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Abstract

Wage inequality declined in the 1990s for full-time male workers in Japan, while it increased in the 2000s. We find that a decreased return to firm-specific human capital, which has been neglected in previous empirical analyses of inequality, is a key factor preventing a rise in wage inequality during the prolonged period of economic stagnation, known as Japan's lost decades. A significant fraction of the increase in wage inequality in the 2000s is a mechanical change arising from an increased share of educated and experienced workers.

Keywords: wage inequality, firm-specific human capital, heterogeneous returns, seniority wages, composition effects

JEL Classification: I24, J24, J31, M52

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1 Introduction

Various measures of wage inequality did not substantially rise in Japan over the 1980s and 1990s, whereas a sizable increase in wage inequality has taken place in other advanced industrialized nations since the 1980s.[1] Looking at the variance of log wages for full-time male workers between the ages of 15 and 59 in Japan, wage inequality declined in the 1990s, while it increased in the 2000s. This trend reversal is illustrated in Figure 1. As we elaborate in the next section, narrowing wage inequality in the 1990s reflects a decline in inequality between skill groups, while widening wage inequality in the 2000s reflects an increase in inequality within skill groups. The aim of this paper is to account for the trends in wage inequality for the prolonged period of economic stagnation, known as Japan's lost decades.

We consider a change in the return to tenure as a possible cause that prevents a rise in wage inequality in Japan. Although firm-specific human capital is widely recognized as a key determinant of wages (Becker, 1994; Farber, 1999), the role of firm-specific human capital has been neglected in previous empirical analyses of inequality. Firm-specific human capital is an essential element of the Japanese labor market, which has been characterized by long-term employment and seniority wages. These employment practices stem from the need to foster firm-specific human capital as a way to keep up with rapid technological change during a period of high economic growth (Koike, 1988; Hashimoto and Raisian, 1985; Mincer and Higuchi, 1988; Clark and Ogawa, 1992).[2] There was, however, a slowdown in technological progress in the 1990s (Hayashi and Prescott, 2002). We would expect that in the waves of economic downturn firms provided less on-the-job training, and consequently, the return to tenure decreased. Indeed, we find that a decreased return to tenure accounts for a large part of the decline in wage inequality in the 1990s and continued to prevent a rise in wage inequality in the 2000s. These findings deserve attention for two reasons. First, the findings suggest an alternative explanation for international differences in trends in wage inequal-

[1] See Katz and Revenga (1989), Katz, Loveman, and Blanchflower (1995), Kambayashi, Kawaguchi, and Yokoyama (2008), and Moriguchi and Saez (2008) for Japan; and Bound and Johnson (1992), Katz and Murphy (1992), Juhn, Murphy, and Pierce (1993), Lemieux (2006a), and Autor, Katz, and Kearney (2008) for the United States.

[2] Koike (1988) discusses the rationale for skill formation within firms. Hashimoto and Raisian (1985) show that job tenure is longer, job turnover is less frequent, and the earnings-tenure profile is steeper for male workers in Japan than their counterparts in the United States. Mincer and Higuchi (1988) attribute the higher return to tenure in Japan to greater on-the-job training to keep up with rapid technological change. Clark and Ogawa (1992) find a decline in the return to tenure between 1971 and 1986 in Japan.

ity. Theoretically, an increased return to tenure because of accelerated technological progress could account for a part of rising wage inequality in the United States (Violante, 2002). International differences in inequality trends thus can be attributed, at least in part, to differences in changes in the importance of firm-specific human capital associated with differences in the speed and timing of technological change. Second, the findings indicate that the erosion of Japan's seniority wages has a strong influence on inequality trends, a result that has not been previously documented.[3] This paper shows that a change in the return to tenure had a major impact on the trends in Japan's wage inequality, while a change in the length of tenure did not.

We extend the empirical analyses of Japan's wage structure conducted in previous studies, including a recent study by Kambayashi, Kawaguchi, and Yokoyama (2008), as follows. First, we update changes in wage inequality with more recent micro data up to 2008. The aforementioned study does not cover the period after 2003, when wage inequality increased more clearly. We uncover two countervailing trends throughout the 1991–2009 period. The reversal of the trends in overall inequality occurred when an increase in within-group inequality exceeded a decline in between-group inequality. Second, we use the quantile regression approach to investigate changes in the wage profile. Following Hashimoto's (1979, 1981) human capital theory, we also estimate the bonus-ratio profile and confirm the importance of firm-specific human capital in Japan's wage structure. Finally, we decompose changes in between- and within-group inequality into the portion attributable to the change in the price of skill (returns to human capital) and the portion attributable to the change in workforce composition. The former is referred to as price effects, and the latter as composition effects (Lemieux, 2006a, 2006b). We allow for heterogeneity in returns to human capital and further decompose price effects into changes in returns on three components of human capital: education, experience, and tenure. We show that the decline in between-group inequality is largely attributable to a decreased return to tenure, while a significant fraction of the increase in the within-group inequality is a mechanical change arising from an increase in college-graduate workers and a decline in youth population size.

The rest of the paper is organized as follows. The next section documents key facts about

[3]None of the studies cited above empirically examines the effects of changes in the return to tenure or the length of tenure on wage inequality. Genda (1998) estimate the contribution of these changes to mean wage differentials between specific age and education groups from 1980 to 1992.

changes in Japan's wage structure since the 1990s. Section 3 describes the method to measure the quantitative contribution of changes in returns on three components of human capital and the composition of the workforce to the trends in between- and within-group inequality. Section 4 presents results regarding heterogeneous returns to human capital and the detailed decomposition of wage inequality. The final section offers a conclusion.

2 Changes in Japan's Wage Structure

In this section, we first describe the data and document changes in wage inequality over the 1990s and 2000s. We then investigate changes in wage profiles and relate the changes to the erosion of seniority wages and bonuses in terms of human capital theory. Finally, we present the link between workforce composition and (within-group) wage inequality.

2.1 Data Description

We use repeated cross sections from the Basic Survey on Wage Structure (BSWS) between 1991 and 2008. The BSWS covers all private establishments with five or more regular employees and public establishments with 10 or more regular employees, except those classified in agriculture, forestry, fishery, and the legislative, administrative, and judicial branches of local and national governments. The analysis focuses on full-time male workers aged 15 to 59, since the mandatory retirement age is typically 60. Their information is extracted from payroll records from more than 51,000 establishments for every year. The yearly sample size ranges between 577,000 and 834,000. We weight all observations by the sampling weight. Board members are not included in the sample, but otherwise there is neither top- nor bottom-coding. Hourly wages are calculated by dividing monthly regular earnings plus one-twelfth of the annual bonus by monthly hours of work and normalized by the consumer price index with the base year of 2005. Regular earnings comprise scheduled earnings, overtime allowance, commutation allowance, family allowance, and perfect-attendance allowance. Hours of work include scheduled hours of work and overtime work. Education is categorized into junior-high school, high school, two-year college (including vocational school), and four-year college and beyond.

Among new hires, the share of university graduates rose from 31.7 to 55.5%, while the share of high-school graduates fell from 48.5 to 33.6% during the sample period. The starting wage differentials between new college graduates and new high-school graduates were stable, ranging from 1.25 to 1.28. The sample means of the number of years of potential experience, which is age minus the number of years of education minus six, range from 19.6 to 20.6. Job tenure tends to be longer in Japan than in such Anglo-Saxon countries as Australia, Canada, the United Kingdom, and the United States, but similar between Japan and such continental European countries as France and Germany, for the period between the late 1970s and the early 1990s (OECD, 1993). During the 1991–2008 period, the sample means of job tenure, which is the length of time with the current employer, range from 12.1 to 13.1. We present detailed changes in the composition of the workforce in section 2.3.

2.2 Decomposing Wage Inequality

We first decompose wage inequality into inequality between and within skill groups to understand the sources of inequality. Throughout the paper, we define skill groups by education, experience, and tenure and consider the augmented Mincer-type wage equation with random coefficients:

$$w_{it} = \alpha_{it} + s_{it}\beta_{it} + x_{it}\gamma_{it} + z_{it}\delta_{it}, \tag{1}$$

where w_{it} is the logarithm of hourly wages for an individual i in year t, s is a vector of education dummies, x is a vector of polynomials of degree four in experience, and z is a vector of polynomials of degree four in job tenure.[4] For the purpose of estimation, we impose restrictions on the vector of random coefficients, such that $\alpha_{it} = \alpha_t + \alpha_t a_i$, $\beta_{it} = \beta_t + \beta_t b_i$, $\gamma_{it} = \gamma_t + \gamma_t c_i$, and $\delta_{it} = \delta_t + \delta_t d_i$ with $\mathbb{E}_t\left(j_i | \, s_{it}, x_{it}, z_{it}\right) = 0$, and $\mathbb{V}_t\left(j_i | \, s_{it}, x_{it}, z_{it}\right) = \sigma_j^2$, $\mathbb{E}_t\left(j_i k_i | \, s_{it}, x_{it}, z_{it}\right) = \sigma_{ij}$ for $j, k = a, b, c, d$, and $j \neq k$. Here we incorporate firm-specific human capital and allow returns to human capital to be correlated. Our model is an extension of the human-capital pricing equation

[4] Perfect multicollinearity occurs if including even higher-order terms.

developed by Lemieux (2006a). The log wage equation (1) can be rewritten as

$$w_{it} = \alpha_t + s_{it}\beta_t + x_{it}\gamma_t + z_{it}\delta_t + u_{it}, \tag{2}$$

where the error term is $u_{it} = \alpha_t a_i + s_{it}\beta_t b_i + x_{it}\gamma_t c_i + z_{it}\delta_t d_i$, and the slope coefficients represent the mean returns to human capital in year t, i.e., $\beta_t = \mathbb{E}_t(\beta_{it})$, $\gamma_t = \mathbb{E}_t(\gamma_{it})$, and $\delta_t = \mathbb{E}_t(\delta_{it})$. The augmented wage equation fits the data remarkably well.[5] Let g denote a vector of skills that includes s, x, and z. The variance of log wages can be decomposed into two components.

$$\mathbb{V}_t(w_{it}) = \mathbb{V}_t\left[\mathbb{E}_t(w_{it}|\, g_{it})\right] + \mathbb{E}_t\left[\mathbb{V}_t(w_{it}|\, g_{it})\right], \tag{3}$$

where the first component represents the variance of log wages between skill groups, and the second component represents the variance of log wages within skill groups. We derive the conditional mean and variance of log wages to decompose between- and within-group variance into changes in the price of skill and the composition of the workforce in section 3.

Figure 1 illustrates trends in overall, between-group, and within-group inequality. Overall inequality declined in the 1990s, while it increased in the 2000s. This reversal of the trends occurs by a change in the relative magnitude of two countervailing trends. Precisely, between-group inequality declined over the 1990s and then fluctuated after 2000, while within-group inequality stayed nearly constant in the early 1990s and increased after the mid-1990s. Narrowing inequality in the 1990s reflects a decline in between-group inequality, while widening inequality in the 2000s reflects an increase in within-group inequality. These results remain unchanged even after adding the full interaction terms among education, experience, and tenure.

2.3 Changes in Wage Profiles

Next, we investigate changes in the shape of wage profiles that would affect the trends in wage inequality. Figure 2 depicts predicted values of log hourly wages along with years of education, experience, and tenure in 1991, 2000, and 2008, holding other attributes at their means. Each wage profile is obtained from quantile regressions of the log wage equation described above for

[5] The R^2 obtained from the log wage regressions by year ranges from 0.47 to 0.56 during the sample period.

the 10th, 50th, and 90th quantiles. Figure 3 illustrates changes in the workforce share by education, experience, and tenure to see the shifts in the supply of skills that would affect changes in wage profiles.

