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Changing Unchanged Inequality: Higher Education, Youth Population, and the Japanese Seniority Wage System*

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Abstract

Wage inequality declined in the 1990s and rose after 2000 among full-time male workers in Japan. Narrowing wage inequality in the 1990s can be accounted for by a decline in between-group inequality resulting from a stable return to education and decreased returns to experience and tenure. Widening wage inequality after 2000 can be accounted for by a rise in within-group inequality resulting from a relative increase in educated and experienced workers, as well as changes in heterogeneous returns to human capital.

Keywords: wage inequality, heterogeneous returns to human capital, composition effects, seniority wages

JEL Classification: I24, J24, J31, M52

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1 Introduction

Various measures of wage inequality did not rise substantially in Japan over the 1980s and 1990s, whereas a sizable increase in wage inequality has taken place in the United States since the 1980s.[1] The top 1% share of wage income, which was identical in the late 1960s between Japan and the United States, remained stable in Japan but doubled in the United States from 1970 to 2000. Since Japan and the United States were at the same stage of industrialization by 1980 and implemented a comparable tax cut for the highest-income workers after 1980, technological change and tax reform alone cannot explain the divergent trends in inequality between the two countries (Moriguchi and Saez, 2007). Whereas enormous studies have been conducted to account for trends in U.S. wage inequality, trends in Japan's wage inequality have not yet been fully explained.

This paper investigates changes in Japan's wage structure between 1991 and 2008. During this period in Japan, real wages rose from 1991 to 2000 but fell from 2001 to 2008 for full-time male and female workers aged between 15 and 59. Although the increase in real wages in the 1990s was greater toward the lower percentiles of the wage distribution, the decline in real wages after 2000 was smaller toward the upper percentiles of the wage distribution for male workers (Figure 1). Accordingly, wage inequality, as measured by the variance of log wages, declined in the 1990s but started to rise after 2000 among male workers (Figure 2). The decline in real wages after 2000 was moderate at the bottom end relative to the middle of the wage distribution for female workers, which can be attributed to increased minimum wages (Kambayashi, Kawaguchi, and Yamada, 2011). The aim of this paper is to account for the reversal of trends in Japan's wage inequality that occurred among male workers for the prolonged period of economic recession in more recent years.

Trends in wage inequality are considered to be determined by interactions among supply, demand, and institutions. On the demand side of the labor market, skill-biased technological change has been pervasive across the world including Japan (Berman, Bound, and Machin, 1998; Sakurai 2001); while on the supply side, the workforce's educational attainment has increased and the youth population has declined. Continuous progress in higher education is a common feature of

[1] See Katz and Revenga (1989), Katz, Loveman, and Blanchflower (1995), and Kambayashi, Kawaguchi, and Yokoyama (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.

advanced East Asian countries such as Japan, the Republic of Korea, Singapore, and Taiwan, where educational wage differentials, which can account for a large part of widening wage inequality in the United States since the 1980s, were stable or declined over the 1980s and 1990s.[2] Moreover, a significant decline in fertility rates, which is also common nowadays in advanced East Asian countries, started earlier in Japan; thus, it has reduced the proportion of the young and inexperienced workforce in recent years. On the institutional side, a highly developed system of Japanese internal labor markets, which is known as the Japanese employment system, has been changing. The Japanese employment system, as represented by long-term employment and seniority wages, is a system of fostering firm-specific human capital.[3] This system was fully institutionalized to keep up with rapid technological change during high-growth periods and still persists; however, some features of the system may have been eroded in the waves of economic slowdown.

We begin our analysis by documenting some important changes in Japan's wage structure between 1991 and 2008. Since one of our interests is in the influence of changes in the Japanese employment system on inequality trends, the analysis focuses mainly on full-time male workers and augments the Mincer (1974) wage equation by incorporating job tenure as a measure of firm-specific human capital, in addition to educational attainment and general work experience. The variance decomposition analysis indicates that narrowing wage inequality in the 1990s is accounted for by a decline in between-group inequality and that widening wage inequality after 2000 is accounted for by a rise in within-group inequality, when skill group is defined by education, experience, and tenure. The quantile regression analysis reveals a moderate convexification of the return to education in the middle and upper quantiles of the wage distribution and a decrease in returns to experience and tenure for workers with long experience and tenure in 2008 as compared to 1991. In the main analysis, we quantify the impact of changes in returns on elements in human capital and the composition of the workforce on trends in between- and within-group inequality. The first effect is referred to as price effects and the second as composition effects (Lemieux,

[2]See Ryoo, Nam, and Carnoy (1993) for the Republic of Korea; Toh and Wong (1999) for Singapore; and Gindling and Sun (2002) for Taiwan.

[3]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 in the United States. Clark and Ogawa (1992) and Hashimoto and Raisian (1992) find that the return to tenure fluctuates over the business cycle in Japan in the 1980s. 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.

2006a, 2006b). The price of skill changes according to shifts in the supply of and demand for skills when workers with different age and education levels are imperfect substitutes (Card and Lemieux, 2001). The increased share of skilled workers can directly raise (residual) wage inequality when wage dispersion is higher for more educated and more experienced workers than for less educated and less experienced workers (Lemieux, 2006b). Violante (2002) theoretically demonstrates that an increase in the return to tenure in response to accelerated technological progress can account for one third of rising residual inequality in the United States. The return to tenure would decrease in response to decelerated technological progress; thus, it may have contributed to lowering wage inequality in Japan.[4] Little empirical research, however, examines the contribution of changes in the return to tenure to inequality trends or discusses the implications of the erosion of the Japanese employment system for inequality trends.[5] We extend the random coefficients model in Lemieux (2006a) by incorporating job tenure and by allowing for correlations among heterogeneous returns to education, experience, and tenure. The decomposition analysis based on the augmented Mincer-type wage equation with random coefficients indicates that a decline in between-group inequality results from a stable return to education and decreased returns to experience and tenure, while a rise in within-group inequality results from a relative increase in educated and experienced workers, as well as changes in heterogeneous returns to human capital.

The next section documents key facts about changes in Japan's wage structure since the 1990s and discusses changes in the wage, bonus, and promotion system.[6] Section 3 describes the econometric framework used to analyze the quantitative contribution of changes in returns on elements in human capital and the composition of the workforce to inequality trends. Section 4 presents results regarding heterogeneous returns to human capital and price and composition effects on between- and within-group inequality; confirms the robustness of the findings against changes in industry composition, firm size distribution, and the proportion of part-time employment and the choice of sample period; and discusses the impact of deunionization on residual inequality. The final section concludes.

[4] See Hayashi and Prescott (2002) for the slowdown of total factor productivity growth in the 1990s.

[5] An exception is Genda (1998), who examines the quantitative contribution of changes in the return to tenure and the length of job tenure to changes in wage differentials between age and education groups from 1980 to 1992.

[6] Figures A1 to A9 illustrate trends in Japan's wage inequality for both male and female workers aged between 25 and 59, including those who work part-time. Lise and Yamada (2012) discuss the details.

2 Changes in Japan's Wage Structure

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, fishery, and the legislative, administrative, and judicial branches of local and national governments. The analysis focuses on full-time 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 for male workers and between 264,000 and 391,000 for female workers. 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 (the base year is 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 proportion of university graduates rose from 31.7 to 55.5%, while the proportion 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 for male workers and from 1.26 to 1.32 for female workers. 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 for male workers and from 16.4 to 18.5 for female workers. Job tenure tends to be longer in Japan than in Anglo-Saxon countries, such as Australia, Canada, the United Kingdom, and the United States, but similar between Japan and continental European countries, such as France and Germany, for the period between the late 1970s and the early 1990s (OECD, 1993). During the period between 1991 and 2008, the sample means of job

tenure, which is the length of time with the current employer, range from 12.1 to 13.1 for male workers and from 6.70 to 8.29 for female workers. Job tenure decreased slightly for younger male cohorts with university degrees. Mean job tenure at the age of 35 for male university graduate workers born in the 1960s, 1970s, and 1980s was 9.55, 9.68, and 8.69 years, respectively.

