	281,894	44,271	6.37	7.12	1	118
2006	292,077	47,181	6.19	6.50	1	209
2007	286,038	44,824	6.38	6.53	1	125
2008	262,019	44,486	5.89	6.27	1	158
2009	264,802	45,840	5.78	6.22	1	175
2010	264,623	45,577	5.81	6.17	1	92
2011	256,914	44,867	5.73	6.09	1	118
2012	265,948	46,546	5.71	6.17	1	134

Appendix C

Figure C1: Simple Decomposition across Percentiles from 1992 to 2002 and 2002 to 2012