2.3.1 Education

The wage-education profile is approximately linear at the lower quantile but is more convex-shaped for the upper quantile in recent years. Convexification of the wage-education profile implies a relative increase in the demand for workers with college degrees. The extent to which the wage-education profile is convexified, however, is far less prominent for every quantile in Japan than in the United States (Lemieux, 2006b).[6] The relatively stable return to education in Japan can be explained by a rise in the supply of the educated workforce (Katz and Revenga, 1989; Katz, Loveman, and Blanchflower, 1995). On the other side of the coin, the stable return to education despite a substantial rise in the supply of skills implies a substantial rise in the demand for skills. During the 1991–2008 period in Japan, the share of university and two-year college-graduate workers, respectively, rose from 25.0 to 36.4% and from 5.1 to 10.5%, whereas the share of junior-high and high-school-graduate workers, respectively, fell from 18.0 to 5.3% and from 51.9 to 47.7%. This phenomenon contrasts with the rising return to education and the stagnation of higher education after the late 1970s in such Anglo-Saxon countries as Canada, the United Kingdom, and the United States (Card and Lemieux, 2001) but is similar to the stable or decreased return to education and continuous progress in higher education in such other advanced East Asian countries as the Republic of Korea, Singapore, and Taiwan.[7]

[6] Lemieux (2008) finds a positive correlation between the change in residual wage variance and the level of education by occupation in the United States. We also examined this issue by plotting the change in the residual variance along with education, experience, and tenure by occupation, but we found no evidence that the residual variance increased more substantially in professions that require higher levels of skill and training, such as analyst, doctor, engineer, and programmer.

[7] See Kim and Topel (1995) for the Republic of Korea; Toh and Wong (1999) for Singapore; and Gindling and Sun (2002) for Taiwan.

2.3.2 Experience

The wage-experience profile is concave-shaped for every quantile. The slope of the wage-experience profile is more moderate and the turning points are located earlier for lower quantiles.[8] Comparing the wage-experience profiles between 1991 and 2008, the return to experience decreased for workers with 20 or more years of experience at the middle and lower quantiles and increased slightly for workers with about 10 years of experience at the upper quantile. The reduction in experience wage differentials is considered to be a consequence of a relative increase in experienced workers caused by a decline in youth population size. The phenomenon mirrors a reduction in the relative wages of baby boomers in the United States (Welch, 1979). Two demographic changes underlie the decline in the share of young and inexperienced workers. First, the number of younger cohorts entering the labor market decreased in recent years because of declining fertility rates. Second, second-generation baby boomers, who were born in the early 1970s, reached middle age.

2.3.3 Tenure

The wage-tenure profile is steeper than the wage-experience profile, indicating the importance of firm-specific human capital acquired through on-the-job training or the prevalence of deferred compensation contracts in the Japanese labor market. In either case, seniority wages firmly remain, as can be seen from a monotonic increase in wages up to 30 years of job tenure for every quantile. The slope of the wage-tenure profile, however, decreased around 20 years of job tenure, especially at the upper quantile in 2008 as compared to 1991. The fluctuation of the shares of groups whose tenure ranges from 1 to 5, from 6 to 10, and from 11 to 15 is attributable to the aging of second-generation baby boomers. A fall in job tenure has not yet clearly appeared, which is consistent with Kambayashi and Kato (2011), who find that long-term employment has been stable, using the Employment Status Survey. The decline in the slope of the wage-tenure profile can be explained by sluggish technological change and the extension of the mandatory retirement age. As technological change slows, the skills acquired on the job become obsolete more slowly, firms invest less in on-the-job training, and the return to tenure would decline (Mincer and Higuchi, 1988). Moreover, as

[8] Hamaaki, Hori, Maeda, and Murata (2012) find a flattening of the earnings-age profile when not conditioning on tenure.

the mandatory retirement age is extended under the Elderly Employment Stabilization Law,[9] the wage-tenure profile would be flatter under a deferred compensation contract (Lazear, 1979; Clark and Ogawa, 1992).[10]

Job turnover The wage-tenure profile could potentially change because of a change in the distribution of unobserved ability by tenure. If there were a trend for workers with high ability to switch their jobs for higher wages, the wage-tenure profile would be flatter. The wage increase associated with job changes, however, became less likely during the period of economic stagnation. Figure 4 illustrates percentage wage changes associated with job changes over the life cycle in the years 1991, 1996, 2001, and 2006.[11] The declining pattern of wage changes over the life cycle remains the same over time, and the life-cycle profile of wage changes shifts downward relative to the 1991 level, except for teens in 2006. There is thus no evidence that a decline in the return to tenure results from an increase in job changes accompanied by a rise in wages.

Promotion The promotion system in Japan is represented by late selection (Hart and Kawasaki, 1999). Late selection promotes the acquisition of firm-specific human capital, facilitates skill transfer from senior to junior workers, and maintains strong competition among workers who enter the firm in the same year, at the risk of job turnover by new and talented workers. Organizational changes that facilitate early promotion could potentially weaken the effect of tenure on wages. No substantial change is observed, however, in the proportion of workers in managerial positions or the speed of promotion.[12] The change in seniority wages seems to be better described as a gradual

[9] The Elderly Employment Stabilization Law was enacted in 1986 to increase employment opportunities for the elderly and was amended in 1994 to prohibit mandatory retirement under the age of 60. According to the Survey on Employment Management between 1992 and 2004, the proportion of firms with a retirement system ranged between 88.2 and 96.8%. Among firms with a retirement system, the proportion of firms where the mandatory retirement age was 59 or under decreased from 23.4% in 1992 to 0.7% in 2004.

[10] A negative association between return to tenure and retirement age can also be explained by human capital theory when the retirement age is endogenous. As technological change slows, older workers delay their retirement because they have less need to update their skills (Mincer and Higuchi, 1988).

[11] In this figure, wage changes are estimated by interval regressions using repeated cross sections from the Survey on Employment Trends in the years 1991, 1996, 2001, and 2006, in which the Ministry of Health, Labour and Welfare collects ordered categorical information about changes in the wages of job switchers. The yearly sample size ranges between 14,400 and 15,300.

[12] Proportions of division chiefs, section chiefs, subsection chiefs, other chiefs, and foremen, respectively, changed only from 2.1 to 2.4%, from 5.1 to 5.8%, from 4.6 to 4.9%, from 4.9 to 4.7%, and from 1.8 to 1.5% between 1991 and 2008 in firms with more than 100 regular employees for which the information about job rank is available. The average job tenure (years of experience) of division chiefs, section chiefs, subsection chiefs, other chiefs, and foreman, respectively, changed only negligibly, from 23.8 to 23.6 (29.3 to 29.7) years, from 20.8 to 21.2 (24.9 to 25.9) years,

change in the wage scale for all workers rather than as a discontinuous change in the promotional ladder for only some workers.

2.3.4 Bonus

Biannual bonuses are prevalent in Japanese firms; in 1991, for example, 92.2% of workers received bonuses. As shown by Hashimoto (1979, 1981), the return to specific training is maximized under a flexible wage contract, if productivity is subject to macroeconomic fluctuations and the costs of collective bargaining are low. In this context, the presence of biannual bonuses helps firms to provide on-the-job training programs and workers to develop corporate loyalty. Hashimoto (1981) and Hart and Kawasaki (1999) confirm with aggregate data that the bonus ratio varies with macroeconomic conditions and increases with tenure. During a period of economic stagnation over the 1990s and 2000s, the proportion of workers who received bonuses declined from 92.2 to 83.8%, and the ratio of bonuses to regular wages declined from 28.6 to 21.6%.

The logarithm of total wages (w) can be decomposed into the logarithm of regular wages and the bonus ratio as follows: $w = \ln r + \ln(1 + b/r)$, where r denotes regular wages per hour, and b denotes bonus per hour. Figure 5 depicts predicted values of the log regular wages and the bonus ratio along with years of education, experience, and tenure in 1991, 2000, and 2008, holding other attributes at their means. The profiles are obtained from quantile regressions of $\ln r$ and $\ln(1 + b/r)$ on the skill attributes (g) described above for the 10th, 50th, and 90th quantiles. The shapes of the wage-education profile and wage-experience profile are similar between total wages and regular wages, but the wage-tenure profile is steeper for total wages than for regular wages at every quantile (Figure 5, Panel A). The difference in the wage-tenure profile between total wages and regular wages is attributable to a steeper bonus-tenure profile (Figure 5, Panel B). Consistent with Hashimoto's (1979, 1981) human capital theory, the bonus ratio increases with education and tenure, but not experience, and thus, the bonus can be interpreted as a shared return to investment in firm-specific human capital. The bonus ratio profile shifts downward, especially at the lower quantile, whereas the regular wage profile shifts slightly upward between 1991 and 2008. These results indicate that a reduction in bonuses plays a major role in declining real wages

from 18.0 to 18.4 (21.5 to 22.5) years, and from 20.3 to 20.9 (24.8 to 24.3) years between 1991 and 2008.

in the 2000s. Moreover, the downward shift in the bonus-tenure profile results in a decline in the return to tenure. The slope of the regular wage-tenure profile is also less steep for workers with long tenure in more recent years.[13] Therefore, firms seem to reduce the rate of increase in total wages with respect to tenure by decreasing the bonus ratio and introducing a wage system that is less dependent on tenure.[14]

2.4 Workforce Composition and Within-group Inequality

As shown in Figure 3, the share of educated and experienced workers has increased in recent years. Such a change in the composition of the workforce could mechanically raise within-group wage inequality (Lemieux, 2006b). Table 1 summarizes within-group (residual) variance defined in equation (3) for the years 1991, 2000, and 2008, along with workforce share by education, experience, and tenure, to understand the relation between workforce composition and within-group inequality. On the one hand, within-group variance increases with education and experience (Table 1, Panel A). This implies that the increased share of educated and experienced workers would mechanically raise within-group inequality. On the other hand, within-group variance does not increase with tenure (Table 1, Panel B). This implies that a change in the length of tenure would not significantly affect within-group inequality regardless of a change in long-term employment. We present the quantitative contribution of changes in the composition of the workforce, as well as the price of skill, to the trends in between- and within-group inequality in section 4, followed by an explanation of the decomposition method in section 3.

[13] There is direct evidence on a decline in the importance of age and tenure as determinants of regular wages. According to the General Survey on Working Conditions conducted by the Ministry of Health, Labour, and Welfare, the proportion of firms considering age and tenure as key determinants of regular wages decreased from 72.5 to 56.6% for managerial positions and from 79.0 to 63.7% for non-managerial positions during the 2001–2009 period.

[14] Since 2000, there has been a significant increase in the number of firms adopting wage systems that place a greater emphasis on performance. The new pay schemes are referred to as *shokumu-kyū* and *yakuwari-kyū*, as opposed to *shokunō-kyū*, which was prevalent during the 1980s. According to the Survey on the Change of Japanese Personnel Systems conducted for all listed firms by the Japan Productivity Center, the proportion of firms adopting the new schemes increased from 21.1 to 72.3% for managerial positions and from 17.7 to 56.7% for non-managerial positions during the 1999–2008 period.