2.2 Trends in Wage Inequality

We begin our analysis by decomposing overall inequality into between- and within-group inequality to understand the sources of inequality. We consider a log wage equation such that $w_{it} = X_{it}\theta_{it} + u_{it}$, where X is a vector of skills determined by education dummies and fourth-order polynomials in experience and tenure, i is an index for individuals, and t is an index for years, in order to account for the impact of progress in higher education, a decline in youth population, and the erosion of the Japanese employment system on changes in the wage structure. Under a zero conditional mean assumption: $\mathbb{E}_t\left(u_{it} | X_{it}\right) = 0$, the variance of log wages can be decomposed into two components.

$$\mathbb{V}_t\left(w_{it}\right) = \mathbb{V}_t\left[\mathbb{E}_t\left(w_{it} | X_{it}\right)\right] + \mathbb{E}_t\left[\mathbb{V}_t\left(w_{it} | X_{it}\right)\right], \tag{1}$$

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. For the purpose of estimation, we impose a restriction on the mean of the vector of random coefficients such that $\mathbb{E}_t\left(\theta_{it} | X_{it}\right) = \theta_t$. We further discuss the details of the restriction and derive its implications for the conditional mean and variance in Section 3. The augmented Mincer-type wage equation fits the wage structure of Japanese male workers remarkably well. The R^2 obtained from the log wage regressions by year ranges from 0.47 to 0.56 during the sample period. The inclusion of full interaction terms among education, experience, and tenure increases the R^2 only marginally. Trends in between- and within-group inequality described here remain unchanged even after adding the full interaction terms.

Figure 2 illustrates trends in overall, between-group, and within-group inequality separately for male and female workers. For male workers, 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. Thus, narrowing overall inequality in the 1990s is accounted for by a decline in between-group inequality, while widening overall inequality after 2000 is accounted for by a rise in within-group inequality. For female workers, between-group inequality remained stable, while within-group inequality declined in the early 1990s and remained stable after the mid-1990s. Changes in wage inequality are less pronounced for female workers than for male workers. The analysis hereafter focuses on male workers.

2.3 Changes in Wage Profiles

Trends in wage inequality reflect changes in the shape of wage profiles. Figure 3 depicts predicted values of log hourly wages along with education, experience, and tenure in 1991 and 2008, holding other characteristics at their means. Each wage profile is obtained from quantile regressions of the log wage equation described above for the 10th, 50th, and 90th quantiles. Figure 4 illustrates changes in the workforce share by education, experience, and tenure to see the shifts in the supply of skills.

The wage-education profile is approximately linear at the lower quantile but is more convex-shaped for the upper quantile in more recent years. Convexification of the wage-education profile implies a relative decrease in the demand for workers without college degrees, namely 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). The relatively stable return to education in Japan can be explained by a rise in the supply of the educated workforce. During the period between 1991 and 2008 in Japan, the proportion 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 proportion 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 mirrors the rising return to education and the stagnation of higher education after the late 1970s in Anglo-Saxon countries such as Canada, the United Kingdom, and the United States (Card and Lemieux, 2001). The relatively stable return to education despite a substantial rise in the supply of skills can be interpreted as indicating a substantial rise in the demand for skills in Japan.

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. 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 mechanism that underlies these changes is the same as that behind a reduction in the relative wages of baby boomers in the United States (Welch, 1979). The reduction in wage differentials between experienced and inexperienced workers can be explained by a relative increase in experienced workers, namely a relative decrease in inexperienced workers. The proportion of young and inexperienced workers decreased in Japan for two reasons. First, the number of younger cohorts entering the labor market decreased in recent years because of declining fertility rates. Second, the second-generation baby boomers, who were born in the early 1970s, reached middle age.

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, the seniority wage system firmly remains, 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. A fall in job tenure has not yet clearly appeared, despite a recent moderate decline in job tenure among younger cohorts with university degrees. The fluctuation of the proportions 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. 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 declines (Mincer and Higuchi, 1988). Moreover, as the mandatory retirement age is extended under the Elderly Employment Stabilization Law,[7] the wage-tenure profile will be

[7]The Elderly Employment Stabilization Law was enacted in 1986 to increase employment opportunities for the elderly and 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 retirement system ranges between 88.2 and 96.8%. Among firms with retirement system, the proportion of firms where the mandatory retirement age is 59 or under decreased from 23.4% in 1992 to 0.7% in 2004.

flatter under a deferred compensation contract (Lazear, 1979; Clark and Ogawa, 1992).[8] A change in the wage-tenure profile could potentially occur by 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 Japanese job market, however, seems to undergo the opposite change, in that the wage increase associated with job changes has become less likely under economic recession. Figure 5 shows percentage wage changes associated with job changes over the life cycle in the years 1991, 1996, 2001, and 2006.[9] 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.

2.4 Trends in Workforce Composition

The proportion of educated and experienced workers has increased in recent years (Figure 4). Such a change in the composition of the workforce can mechanically raise within-group (residual) inequality (Lemieux, 2006b). Table 1 summarizes workforce share by education, experience, and tenure for the years 1991, 2000, and 2008 along with residual variance in more detail, to discuss the relationship between workforce composition and within-group inequality. On the one hand, residual variance increases with education and experience (Table 1, Panel A). This implies that the increased share of educated and experienced workers is a factor in raising within-group inequality. On the other hand, residual variance does not increase with tenure (Table 1, Panel B). This implies that, even though it may be inconclusive whether there was a change in long-term employment, a change in tenure composition would not have large (composition) effects on within-group inequality. Residual variance increased in most skill groups from 1991 to 2008, indicating that composition effects are not the only explanation for a rise in within-group inequality. Section 4

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

[9] In this figure, the 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.

presents the quantitative contribution of changes in price, as well as workforce composition, to the trends in within-group inequality, followed by specifications of the conditional expectation and variance of log wages in Section 3.

2.5 Bonus System

The bonus system prevalent in Japanese firms is best described as a shared return to specific investment, as evidenced by the bonus ratio increasing with tenure and fluctuating over the business cycle (Hashimoto, 1979, 1981; Hart and Kawasaki, 1999).[10] The theory of firm-specific human capital predicts that the bonus ratio will decline as the firm's profitability decreases (under economic recession and increased market competition) and the accumulation of specific human capital decreases (under sluggish technological progress). Indeed, during the period between 1991 and 2008, the proportion of workers who received bonuses fell from 92.2 to 83.8%, and the ratio of bonuses to regular wages fell from 28.6 to 21.6%. The fall in the bonus ratio itself does not counter the trend toward performance-based pay.

Recognizing that the logarithm of total wages per hour can be written as $w = \log r + \log(1 + b/r)$, where r denotes regular wages per hour, and b denotes bonus per hour, we perform separate regressions for log regular wages ($\log r$) and the bonus ratio ($\log(1 + b/r)$). Figure 6 illustrates the profiles of regular wages and the bonus ratio according to education, experience, and tenure in 1991 and 2008. 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 6, Panel A). The difference in the wage-tenure profile between total wages and regular wages can be attributed to a steeper bonus-tenure profile (Figure 6, Panel B). Consistent with firm-specific human capital theory in Hashimoto (1979, 1981), the bonus ratio increases with education and tenure, but not experience. Thus, the bonus system can be interpreted as a system that encourages workers to acquire 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, indicating that a reduction in bonus payments plays a major role in declining real wages after 2000. The downward shift in the bonus-tenure profile

[10] Hart and Kawasaki (1999) discuss competing hypotheses and their empirical relevance.

results in a decline in the return to tenure. The slopes of not only the bonus-tenure profile but also the regular wage-tenure profile are less steep for workers with long tenure in more recent years.[11] 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.[12]

2.6 Promotion System

The promotion system in Japan, as represented by late selection, is incorporated into the Japanese employment system (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. Recent changes in external environments, such as the speed of technological change and the degree of market competition, might affect firms' internal structure. One possible example of organizational change may be early promotion, which could potentially weaken the effect of tenure on wages. Neither the proportion of workers in managerial positions nor the speed of promotion changed substantially, however. Proportions of division chiefs, section chiefs, subsection chiefs, other chiefs, and foreman, 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. The average job tenure of division chiefs, section chiefs, subsection chiefs, other chiefs, and foreman, respectively, changed only negligibly from 23.8 to 23.6 years, from 20.8 to 21.2 years, from 18.0 to 18.4 years, and from 20.3 to 20.9 years between 1991 and 2008.

[11] There is direct evidence on a decline in the importance of age and tenure as a determinant 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 a key determinant 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 period between 2001 and 2009.

[12] There has been a significant increase in the number of firms adopting the wage system that places a greater emphasis on performance since 2000. 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 period between 1999 and 2008.

3 Econometric Framework

In this section, we present an empirical framework to decompose between- and within-group inequality into price and composition effects. We specify the logarithm of hourly wages for an individual i in year t by the augmented Mincer-type wage equation with random coefficients:

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

where 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. Both the intercept and slope coefficients are heterogeneous across individuals and time. 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 $\mathbb{E}_t\left(j_i \middle| s_{it}, x_{it}, z_{it}\right) = 0$, and $\mathbb{V}_t\left(j_i \middle| s_{it}, x_{it}, z_{it}\right) = \sigma_j^2$, $\mathbb{E}_t\left(j_i k_i \middle| s_{it}, x_{it}, z_{it}\right) = \sigma_{ij}$ for $j, k = a, b, c, d$, and $j \neq k$. The log wage equation can then be written as

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

where the error term is $u_{it} = \alpha_t a_i + s_{it}\beta_t b_i + x_{it}\gamma_t c_i + z_{it}\delta_t d_i$. The coefficients represent the mean effects of human capital on log wages in year t, i.e., $\beta_t = \mathbb{E}_t\left(\beta_{it}\right)$, $\gamma_t = \mathbb{E}_t\left(\gamma_{it}\right)$, and $\delta_t = \mathbb{E}_t\left(\delta_{it}\right)$.

The mean and variance of the log wages are given by

$$\mathbb{E}_t\left(w_{it} \middle| s_{it}, x_{it}, z_{it}\right) = \alpha_t + s_{it}\beta_t + x_{it}\gamma_t + z_{it}\delta_t, \tag{2}$$

$$\begin{aligned}\mathbb{V}_t\left(w_{it} \middle| s_{it}, x_{it}, z_{it}\right) = {} & \sigma_a^2\alpha_t^2 + \sigma_b^2\left(s_{it}\beta_t\right)^2 + \sigma_c^2\left(x_{it}\gamma_t\right)^2 + \sigma_d^2\left(z_{it}\delta_t\right)^2 \\ & + \sigma_{ab}\left(2\alpha_t \cdot s_{it}\beta_t\right) + \sigma_{ac}\left(2\alpha_t \cdot x_{it}\gamma_t\right) + \sigma_{ad}\left(2\alpha_t \cdot z_{it}\delta_t\right) \\ & + \sigma_{bc}\left(2s_{it}\beta_t \cdot x_{it}\gamma_t\right) + \sigma_{bd}\left(2s_{it}\beta_t \cdot z_{it}\delta_t\right) + \sigma_{cd}\left(2x_{it}\gamma_t \cdot z_{it}\delta_t\right).\end{aligned} \tag{3}$$

This framework allows returns to human capital to be correlated and nests the random coefficients model developed in Lemieux (2006a) as a special case when $\delta_t = 0$ and $\sigma_{ij} = 0$ for $j, k = a, b, c, d$, and $j \neq k$. Equation (2) expresses the relation of between-group inequality to the price of skill and the composition of the workforce, while equation (3) expresses the relation of within-group

(residual) inequality to the price of skill and the composition of the workforce. Between-group inequality increases with the price of skill, while, if there were no heterogeneity in returns to human capital, i.e. $\sigma_j^2 = \sigma_{ij} = 0$, within-group inequality does not change according to the price of skill. 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. 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 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 (2), and the variance and covariance of returns to human capital are identified from equation (3). 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 (2) and (3) 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. While no excluded instrument is used for estimating equation (2), 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 (3). We adopt the efficient two-step GMM and use the BSWS data from the years 1991, 2000, and 2008 to examine the sources of reversal of trends in Japan's wage inequality.

An advantage of this approach developed in Lemieux (2006a) is that it enables us to isolate

the impact of changes in returns on elements 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, or 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 return to education, experience, or 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, or 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 (2) and (3) are used to quantify the impact on between- and within-group inequality, respectively. 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 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). The 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 Price and Composition Effects

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 (3). Given the nonlinear relationship between productivity and human capital, 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. 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 slightly increased for workers with 10 years of experience and steadily decreased for workers with 30 years of experience from 1991 to 2008. Changes in the return to tenure are more complex, but the return to tenure steadily decreased for workers with 20 years of tenure.

The estimated variance of the returns to human capital indicates significant heterogeneity in the returns to human capital, especially the return to experience. The size of heterogeneity is greater in the returns to education and experience than in the return to tenure. The estimated covariance of the returns to human capital is 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 the returns to human capital is significant. The return to education moves in the same direction with the return to experience, whereas the return to tenure changes inversely with the returns to education and experience. The results seem plausible, since both education and experience are components of general human capital and tenure is a component of specific human capital. The implication is 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 an opposite trend from the demand for specific human capital.

Narrowing wage inequality in the 1990s is accounted for by a decline in between-group inequality, while widening wage inequality after 2000 is accounted for by a rise in within-group inequality. Table 3 presents the results on the 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 attributed 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 positive composition effects generated by the increased share of educated and experienced workers countervail negative price effects. The size of composition effects on within-group

inequality increased after 2000, as the proportion of educated and experienced workforce continued to increase. The size of price effects on between-group inequality decreased after 2000, while the sign of price effects on within-group inequality changed from negative to positive, as the return to college education started to increase. Consequently, between-group inequality did not change substantially after 2000, while within-group inequality increased. To summarize, a decline in between-group inequality, which accounts for narrowing wage inequality in the 1990s, results from decreased returns to human capital, especially firm-specific human capital, while a rise in within-group inequality, which accounts for widening wage inequality after 2000, results from the increased share of educated and experienced workers, as well as changes in heterogeneous returns to human capital.

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; but, the relative size of price effects to composition effects on within-group inequality after 2000 is greater in the case of no restriction. The increase in total price effects is attributed to changes in the size of price effects associated with returns to education and experience and the sign of price effects associated with the return to tenure.

4.2 Robustness Checks

4.2.1 Industry and Firm Size

Figure 7 illustrates changes in workforce share by industry and firm size. The proportion of workers in the manufacturing sector decreased from 36.8 to 31.5% between 1991 and 2008, while the proportion 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 proportion of workers in large firms with more than 5,000 employees decreased until 2004 and then increased. Hashimoto and Raisian (1985, 1992) and Clark and Ogawa (1992) discuss a difference in wage

profiles by firm size, and Mincer and Higuchi (1988) discuss a difference in wage profiles by 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.[13] Following DiNardo, Fortin, and Lemieux (1996), the weighting factor is given by

$$\psi_t(q) = \frac{\Pr(q|\, t=\tau_0)}{\Pr(q|\, t=\tau)} = \frac{\Pr(t=\tau_0|\, q)/\Pr(t=\tau_0)}{\Pr(t=\tau|\, q)/\Pr(t=\tau)}, \tag{4}$$

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 changes in the distribution of industries and firm size account for virtually nothing of the changes in overall inequality between 1991 and 2000 and 21.9% of the changes in overall inequality between 2000 and 2008. Although price effects are smaller and composition effects are greater on within-group inequality between 2000 and 2008, the main results remain essentially unchanged, even after controlling for industry composition and firm size distribution. A declining trend in wage inequality in the 1990s is accounted for by a decline in between-group inequality resulting from decreased returns to human capital, especially firm-specific human capital. An increasing trend in wage inequality after 2000 is accounted for by a rise in within-group inequality resulting from both price and composition effects that occur through heterogeneous returns to human capital.

[13] 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 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.