3 The Detailed Decomposition

We now consider the decomposition of between- and within-group inequality into price and composition effects. Using the human-capital pricing equation (2), we aim to explain changes in wage inequality in terms of changes in returns to human capital and the composition of the workforce. Since we allow returns to human capital to vary across individuals, a change in the price of skill can affect not only between- but also within-group inequality. Specifically, the following conditional mean and variance are derived from the specifications of log wage equation (2):

$$\mathbb{E}_t\left(w_{it}|\, s_{it}, x_{it}, z_{it}\right) = \alpha_t + s_{it}\beta_t + x_{it}\gamma_t + z_{it}\delta_t, \tag{4}$$

$$\begin{aligned}\mathbb{V}_t\left(w_{it}|\, s_{it}, x_{it}, z_{it}\right) = {} & \sigma_a^2\alpha_t^2 + \sigma_b^2\left(s_{it}\beta_t\right)^2 + \sigma_c^2\left(x_{it}\gamma_t\right)^2 + \sigma_d^2\left(z_{it}\delta_t\right)^2 \\ & +\sigma_{ab}\left(2\alpha_t \cdot s_{it}\beta_t\right) + \sigma_{ac}\left(2\alpha_t \cdot x_{it}\gamma_t\right) + \sigma_{ad}\left(2\alpha_t \cdot z_{it}\delta_t\right) \\ & +\sigma_{bc}\left(2s_{it}\beta_t \cdot x_{it}\gamma_t\right) + \sigma_{bd}\left(2s_{it}\beta_t \cdot z_{it}\delta_t\right) + \sigma_{cd}\left(2x_{it}\gamma_t \cdot z_{it}\delta_t\right). \end{aligned} \tag{5}$$

Our model builds upon the human-capital pricing equation in Lemieux (2006a), which is nested as a special case when $\delta_t = 0$ and $\sigma_{ij} = 0$ for $j, k = a, b, c, d$, and $j \neq k$. Equation (4) expresses the relation of between-group inequality to the price of skill and the composition of the workforce, while equation (5) expresses the relation of within-group inequality to the price of skill and the composition of the workforce. Between-group inequality increases with the price of skill, while within-group inequality does not change according to the price of skill, if there is no heterogeneity in returns to human capital, i.e., $\sigma_j^2 = \sigma_{ij} = 0$. For the case when $\sigma_j^2 \neq 0$ and $\sigma_{ij} = 0$, however, within-group inequality also increases with the price of skill, and the size of price effects on within-group inequality is proportional to the size of heterogeneity in returns to human capital, as can be seen from equation (5). In the more general case, when $\sigma_j^2 \neq 0$ and $\sigma_{ij} \neq 0$, price effects on within-group inequality depend on the sign and size of covariance, as well as the size of the variance of returns to human capital. Suppose that returns to general human capital are negatively correlated with returns to firm-specific human capital. A decline in the return to experience entails an increase in the return to tenure; thus, it will not necessarily lower within-group inequality. Similarly, an increase in the return to education will not necessarily raise within-group inequality. Therefore, ignoring the interaction effect can cause a substantial bias in estimating price effects on within-group inequality.

The mean returns to human capital are identified from equation (4), and the variance and covariance of returns to human capital are identified from equation (5). Since a set of parameters representing returns to human capital $(\alpha_t, \beta_t, \gamma_t, \delta_t)$ appears in both equations, we estimate the system of equations jointly by the generalized method of moments (GMM) to improve efficiency. The moment conditions (4) and (5) can be expressed as

$$\begin{aligned} \mathbb{E}_t \left(u_{it} \middle| s_{it}, x_{it}, z_{it} \right) &= 0, \\ \mathbb{E}_t \left(u_{it}^2 - \mathbb{V}_t \left(w_{it} \middle| s_{it}, x_{it}, z_{it} \right) \middle| s_{it}, x_{it}, z_{it} \right) &= 0. \end{aligned}$$

These conditional moment conditions imply a number of unconditional moment conditions. Although no excluded instrument is used for estimating equation (4), year dummies interacted with l^p and $l \cdot m$ for $p = 1, 2, 4, 6, 8$ and $l \neq m$, where l and m represent education, experience, and tenure, are used as instruments for estimating equation (5). We adopt the efficient two-step GMM and use the BSWS data from the years 1991, 2000, and 2008 to account for the reversal of trends in wage inequality.

An advantage of this approach is that it enables us to isolate the impact of changes in returns on each component of human capital on between- and within-group inequality. After estimating a set of parameters $\left(\alpha_t, \beta_t, \gamma_t, \delta_t, \sigma_j^2, \sigma_{jk}\right)$ for $t = 1991, 2000, 2008$, $j, k = a, b, c, d$, and $j \neq k$, we can quantify the impact of changes in returns to education, experience, and tenure on changes in between- and within-group inequality from 1991 to 2000 (from 2000 to 2008) by comparing the counterfactual wages in the year 2000 (2008) if there has been no change in the returns to education, experience, and tenure since the base year 1991 (2000) to the actual wages in the year 2000 (2008). The counterfactual wages can be obtained by replacing the estimated coefficients of education, experience, and tenure with those at the base-year level. Price effects can then be calculated from the sum of the three effects. Composition effects can be finally calculated as the residual of total predicted changes in between- and within-group inequality. Equations (4) and (5) are used to quantify the impact on between- and within-group inequality, respectively.[15] The

[15]In general, the decomposition results depend on the choice of base year. The results obtained here remain essentially unchanged, however, even if price and composition effects on between- and within-group inequality between

limitation of a decomposition analysis of this sort is that we are unable to quantify the general equilibrium effects of changes in the skill distribution.

4 Results

4.1 Returns to Human Capital

Table 2 summarizes the GMM estimates of the mean, variance, and covariance of heterogeneous returns to human capital with and without the restrictions $\sigma_{ij} = 0$ for $j, k = a, b, c, d$, and $j \neq k$ in equation (5). Given the nonlinear relationship between human capital and wages, the mean returns to education, experience, and tenure vary over years of education, experience, and tenure, respectively. The estimated mean returns to education decreased from 1991 to 2000 and increased from 2000 to 2008, except that the return to high-school education decreased steadily during this latter period. Comparing the estimates of the unrestricted model in 1991 to those in 2008, the return to high-school education decreased by 0.50 percentage point (8.5%), the return to two-year college education remained almost unchanged, and the return to university education increased by 0.22 percentage point (2.8%). The mean return to experience increased slightly for workers with 10 years of experience and decreased steadily for workers with 30 years of experience from 1991 to 2008. The mean return to tenure changed in a complicated way, but it decreased steadily for workers with 20 years of tenure.

The estimated variance of returns to human capital indicates a significant heterogeneity in returns to human capital. The extent of heterogeneity is greater in the returns to education and experience than in the return to tenure. This result reflects the fact that wage dispersion is greater among workers with the same education or experience than workers with the same tenure. The estimated covariances of returns to human capital are all individually, highly significant, indicating a strong rejection of the null hypothesis that the covariance of returns to human capital is zero. The estimated covariance between the intercept and slope coefficients is very small, but the estimated covariance of returns to human capital is significant. The return to education moves in the same

1991 and 2000 (between 2000 and 2008) are calculated by comparing the counterfactual wages in the year 1991 (2000) when returns to human capital were at the 2000 (2008) level to the actual wages in the year 1991 (2000).

direction as the return to experience, whereas the return to tenure moves inversely with the returns to education and experience. These results seem plausible, since both education and experience represent general human capital and tenure represents specific human capital. The implications of the results are that the demand for educated workers would have the same trend as the demand for experienced workers and that the demand for general human capital would have the opposite trend from that of the demand for specific human capital.

4.2 Price and Composition Effects

Narrowing inequality in the 1990s reflects a decline in between-group inequality, while widening inequality in the 2000s reflects an increase in within-group inequality. Table 3 presents the results on the detailed decomposition of the changes in between- and within-group inequality into price and composition effects. These effects are calculated from the regression results with and without the restrictions reported in Table 2. A decline in between-group inequality in the 1990s is mostly attributable to price effects generated by decreased returns to education, experience, and tenure. In particular, the decreased return to tenure accounts for two thirds of the decline in between-group inequality. Within-group inequality was stable in the 1990s, since negative price effects generated by the decreased return to tenure countervailed positive composition effects generated by an increased share of educated and experienced workers. The size of composition effects on within-group inequality increased in the 2000s, as the share of educated and experienced workers continued to increase. The sign of price effects on within-group inequality changed from negative to positive in the 2000s, while the size of price effects on between-group inequality fell, as the return to college education started to increase moderately. Accordingly, within-group inequality increased in the 2000s, while between-group inequality did not change substantially.

The assumption of no correlation among heterogeneous returns understates price effects on within-group inequality. When relaxing this assumption, an increase in the return to education entails an increase in the return to experience (and vice versa), and a decrease in the return to tenure entails an increase in returns to education and experience (and vice versa). The relative size of price and composition effects on within-group inequality in the 1990s does not change substantially regardless of the restrictions, while that in the 2000s is greater in the absence of the restrictions. Nonetheless, composition effects still account for a significant part of the increase in within-group inequality in the 2000s.

To summarize, a decline in between-group inequality, which accounts for narrowing inequality in the 1990s, resulted from decreased returns to human capital, especially firm-specific human capital, while an increase in within-group inequality, which accounts for widening inequality in the 2000s, resulted from the increased share of educated and experienced workers, as well as changes in heterogeneous returns to human capital. Even when we allow for more complex price effects, a significant fraction of the increase in within-group inequality is still a mechanical change arising from the increased share of educated and experienced workers.

4.3 Robustness Checks

We end this section by presenting a set of robustness checks. We examine the robustness of the decomposition results for changes in industry composition, firm-size distribution, and the proportion of part-time employment and the choice of sample period. We also discuss the impact of deunionization on within-group inequality.

Industry and firm size The share of workers in the manufacturing sector decreased from 36.8 to 31.5% between 1991 and 2008 because of globalization and outsourcing, while the share of workers in service and other sectors, respectively, increased from 2.6% to 7.1% and from 22.9 to 26.6%. There is no clear trend for the distribution of firm size, but the share of workers in large firms with more than 5,000 employees decreased until 2004 and then increased. Hashimoto and Raisian (1985), Mincer and Higuchi (1988) and Clark and Ogawa (1992), among others, discuss a difference in wage profiles by firm size and industry. Changes in wage profiles could potentially be driven by changes in industry composition and firm-size distribution. To examine this possibility, we re-weight all observations so as to hold the distribution of industries and firm size fixed at the 1991 level. Let q denote a set of 15 dummy variables for industries and seven dummy variables for firm size and τ_0 the reference year 1991.[16] Following DiNardo, Fortin, and Lemieux (1996), the

[16]The classification of industries is based on the Japan Standard Industry Classification as follows: (a) mining; (b) construction; (c) manufacturing; (d) electricity, gas, and water; (e) information and telecommunication; (f) transport; (g) wholesale and retailing; (h) finance and insurance; (i) real estate and rental; (j) professional; (k) hotel and restaurant; (l) entertainment and daily life-related services; (m) education; (n) medical care and welfare; (o) complex

re-weighting factor is given by

$$\psi_\tau(q) = \frac{\Pr(q|\, t=\tau_0)}{\Pr(q|\, t=\tau)} = \frac{\Pr(t=\tau_0|\, q)/\Pr(t=\tau_0)}{\Pr(t=\tau|\, q)/\Pr(t=\tau)}, \tag{6}$$

where the conditional probabilities are estimated from the logit model.

The first two columns of Table 4 present the decomposition results without the restrictions when the distribution of industries and firm size is held fixed at the 1991 level. Comparing the changes in overall inequality, i.e., the sum of between- and within-group inequality, in the first two columns of Table 4 to those in the last two columns of Table 3, we find that the change in overall inequality between 1991 and 2000 would be greater by 15.9% if there were no change in the distribution of industries and firm size, while changes in the distribution of industries and firm size account for 23.3% of the changes in overall inequality between 2000 and 2008. The main results described above concerning price and composition effects on between- and within-group inequality remain essentially unchanged, however, even after controlling for industry composition and firm-size distribution.