4.2.2 Part-time Employment

The proportion of part-time workers steadily increased from 1.3 to 8.5% between 1991 and 2008. A change in the composition of full-time workers induced by the increase in part-time employment might also account for the changes in wage profiles. To correct for selection into full-time employment, we employ the Heckman (1979) sample-selection method. The estimation procedure is as follows. 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 prefectural dummies, using the sample of full-time and part-time workers for each year. Second, after including the selection correction term as an additional regressor into equation (2), the system GMM estimation is performed on the sample of full-time workers. We allow the coefficients on the selection correction term to vary over time, but not across individuals. The estimated coefficients on the selection correction terms are then all positive and significant, indicating a positive selection into full-time employment during the period. Nonetheless, we find a similar pattern of changes in returns to human capital, even after controlling for selection into full-time employment.[14]

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 1.9% of the changes in overall inequality between 2000 and 2008. Moreover, the main results discussed above concerning price and composition effects on between- and within-group inequality remain the same.

4.2.3 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 for the analysis of inequality trends in the 1990s and after 2000; concern remains, however, about the

[14] Another related concern is a rise in the unemployment rate. In fact, the male unemployment rate increased, but only from 2.0 to 4.1% during the period between 1991 and 2008, according to the Labour Force Survey.

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 the 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) in the case of no restrictions. As the sample period is shorter, the size of changes in inequality naturally diminishes. The main results discussed above, however, do not change substantially.

4.2.4 Labor Unions

Japanese labor unions are typically formed at the level of a company or establishment. In most cases, both white- and blue-collar workers join the same labor union under a union shop 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 8 plots the level and change of residual variance and unionization rates by industry.[15] 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, indicating that deunionization plays a minor role in increasing within-group inequality.

4.2.5 Occupation

The recent polarization of the U.S. labor market motivates the analysis of the task-based model (Autor, Levy, and Murnane, 2003). 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. We found no evidence that the residual variance increased more substantially in professions that require a higher level of skill and training, such as analyst, doctor,

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

engineer, and programmer. This may not be surprising, however, since the degree of convexification in the wage-education profile is moderate thus far in Japan.

5 Conclusion

This paper has documented changes in Japan's wage structure between 1991 and 2008 and quantified the impact of changes in returns on elements in human capital and the composition of the workforce on inequality trends. We found that a decline in returns to human capital resulted in narrowing between-group inequality in the 1990s. In particular, decreased return to firm-specific human capital, which appears both in regular wages and bonus payments under sluggish technological progress, accounts for the two thirds of the decline in between-group inequality. The return to education was moderately convexified in the upper quantiles of the wage distribution after 2000, which resulted in widening within-group inequality through heterogeneity in returns to human capital. The increased share of educated and experienced workers, owing to progress in higher education and a decline in youth population, also contributed to increasing within-group inequality. The relative size of price effects on within-group inequality increases when allowing for correlations among heterogeneous returns to education, experience, and tenure. The reversal of trends in Japan's wage inequality that occurred by narrowing between-group inequality and widening within-group inequality can be attributed to changes in the sign and size of price effects and the size of composition effects.

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Table 1: Workforce Composition and Residual Inequality

	Workforce Share (%)			Residual 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

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:	–0.0161	–0.0019	–0.0126	–0.0023
education	*–0.0010*	*–0.0011*	*–0.0019*	*–0.0015*
experience	*–0.0046*	*–0.0000*	*–0.0019*	*0.0006*
tenure	*–0.0106*	*–0.0008*	*–0.0088*	*–0.0012*
intercept		*–0.0001*		*–0.0002*
Composition effects:	–0.0032	0.0056	–0.0046	0.0039
Total	–0.0193	0.0037	–0.0172	0.0016
	2000–2008		2000–2008	
Price effects:	–0.0045	0.0066	0.0023	0.0135
education	*0.0042*	*0.0020*	*0.0063*	*0.0037*
experience	*–0.0027*	*0.0017*	*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	0.0192	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: Changes in the log Real Hourly Wages by Percentile of the Wage Distribution