Part-time employment The proportion of part-time workers increased steadily from 1.3 to 8.5% between 1991 and 2008. Part-time workers serve as a buffer against economic stagnation, whereas the employment of regular workers is stringently protected in Japan compared with other Organisation for Economic Co-operation and Development (OECD) countries (OECD, 2004). Part-time workers are typically not entitled to bonuses, fringe benefits, or training programs. In fact, the proportion of workers who received bonuses in 2008 is only 13.2% for part-time workers, as compared to 83.8% for full-time workers. A change in the composition of full-time workers induced by the increase in part-time employment might also account for changes in wage profiles. To control for selection into full-time employment, we employ the Heckman (1979) sample-selection method. The estimation process consists of two steps. First, the selection-correction term (the inverse Mills ratio) is obtained from the probit regression of full-time employment on fourth-order polynomials in age and tenure, cohort-prefecture-specific part-time employment rates, and pre-

services; and (p) service. Firm size is classified according to the number of employees as follows: (a) 5000+, (b) 1000–4999, (c) 500–999, (d) 300–499, (e) 100–299, (f) 30–99, (g) 10–29, and (h) 5–9.

fectural dummies, using the sample of full- and part-time workers for each year. Second, after including the selection-correction term as an additional regressor into equation (4), the system GMM estimation is performed on the sample of full-time workers. We allow the coefficient on the selection-correction term to vary over time, but not across individuals. The estimated coefficients on the selection-correction terms are then 0.47, 0.26, and 0.25, with standard errors of 0.02, 0.01, and 0.01 in 1991, 2000, and 2008, respectively. These results indicate that male workers were positively selected into full-time employment, but the degree of the selection decreased with a rise in part-time employment over time. We find a similar pattern of changes in returns to human capital, even after controlling for selection into full-time employment.[17]

The last two columns of Table 4 present the decomposition results without the restrictions when controlling for selection into full-time employment. Comparing the changes in overall inequality in the last two columns of Table 4 to those in the last two columns of Table 3, we find that the selection effect accounts for virtually nothing of the changes in overall inequality between 1991 and 2000 and only 1.9% of the changes in overall inequality between 2000 and 2008. Moreover, the main results described above remain essentially unchanged.

Sample period The decomposition results thus far have been obtained by comparing the years 1991, 2000, and 2008. The choice of the first and last years of the data as reference years seems natural; concern remains, however, about the sensitivity of the results with respect to the choice of sample period. To address this concern, we conduct the same decomposition analysis as the one discussed in the previous section, using BSWS data from the years 1992, 2000, and 2007 and the years 1993, 2000, and 2006. The first (last) two columns of Table 5 present the decomposition results drawn on the comparison among the years 1992, 2000, and 2007 (1993, 2000, and 2006) without the restrictions. As the sample period is shorter, the size of changes in inequality naturally diminishes. The main results described above, however, remain essentially unchanged.

Labor unions Japanese labor unions are typically formed at the company or establishment level. In most cases, both white- and blue-collar workers join the same labor union under a union shop

[17] Another related concern is an increase in the unemployment rate. The male unemployment rate increased, but only from 2.0 to 4.1% during the 1991–2008 period, according to the Labour Force Survey.

agreement. The enterprise union plays a role in sharing information and negotiating a mutually acceptable settlement on firm-specific working conditions (Hart and Kawasaki, 1999). Japanese unions do not represent any particular skill group but perform functions similar to Western unions at the industry level in terms of reducing the wage dispersion among unionized workers. Therefore, recent trends toward deunionization may explain a rise in within-group inequality. Figure 6 plots the level and change of within-group variance and unionization rates by industry.[18] Despite a large dispersion of unionization rates, ranging from 9.9 to 68.0% in level and from –21.7 to 3.0 percentage points in change, neither the level nor the change of residual variance varies so significantly by industry. These results indicate that deunionization plays a quantitatively minor role in increasing within-group inequality.

Summary The main decomposition results are robust to the choice of sample period and to extensions of the model that allow for a change in the industry composition and the firm-size distribution, an increase in part-time employment, and the erosion of the enterprise union.

5 Conclusion

This paper has documented and discussed some important changes in Japan's wage structure over the 1990s and 2000s. We have shown that trends in Japan's wage inequality over the past two decades can be well understood in terms of changes in returns to human capital and the composition of the workforce, along the lines of human capital theory, when allowing for heterogeneous returns to human capital and incorporating firm-specific human capital. We found that wage inequality for full-time male workers declined in the 1990s along with a decrease in between-group inequality, while it increased in the 2000s along with an increase in within-group inequality. The decline in between-group inequality in the 1990s resulted from decreased returns to human capital. In particular, the decreased return to firm-specific human capital, which appears in both regular wages and biannual bonuses, accounted for two thirds of the decline in between-group inequality. Because of significant heterogeneity in the return to general human capital, changes in returns to human capital contributed to widening within-group inequality in the 2000s. Nonetheless, a signif-

[18] The unionization rates are from the Basic Survey on Labour Unions.

icant fraction of the increase in within-group inequality in the 2000s is attributable to a mechanical change arising from the increased share of educated and experienced workers.

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Table 1: Workforce Composition and Within-group Inequality

	Workforce Share (%)			Within-group Variance		
	1991	2000	2008	1991	2000	2008
	Panel A: by Education and Experience					
Junior High School						
0–10	1.2	0.6	0.4	0.097	0.084	0.088
11–20	1.5	1.1	0.8	0.105	0.102	0.107
21–30	5.1	1.4	1.0	0.098	0.117	0.121
31+	10.4	6.9	3.2	0.119	0.120	0.137
High School						
0–10	14.1	11.0	8.1	0.063	0.062	0.079
11–20	12.7	13.2	13.5	0.083	0.080	0.095
21–30	15.2	12.3	12.7	0.108	0.107	0.123
31+	9.8	14.0	13.4	0.153	0.138	0.155
Two-year College						
0–10	2.5	4.0	3.3	0.052	0.054	0.069
11–20	1.4	2.7	4.2	0.090	0.079	0.094
21–30	0.8	1.6	2.0	0.141	0.122	0.134
31+	0.3	0.8	1.0	0.191	0.145	0.186
Four-year College or Above						
0–10	10.1	11.0	11.3	0.072	0.069	0.086
11–20	8.4	9.7	11.8	0.135	0.130	0.152
21–30	5.0	7.3	9.1	0.158	0.169	0.202
31+	1.6	2.5	4.3	0.218	0.211	0.242
	Panel B: by Education and Tenure					
Junior High School						
0	1.2	0.6	0.4	0.104	0.090	0.088
1–5	3.5	1.9	1.4	0.104	0.106	0.111
6–15	4.3	2.4	1.3	0.106	0.105	0.117
16+	9.0	5.0	2.3	0.116	0.128	0.146
High School						
0	4.4	3.2	3.8	0.087	0.089	0.097
1–5	14.3	12.9	13.5	0.091	0.096	0.117
6–15	14.4	16.4	12.7	0.092	0.089	0.112
16+	18.7	18.0	17.8	0.110	0.112	0.123
Two-year College						
0	0.6	0.7	1.0	0.068	0.075	0.084
1–5	1.9	3.1	3.5	0.071	0.073	0.105
6–15	1.5	3.5	3.4	0.088	0.072	0.098
16+	1.1	1.8	2.7	0.122	0.118	0.112
Four-year College or Above						
0	1.8	1.9	2.9	0.134	0.150	0.153
1–5	7.5	8.3	10.7	0.106	0.123	0.163
6–15	8.7	11.0	10.7	0.117	0.114	0.146
16+	7.1	9.4	12.2	0.133	0.132	0.155

Notes: Within-group variance is obtained from the year-by-year regression of log wages on education dummies and fourth-order polynomials in experience and tenure.

Table 2: GMM Estimates of Heterogeneous Returns to Human Capital

	Restricted Model			Unrestricted Model		
	Returns to Human Capital			Returns to Human Capital		
	1991	2000	2008	1991	2000	2008
Mean						
Education						
high school	0.0616	0.0584	0.0539	0.0587	0.0550	0.0537
	(0.0006)	(0.0009)	(0.0014)	(0.0006)	(0.0009)	(0.0009)
two-year college	0.0623	0.0585	0.0609	0.0603	0.0574	0.0599
	(0.0006)	(0.0008)	(0.0010)	(0.0006)	(0.0007)	(0.0007)
four-year college	0.0796	0.0762	0.0805	0.0783	0.0749	0.0805
	(0.0003)	(0.0005)	(0.0007)	(0.0003)	(0.0004)	(0.0005)
Experience						
10 years	0.0201	0.0216	0.0221	0.0208	0.0217	0.0220
	(0.0002)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0003)
20 years	0.0086	0.0065	0.0053	0.0091	0.0068	0.0076
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
30 years	–0.0018	–0.0033	–0.0053	–0.0028	–0.0032	–0.0046
	(0.0002)	(0.0003)	(0.0003)	(0.0002)	(0.0003)	(0.0003)
Tenure						
5 years	0.0338	0.0356	0.0297	0.0330	0.0342	0.0292
	(0.0002)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0003)
10 years	0.0243	0.0187	0.0232	0.0236	0.0189	0.0222
	(0.0002)	(0.0003)	(0.0003)	(0.0002)	(0.0003)	(0.0003)
20 years	0.0269	0.0227	0.0217	0.0265	0.0229	0.0209
	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0003)
Variance						
intercept		0.0009			0.0022	
		(0.0000)			(0.0005)	
education		0.0946			0.3102	
		(0.0025)			(0.0098)	
experience		0.3442			0.8501	
		(0.0049)			(0.0314)	
tenure		0.0097			0.1818	
		(0.0013)			(0.0047)	
Covariance						
intercept, education					–0.0197	
					(0.0007)	
intercept, experience					–0.0226	
					(0.0012)	
intercept, tenure					0.0093	
					(0.0009)	
education, experience					0.3570	
					(0.0119)	
education, tenure					–0.1596	
					(0.0055)	
experience, tenure					–0.3056	
					(0.0151)	

Notes: The sample size is 2,119,768. Standard errors are in parentheses. The base group for education dummies is junior-high-school graduates.

Table 3: Price and Composition Effects on Between- and Within-Group Inequality

	Restricted Model		Unrestricted Model	
	Between-group	Within-group	Between-group	Within-group
	1991–2000		1991–2000	
Price effects:	–0.0160	–0.0030	–0.0155	–0.0032
education	*–0.0019*	*–0.0010*	*–0.0018*	*–0.0014*
experience	*–0.0028*	*–0.0020*	*–0.0029*	*–0.0007*
tenure	*–0.0114*	*0.0000*	*–0.0108*	*–0.0011*
intercept		*0.0000*		*0.0000*
Composition effects:	–0.0013	0.0048	–0.0014	0.0045
Total	–0.0174	0.0017	–0.0169	0.0012
	2000–2008		2000–2008	
Price effects:	–0.0046	0.0085	–0.0039	0.0135
education	*0.0058*	*0.0010*	*0.0060*	*0.0034*
experience	*–0.0012*	*0.0082*	*0.0012*	*0.0062*
tenure	*–0.0093*	*–0.0005*	*–0.0111*	*0.0039*
intercept		*–0.0001*		*0.0000*
Composition effects:	0.0073	0.0142	0.0070	0.0099
Total	0.0026	0.0228	0.0031	0.0234

Table 4: Decomposition Results when Controlling for the Distribution of Industries and Firm Size and Selection into Full-time Employment

	Industries & Firm Size		Full-time Employment	
	Between-group	Within-group	Between-group	Within-group
	1991–2000		1991–2000	
Price effects:	–0.0174	–0.0024	–0.0126	–0.0023
education	*–0.0014*	*–0.0014*	*–0.0019*	*–0.0015*
experience	*–0.0048*	*–0.0002*	*–0.0019*	*0.0006*
tenure	*–0.0112*	*–0.0008*	*–0.0088*	*–0.0012*
intercept		*–0.0000*		*–0.0002*
Composition effects:	–0.0037	0.0053	–0.0046	0.0039
Total	–0.0211	0.0029	–0.0172	0.0016
	2000–2008		2000–2008	
Price effects:	–0.0045	0.0062	0.0023	0.0135
education	*0.0042*	*0.0022*	*0.0063*	*0.0037*
experience	*–0.0027*	*0.0012*	*0.0004*	*0.0073*
tenure	*–0.0060*	*0.0026*	*–0.0044*	*0.0026*
intercept		*0.0003*		*–0.0001*
Composition effects:	0.0060	0.0126	0.0008	0.0094
Total	0.0015	0.0188	0.0031	0.0229

Table 5: Decomposition Results for Different Sample Periods, 1992–2007 and 1993–2006