Figure 2: Trends in the Variance of log Hourly Wages

Figure 3: Wage Profiles for the 10th, 50th and 90th percentiles

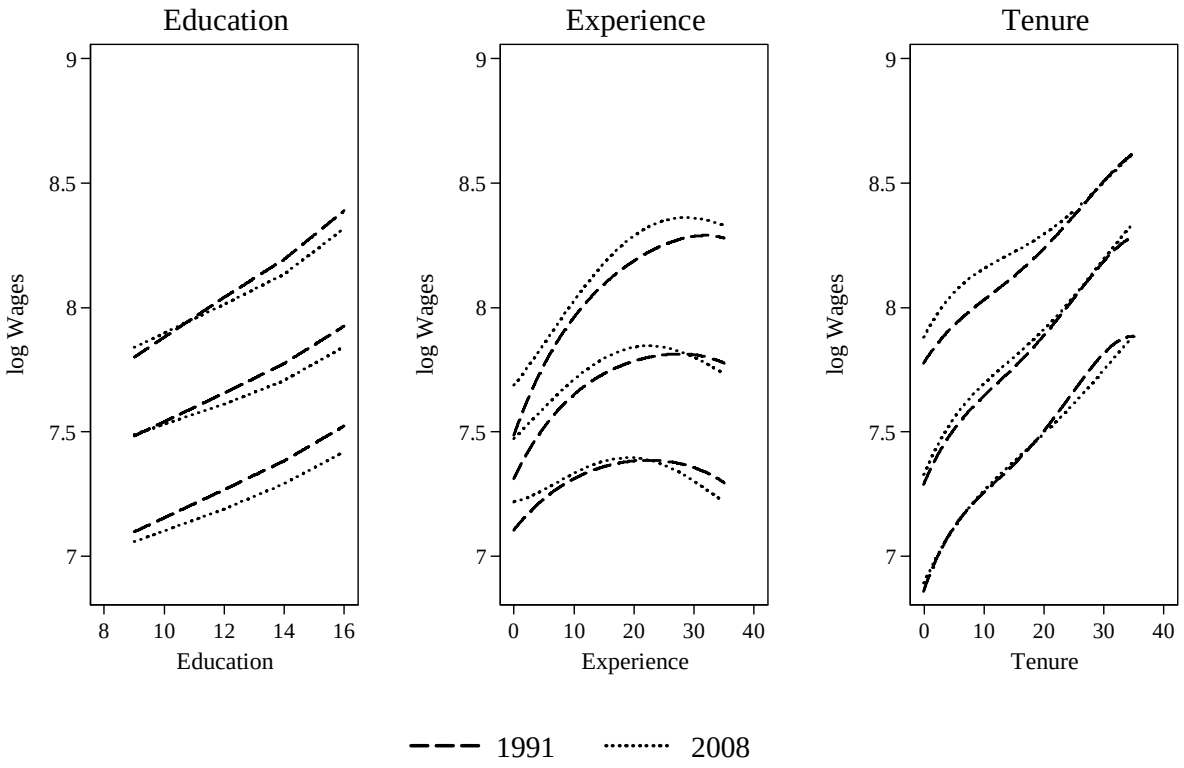


Figure 4: Trends in the Workforce Share by Education, Experience, and Tenure