	1992–2007		1993–2006	
	Between-group	Within-group	Between-group	Within-group
	1992–2000		1993–2000	
Price effects:	–0.0091	–0.0034	–0.0059	–0.0005
education	*–0.0013*	*–0.0013*	*–0.0004*	*–0.0004*
experience	*–0.0020*	*–0.0009*	*–0.0002*	*0.0012*
tenure	*–0.0058*	*–0.0009*	*–0.0054*	*–0.0006*
intercept		*–0.0003*		*–0.0007*
Composition effects:	–0.0038	0.0043	–0.0056	0.0045
Total	–0.0129	0.0009	–0.0116	0.0040
	2000–2007		2000–2006	
Price effects:	0.0016	0.0132	0.0023	0.0098
education	*0.0079*	*0.0042*	*0.0060*	*0.0032*
experience	*0.0012*	*0.0061*	*–0.0004*	*0.0048*
tenure	*–0.0076*	*0.0031*	*–0.0034*	*0.0020*
intercept		*0.0000*		*–0.0001*
Composition effects:	0.0075	0.0101	0.0060	0.0095
Total	0.0091	0.0234	0.0083	0.0193

Figure 1: Trends in the Variance of log Wages

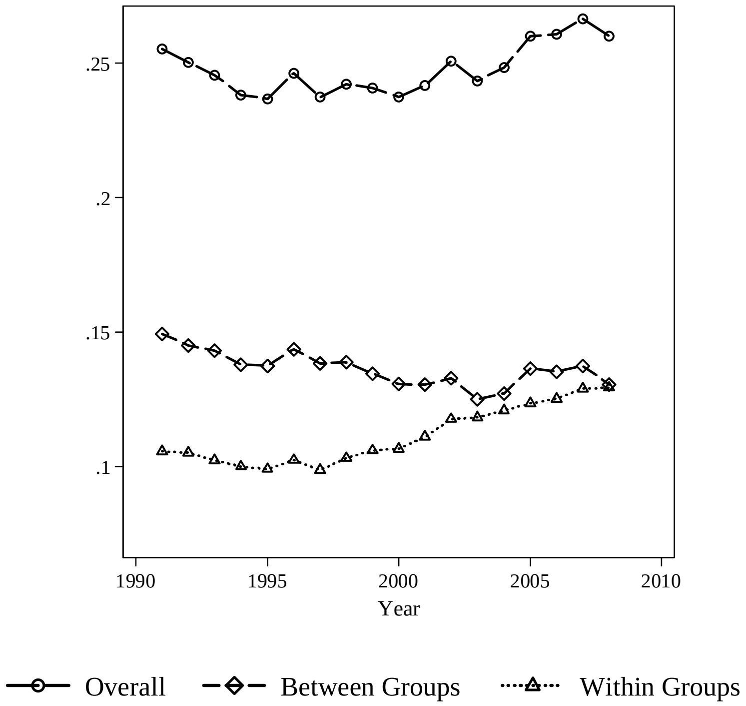
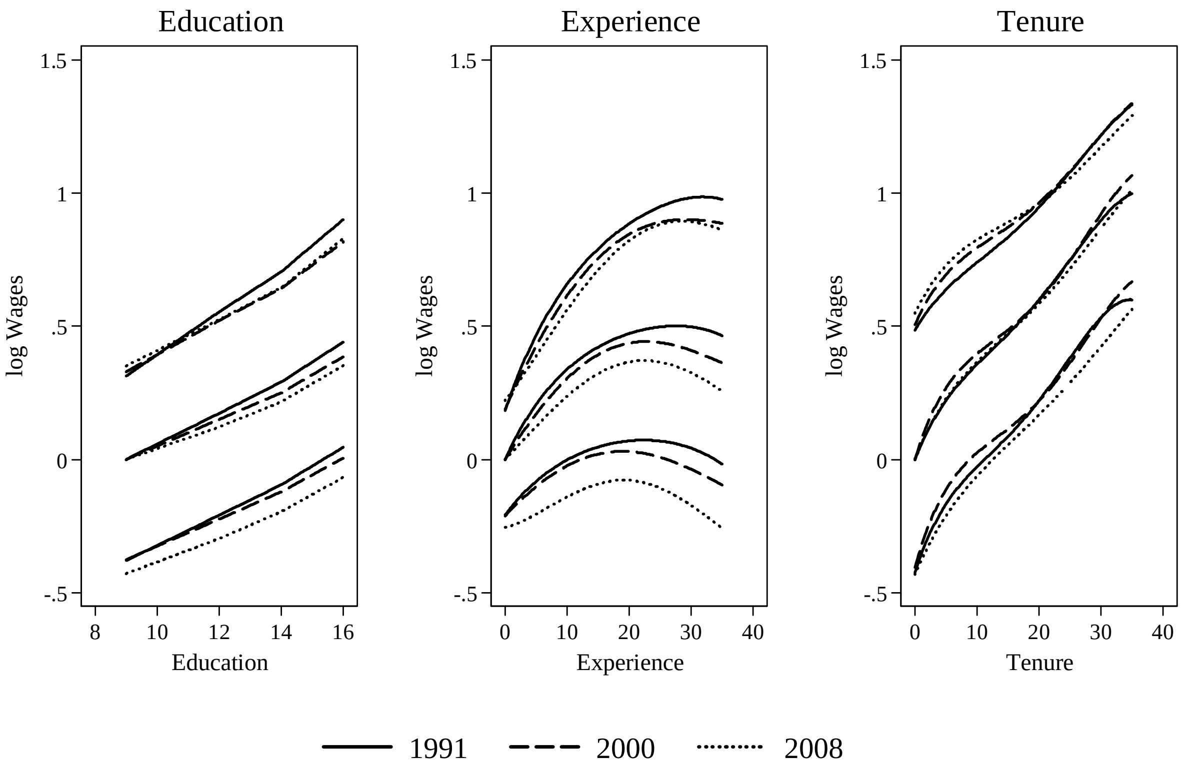


Figure 2: Wage Profiles for the 10th, 50th and 90th percentiles



Notes: The log wages are normalized so that the intercept of the median wage profile is zero.