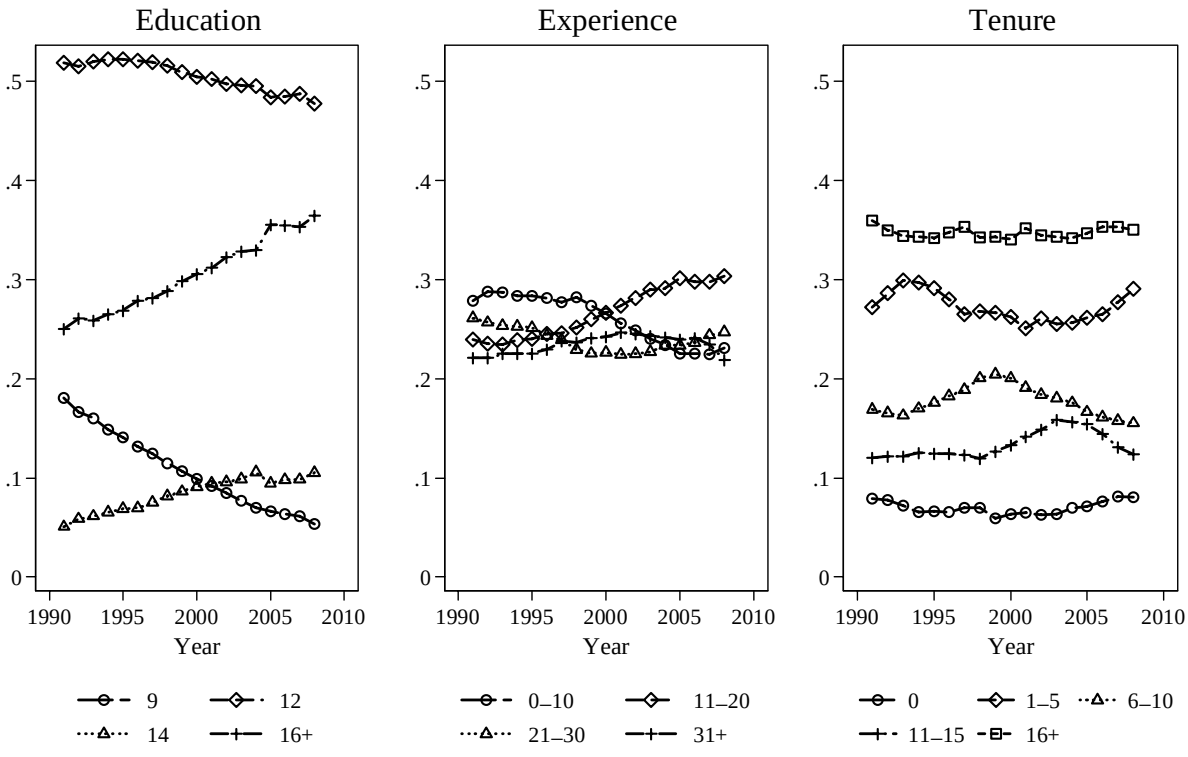


Figure 5: Percentage Wage Changes Associated with Job Changes

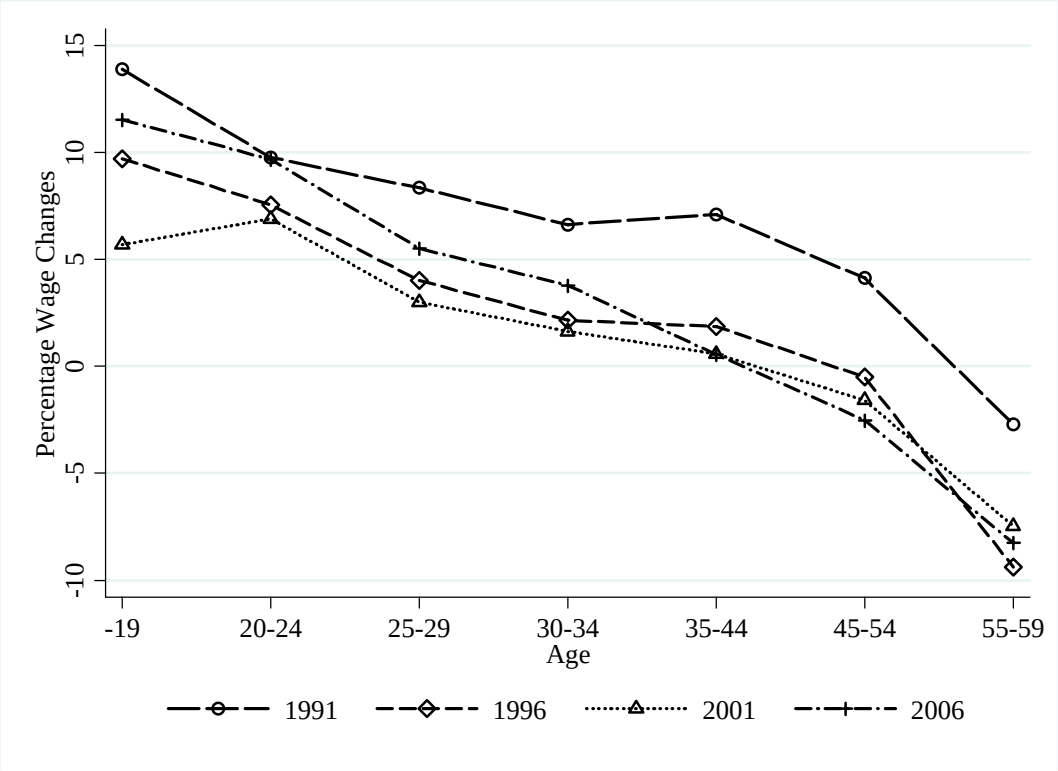
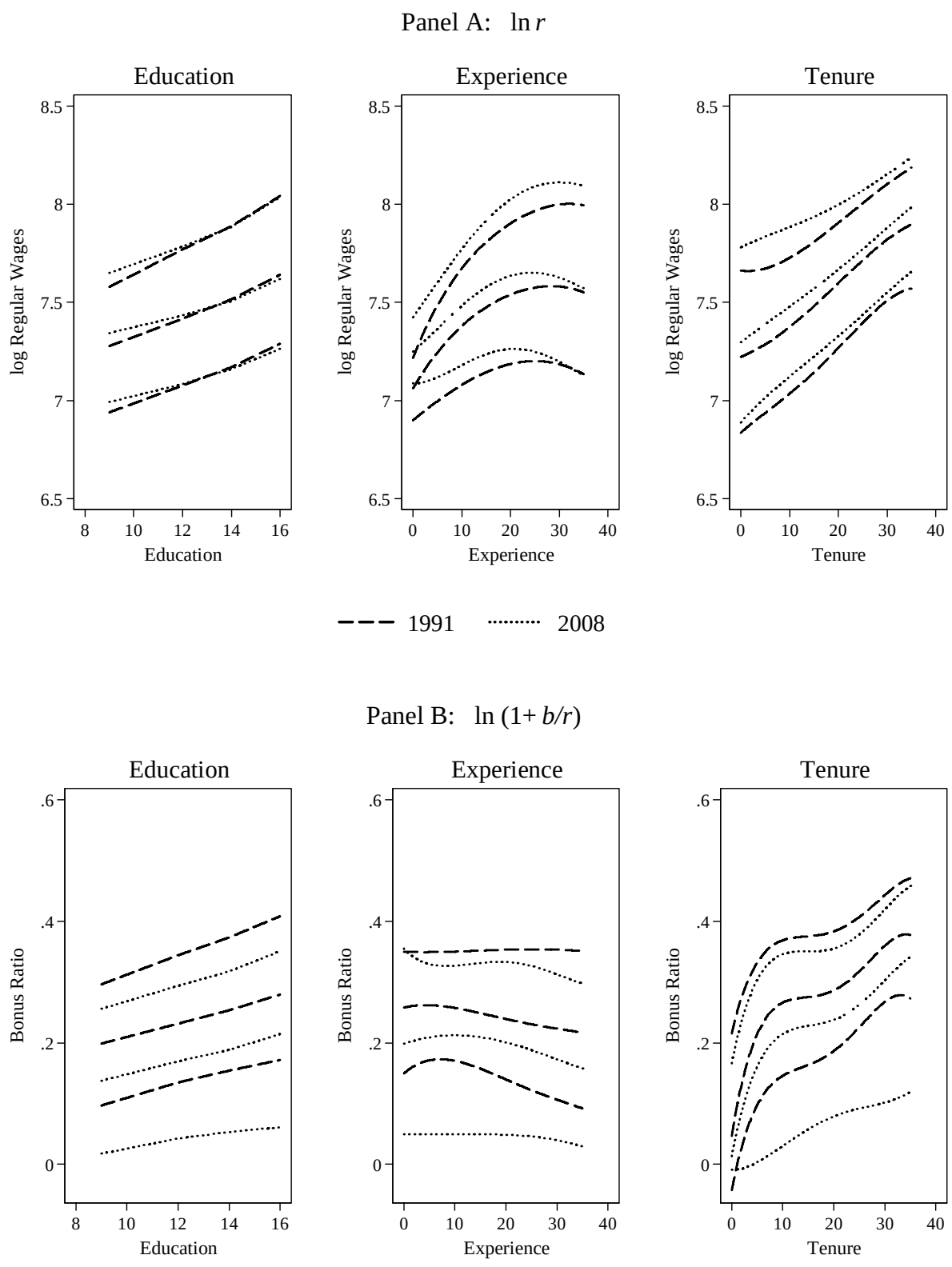
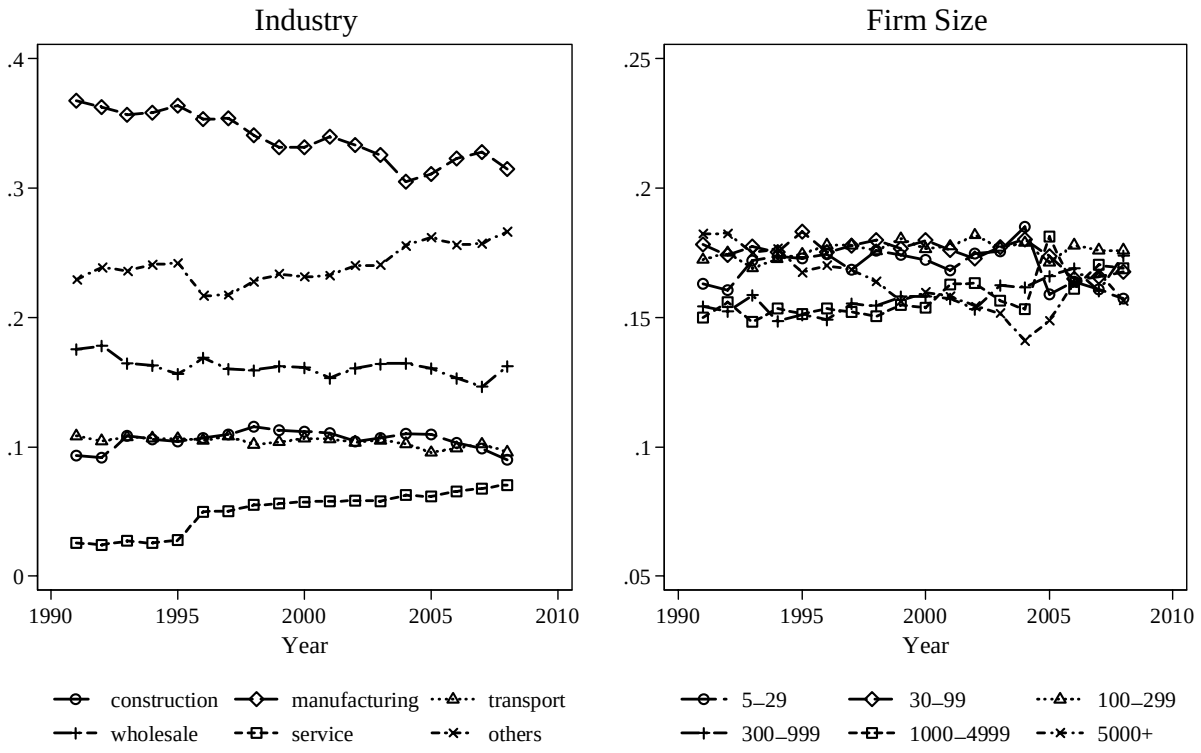


Figure 6: Profiles of Regular Wages and the Bonus Ratio for the 10th, 50th and 90th percentiles



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.

Figure 7: Trends in Workforce Share by Industry and Firm Size



Notes: Other industries include mining, electricity, information, finance, real estate, professional, hotel, entertainment, education, medical care, and complex services.

Figure 8: Within-Group Inequality and Unionization Rates by Industry

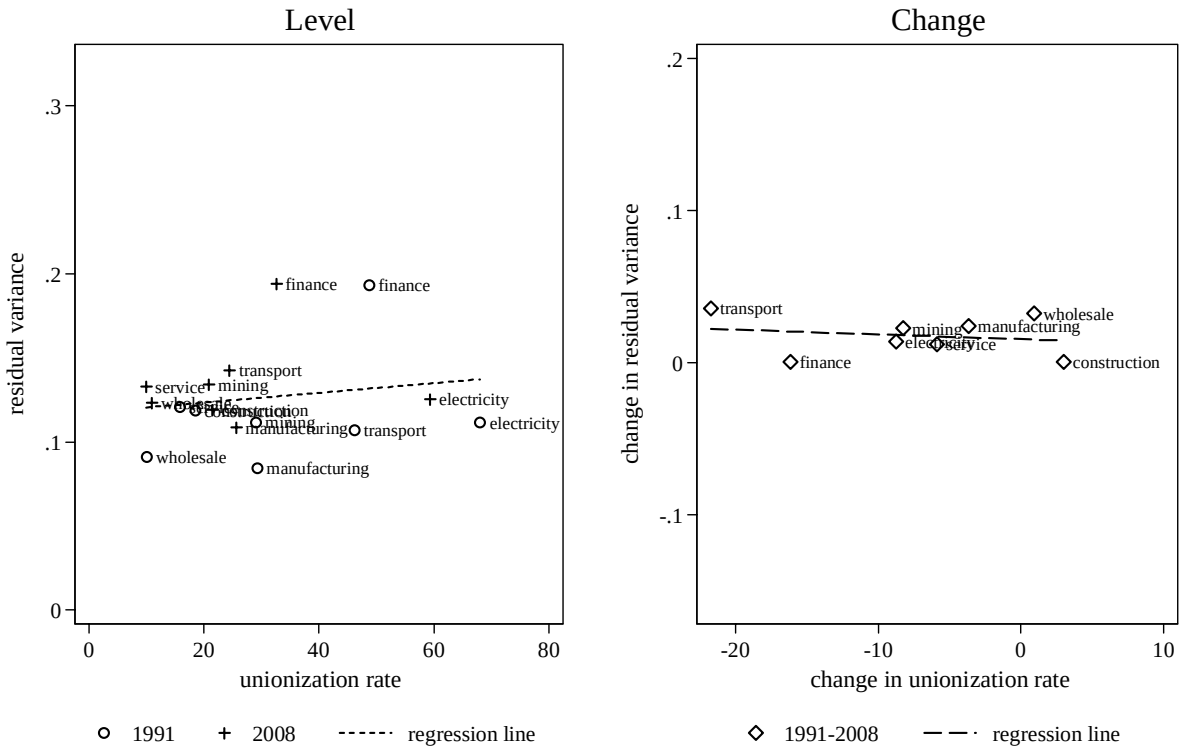


Figure A1: Median Wages, Hours Worked, and Earnings for Men and Women

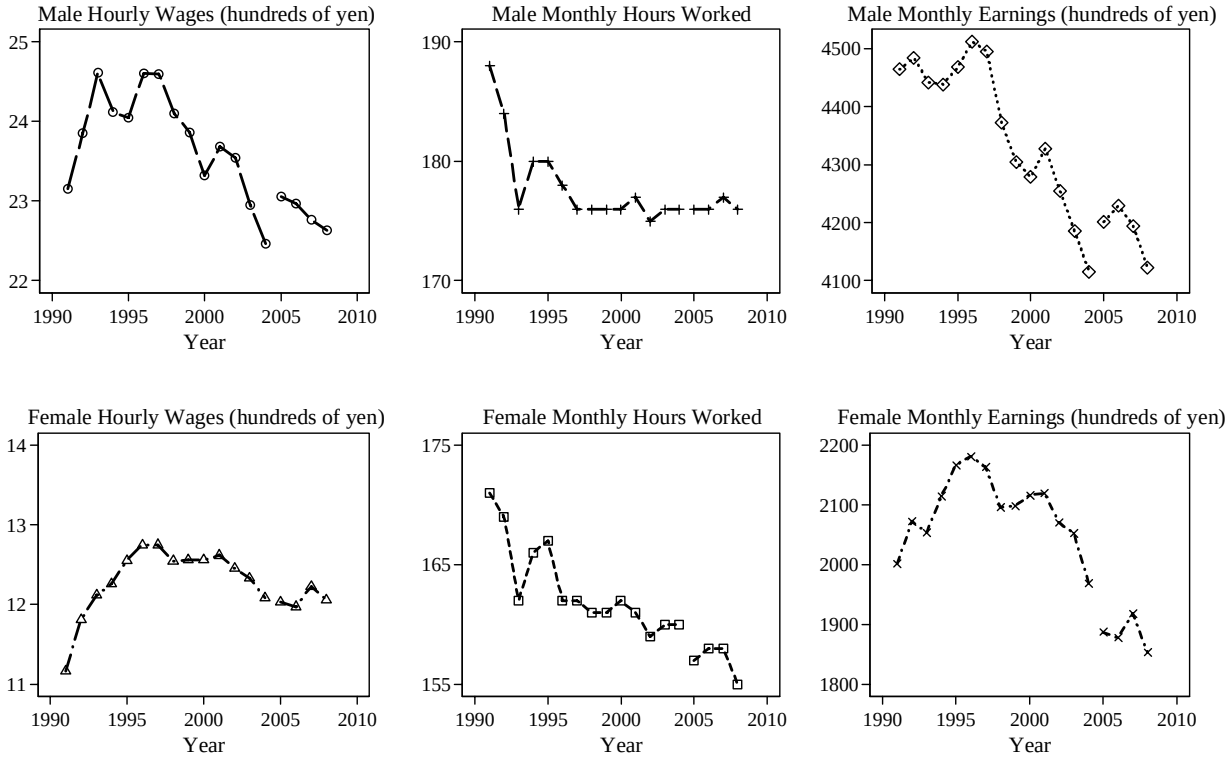


Figure A2: Wage Inequality for Men and Women

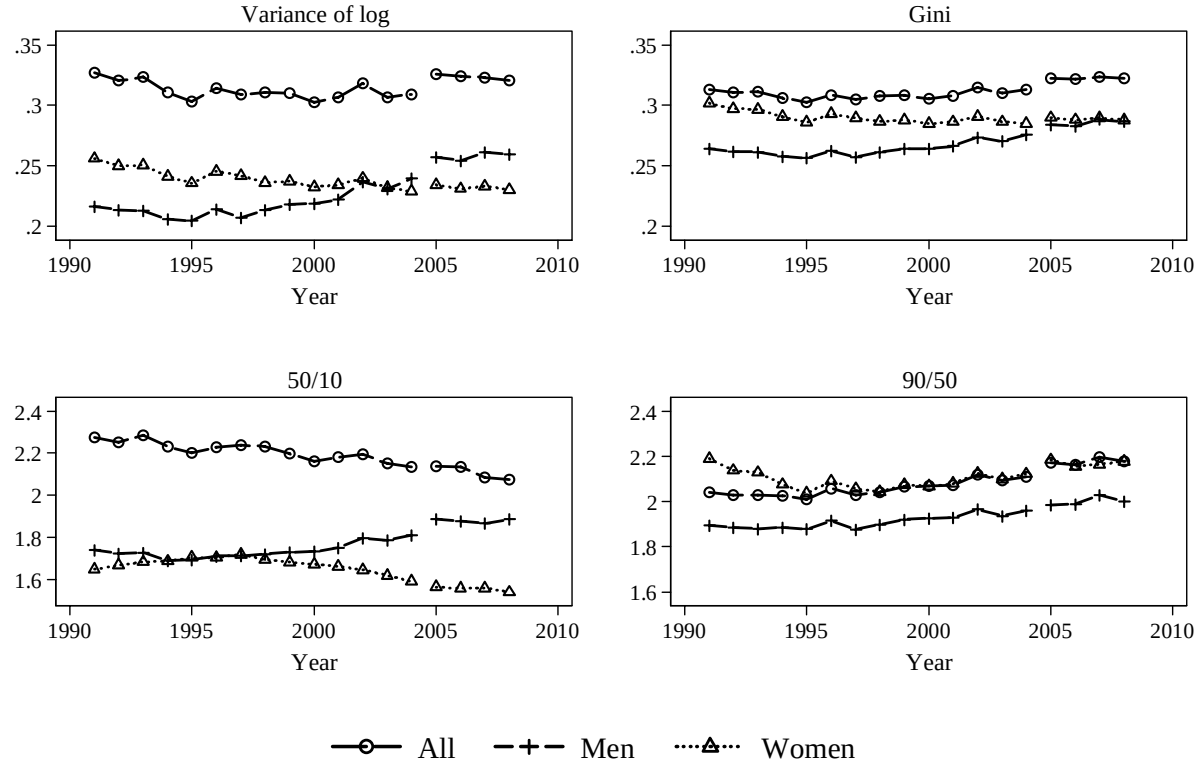


Figure A3: Education, Experience, Gender Wage Premia, and Residual Wage Inequality for Men and Women