Figure 3: Trends in the Workforce Share by Education, Experience, and Tenure

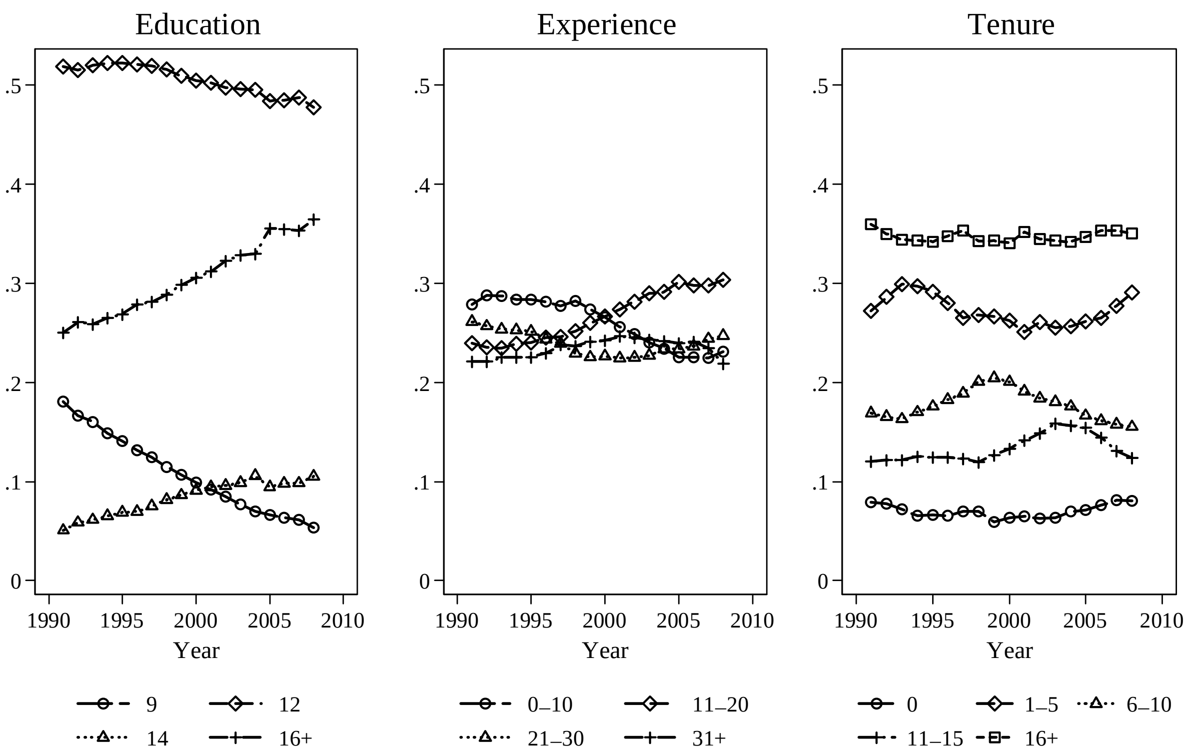


Figure 4: Percentage Wage Changes Associated with Job Changes

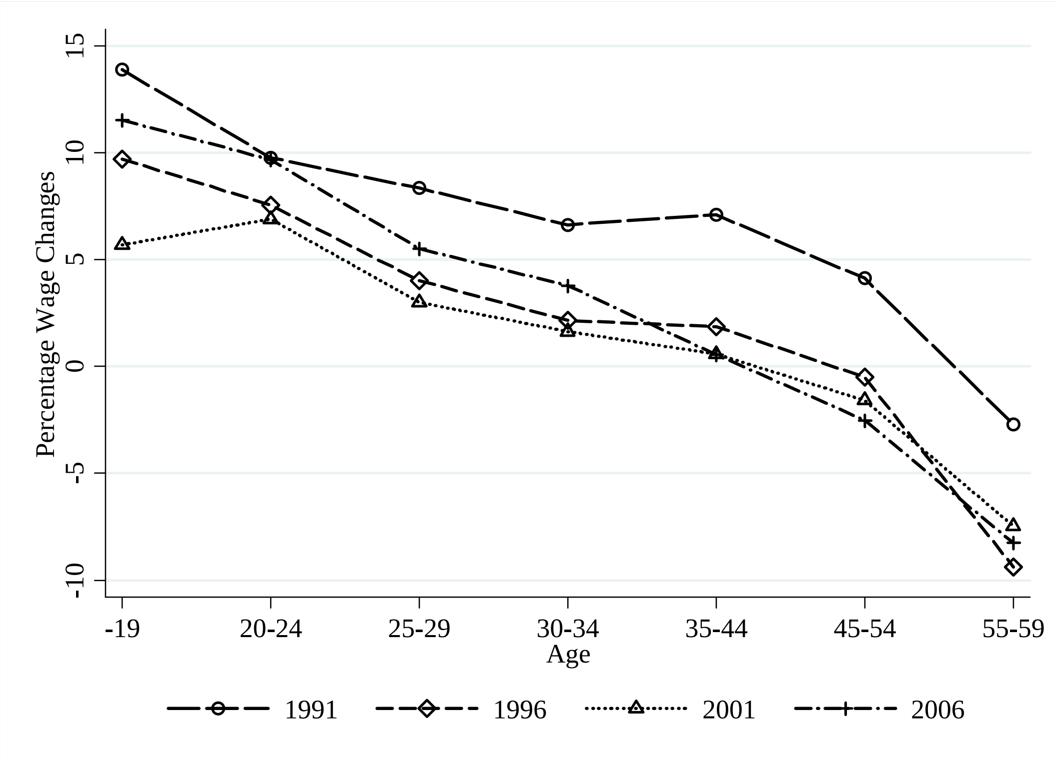
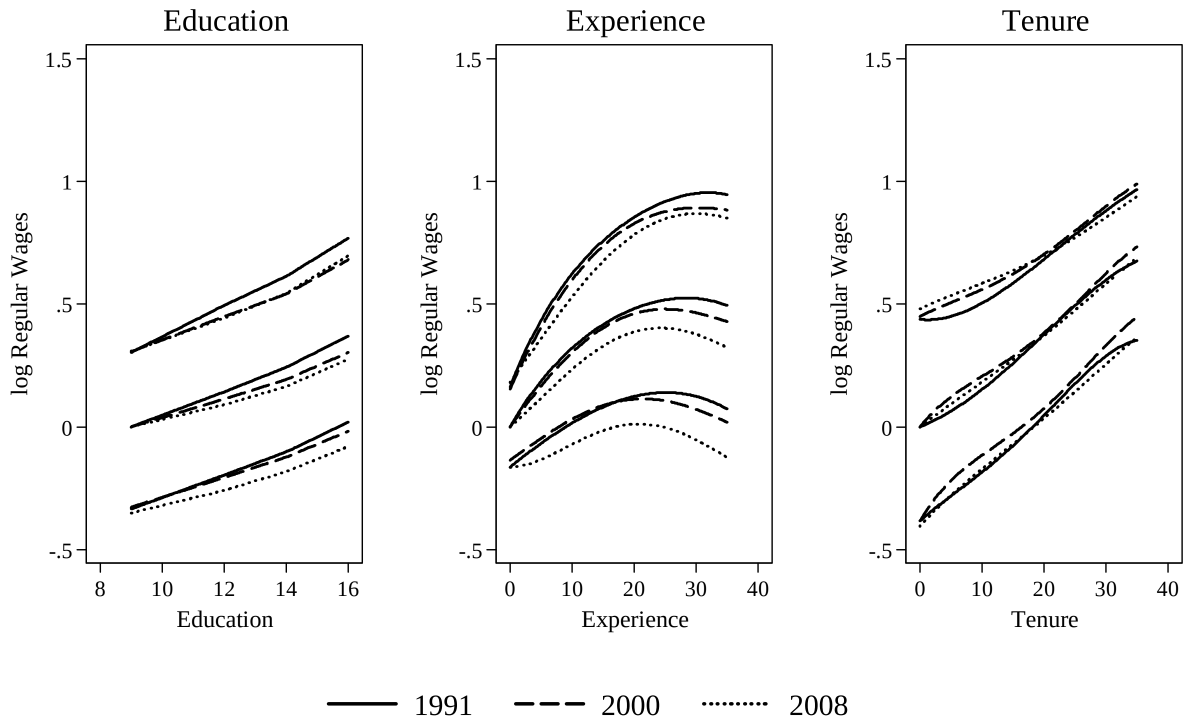
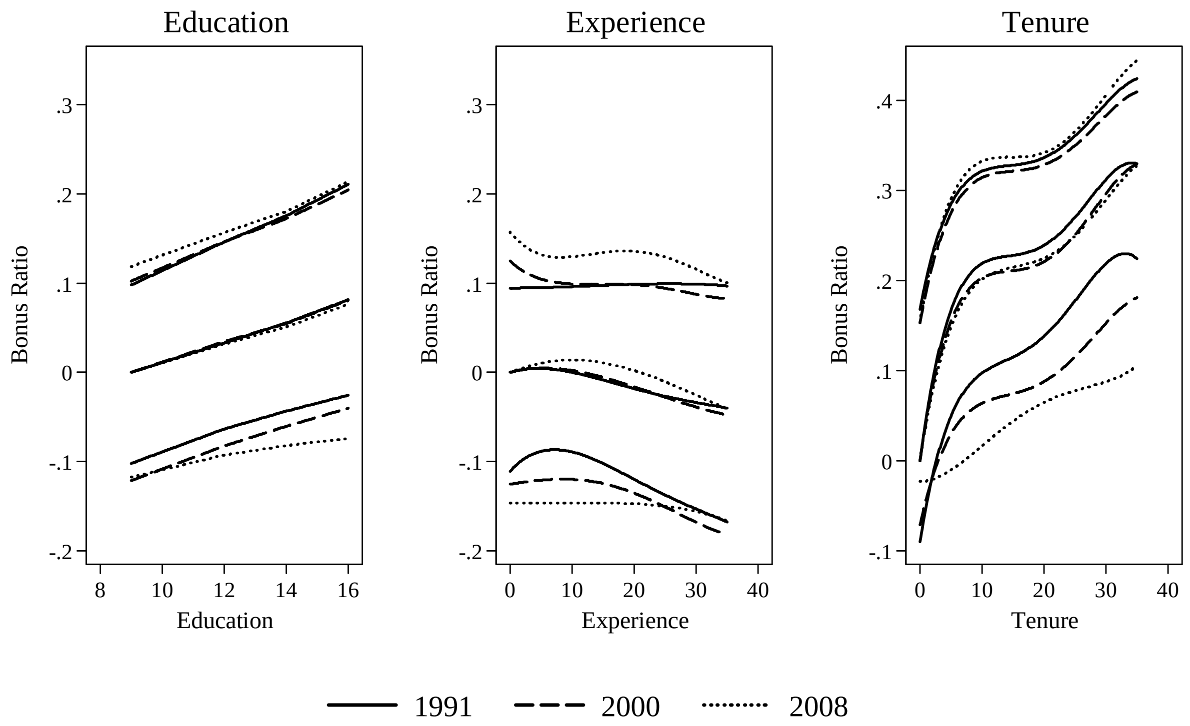


Figure 5: Profiles of Regular Wages and the Bonus Ratio for the 10th, 50th and 90th percentiles

Panel A: log Regular Wages

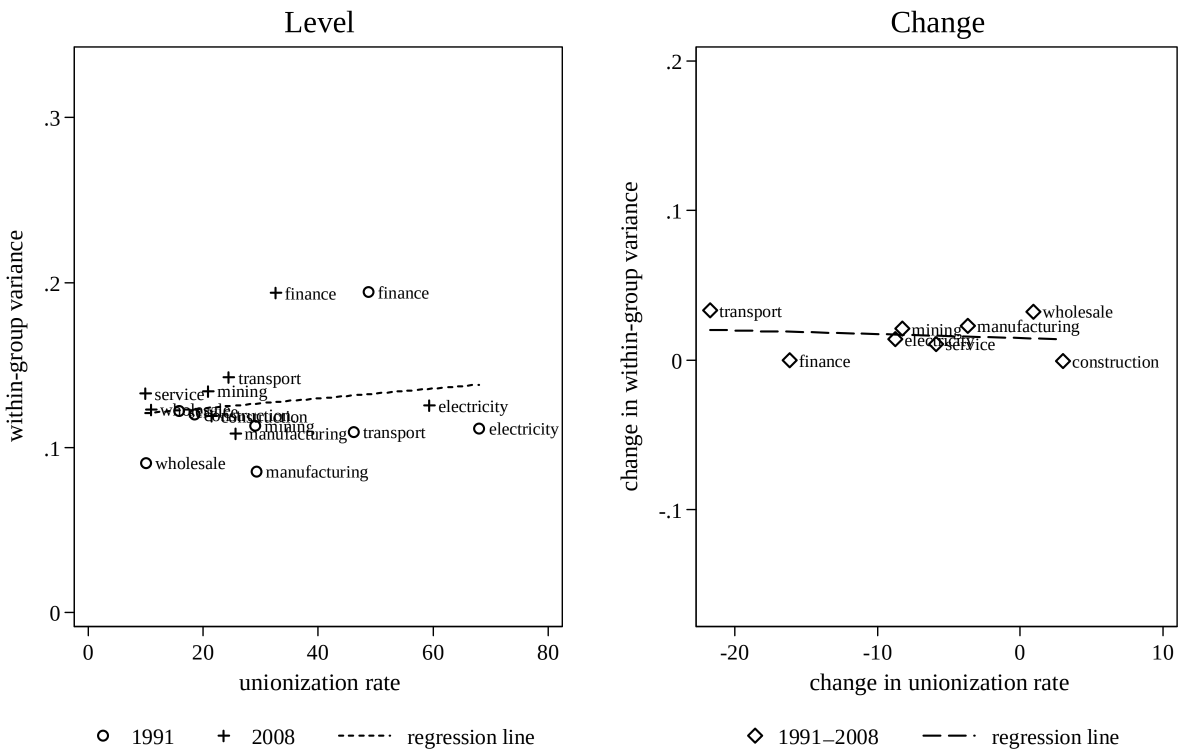


Panel B: Bonus Ratio



Notes: The log of total wages per hour can be decomposed as $w = \ln r + \ln(1 + b/r)$, where r denotes regular wages per hour, and b denotes bonus payments per hour. Both $\ln r$ and $\ln(1 + b/r)$ are normalized so that the intercepts of their median profiles are zero.

Figure 6: Within-Group Inequality and Unionization Rates by Industry



Appendix

Figure A1: Mean Wages, Hours Worked, and Earnings for Men and Women

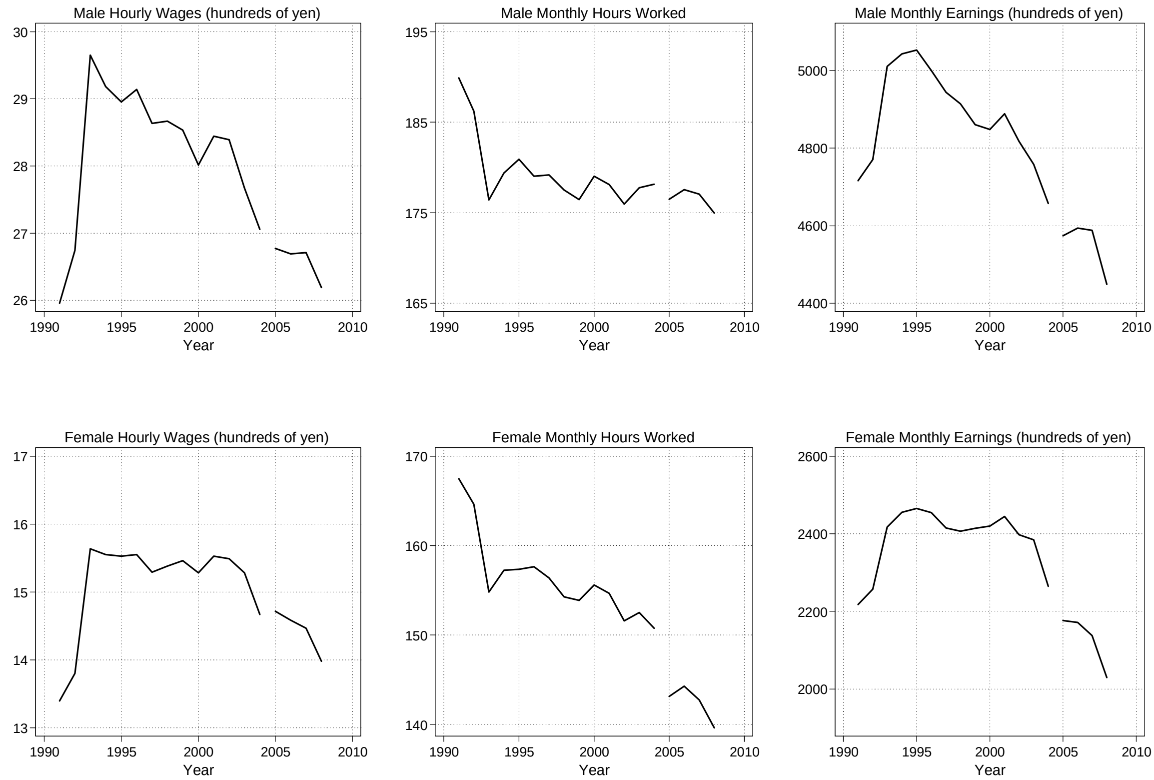


Figure A2: Wage Inequality for Men and Women

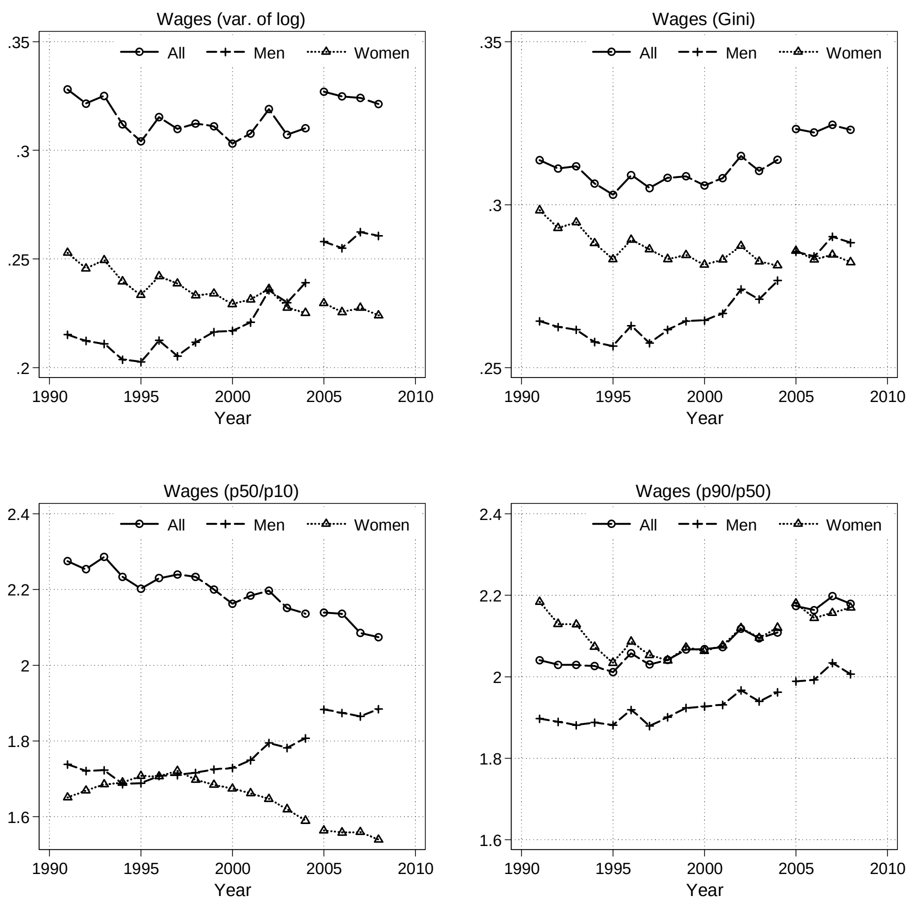


Figure A3: Education, Experience, Gender Wage Premia, and Residual Wage Inequality

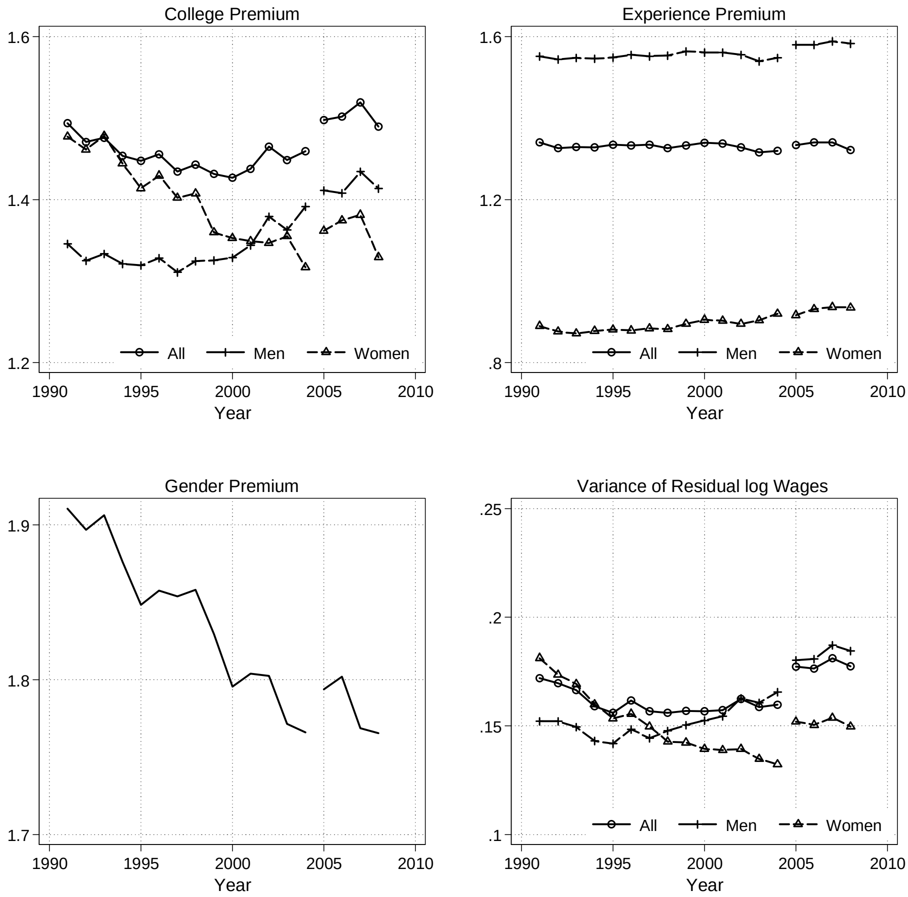


Figure A4: Inequality in Labor Supply and Earnings of Men and Women

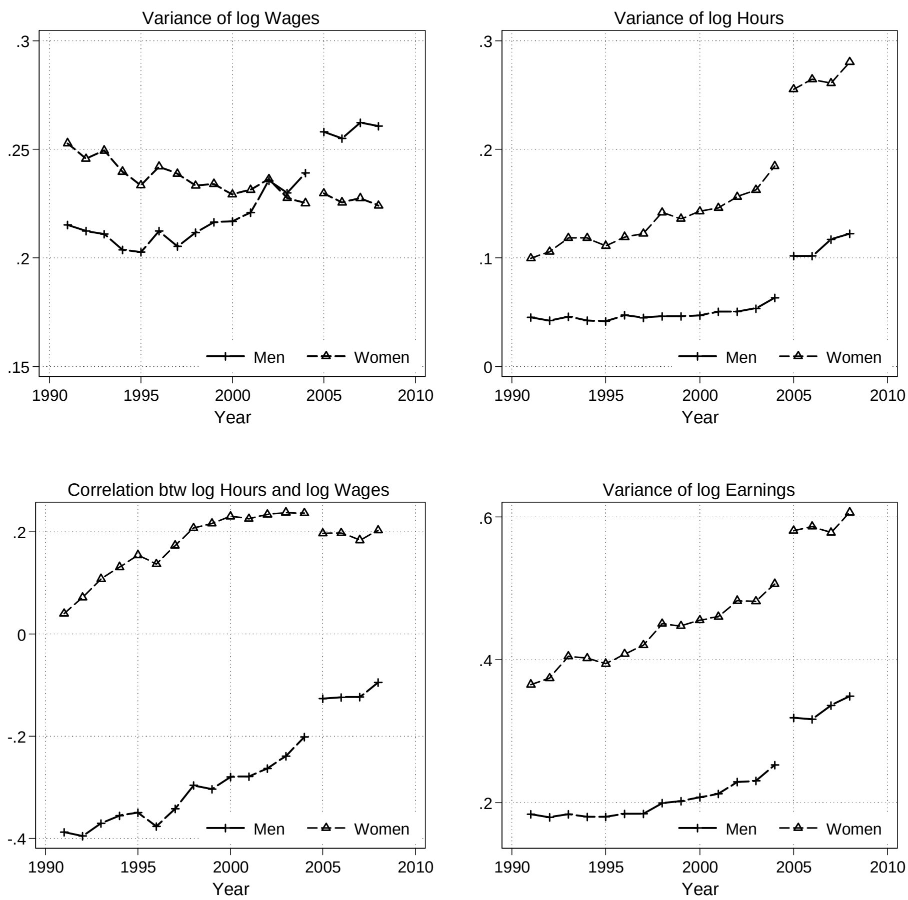


Figure A5: Understanding Earnings Inequality

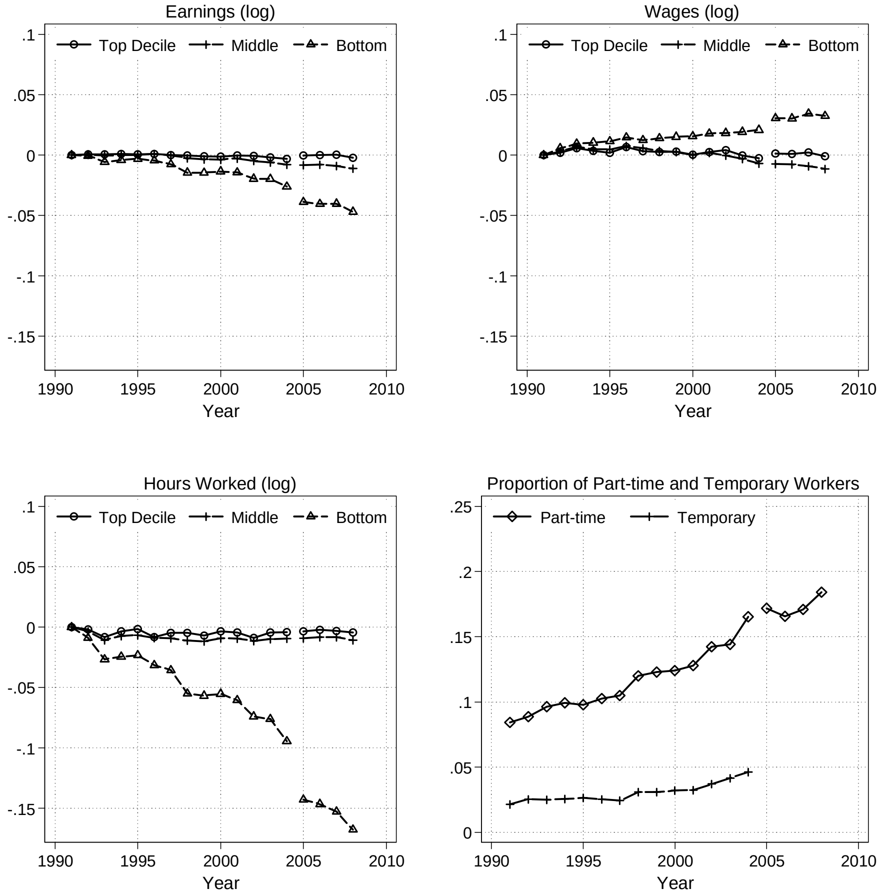


Figure A6: Wages and Hours over the Life Cycle

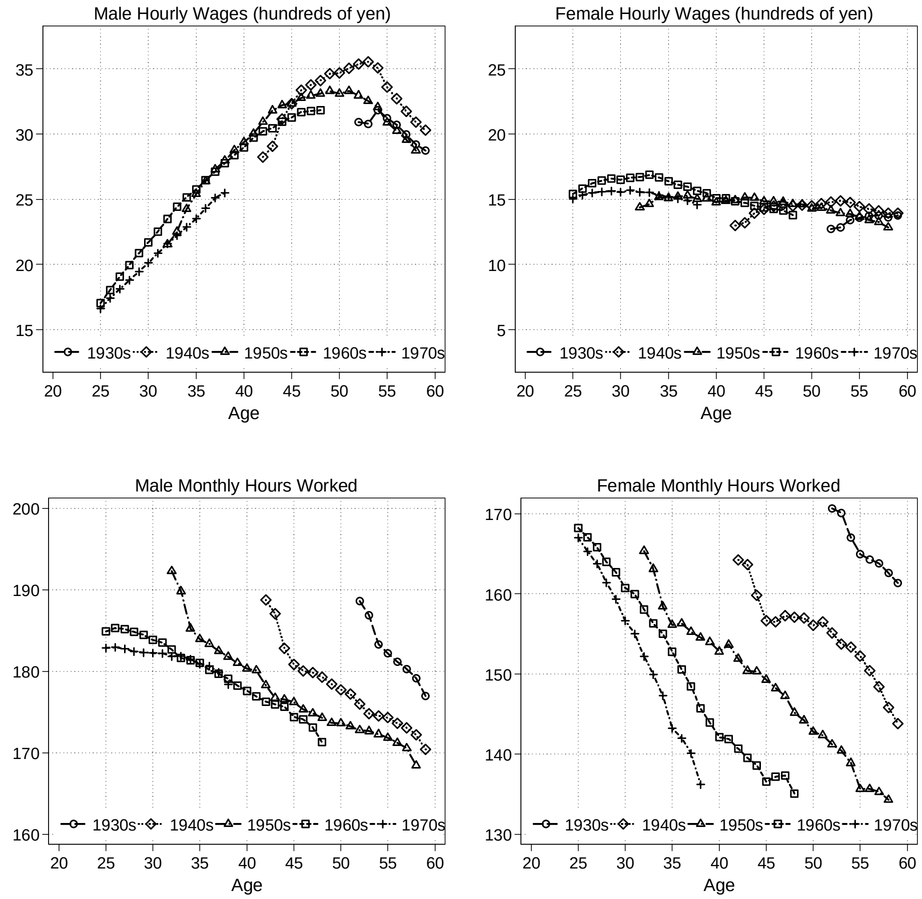


Figure A7: Life Cycle Inequality by Cohort for Men

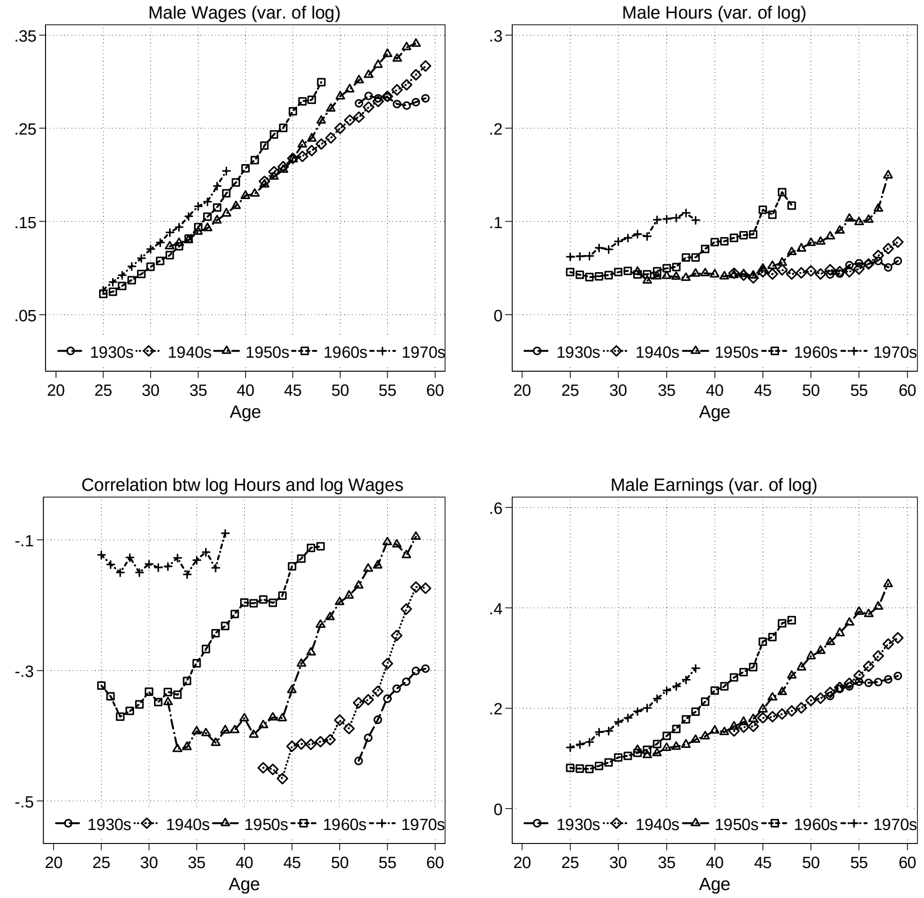


Figure A8: Life Cycle Inequality by Cohort for Women

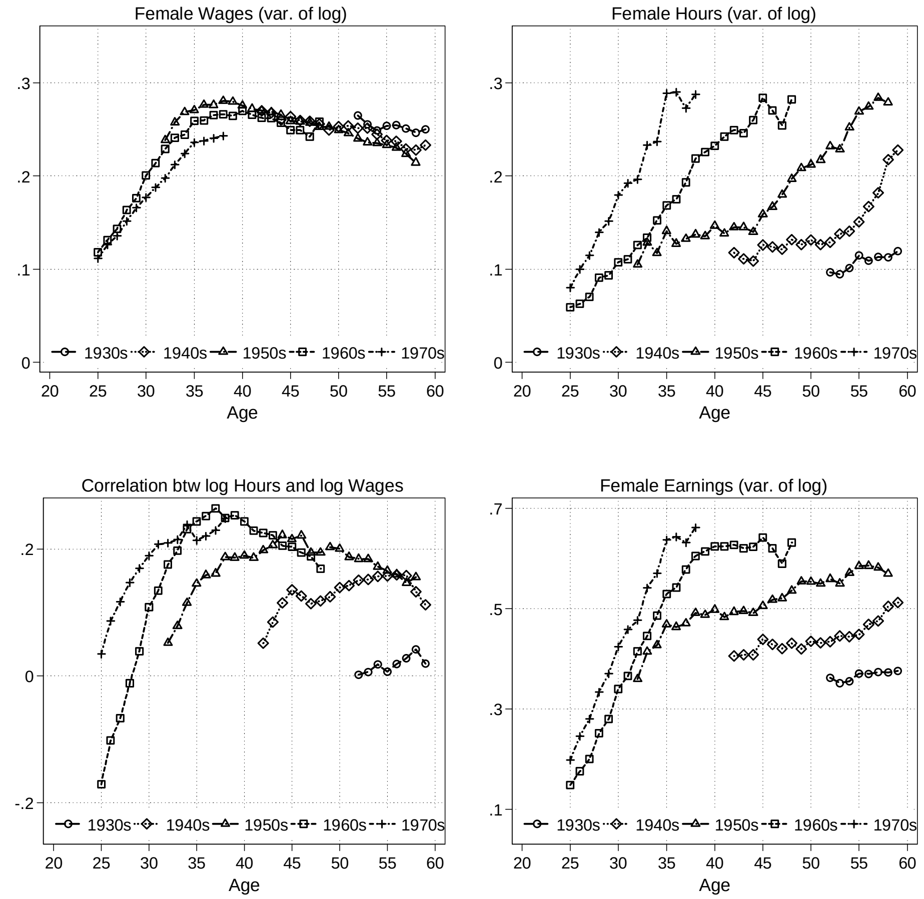


Figure A9: Life Cycle Earnings Inequality, after Controlling for Year and Cohort Effects

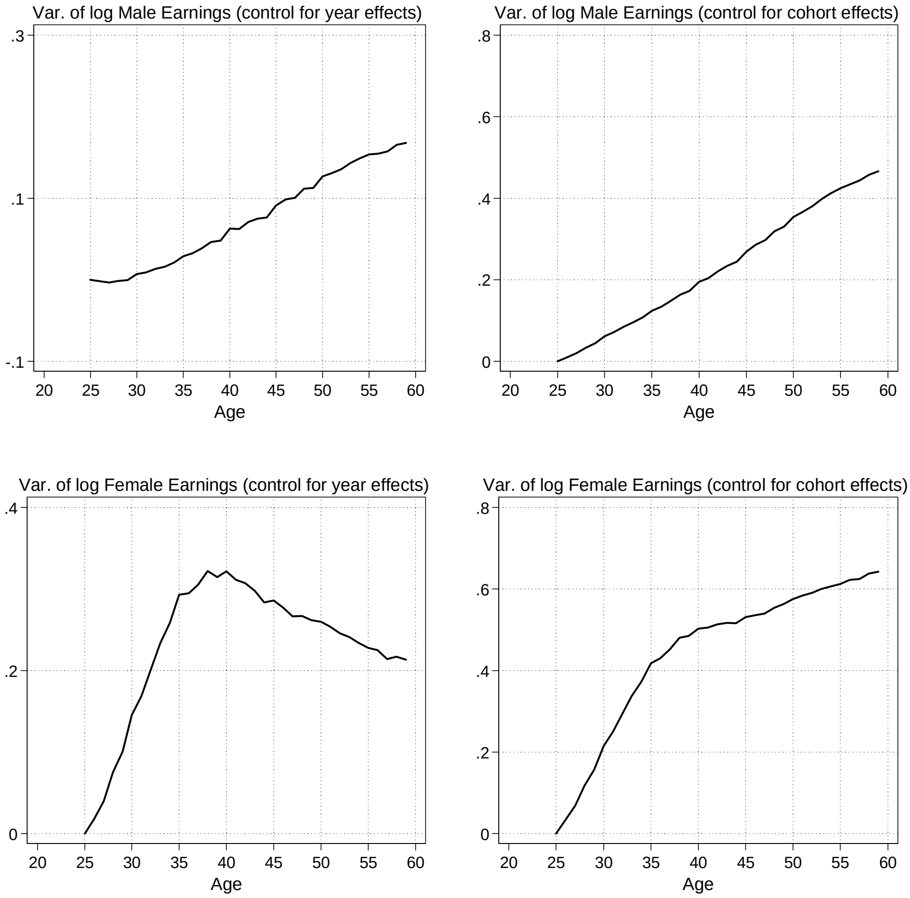


Figure A10: Life Cycle Wage Inequality, after Controlling for Year and Cohort Effects

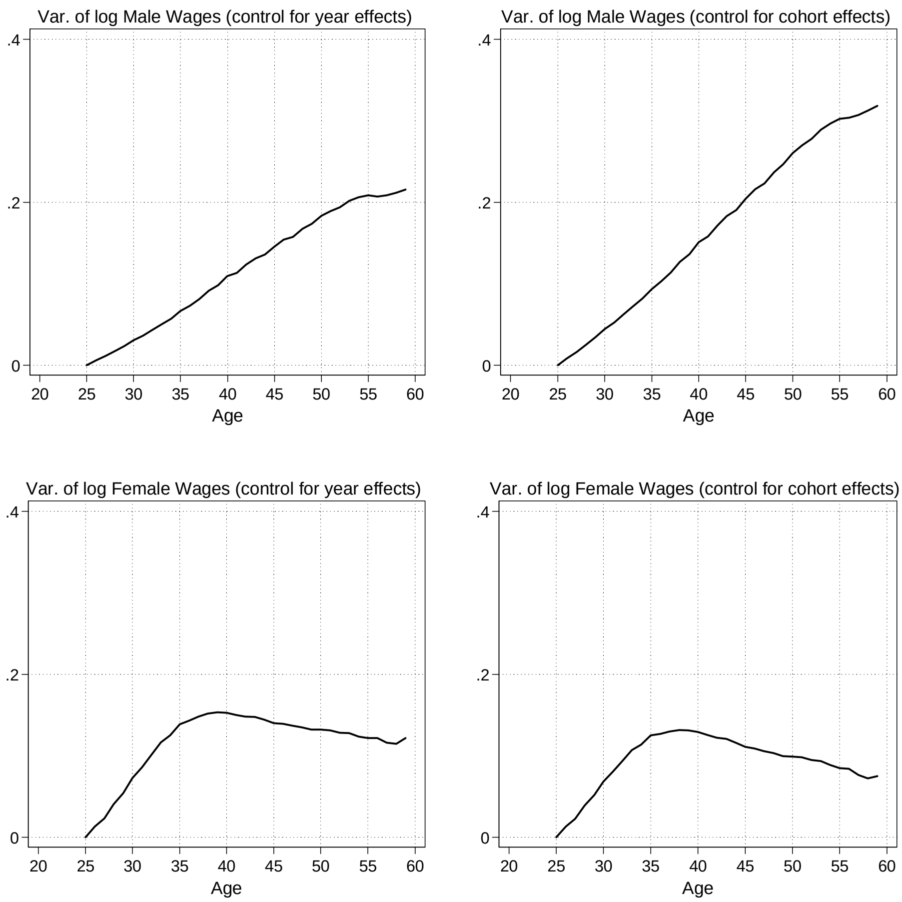


Figure A11: The Evolution of Earnings Inequality