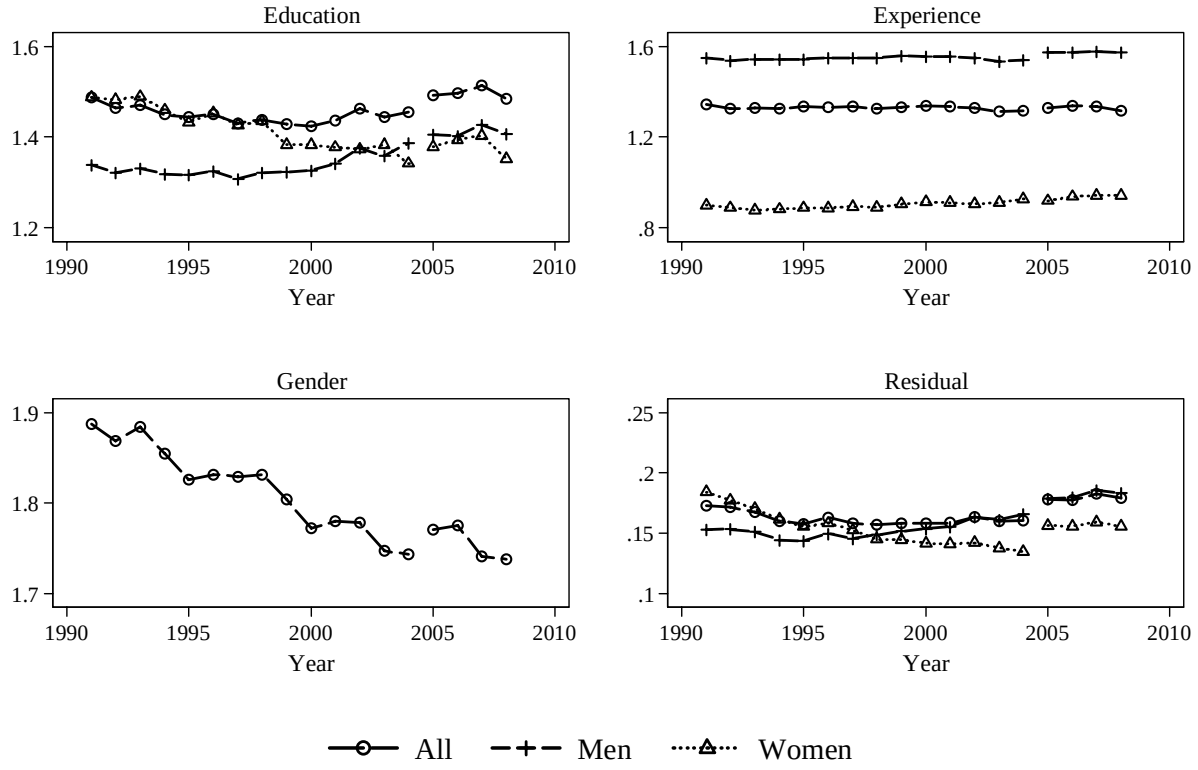


Figure A4: Inequality in Labor Supply and Earnings of Men and Women

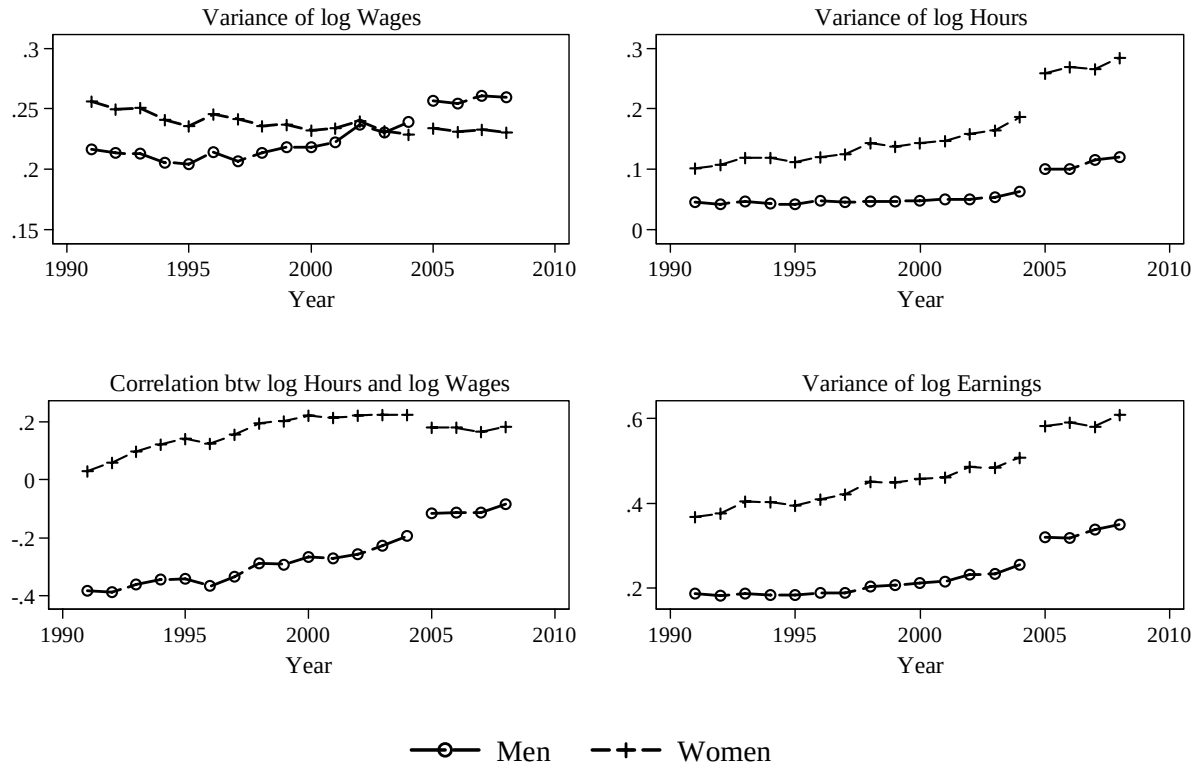


Figure A5: Comparison of Time-Series Mean and Variance of Earnings by Gender in the BSWS and NSFIE.

Normalized to Zero in 1994

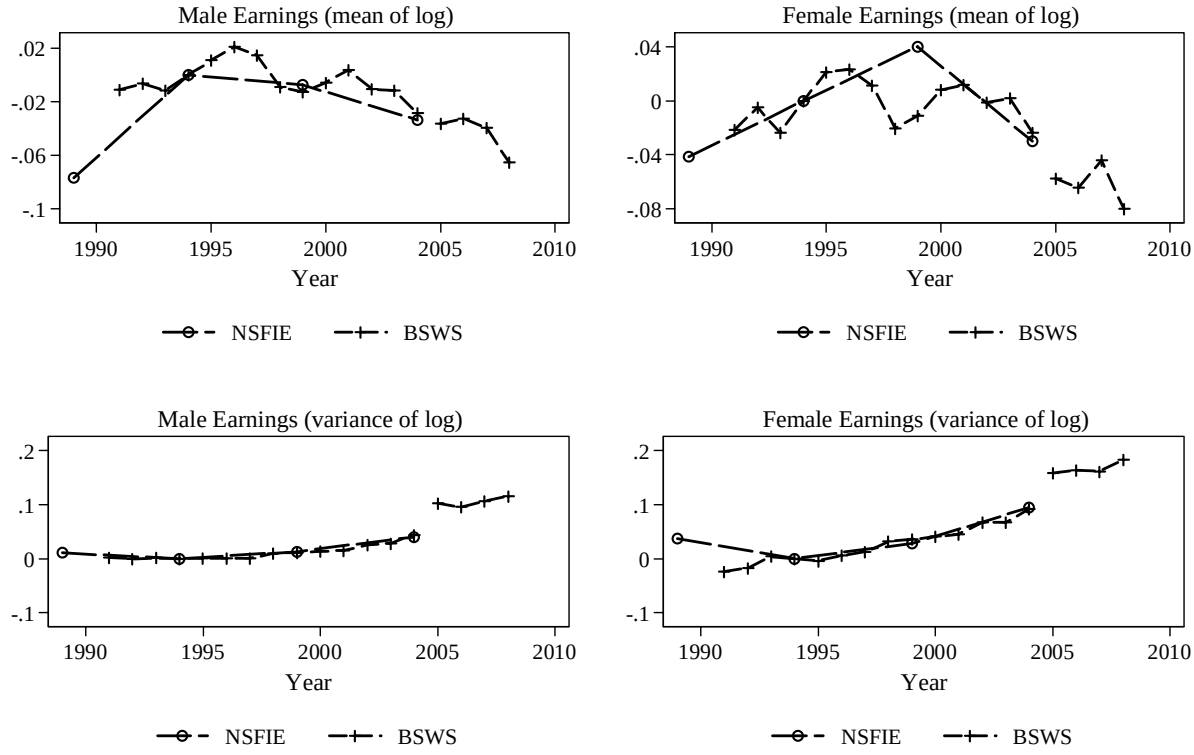


Figure A6: Wages and Hours over the Life Cycle

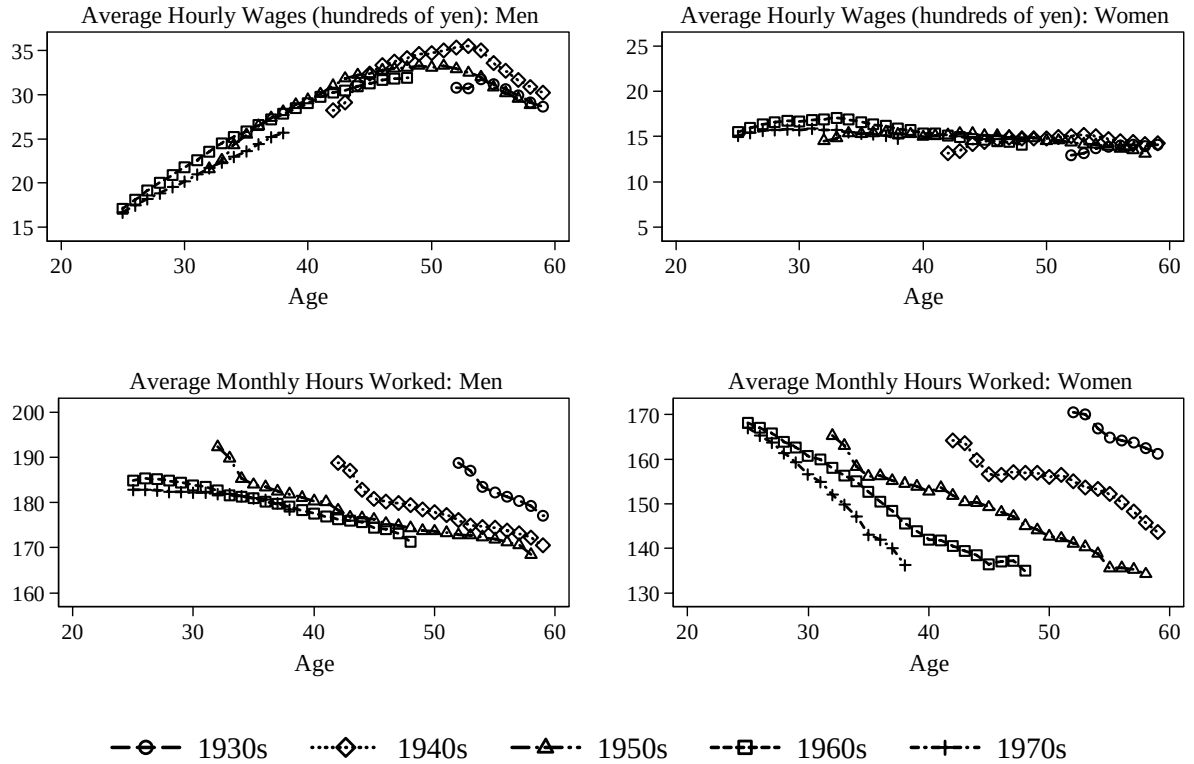
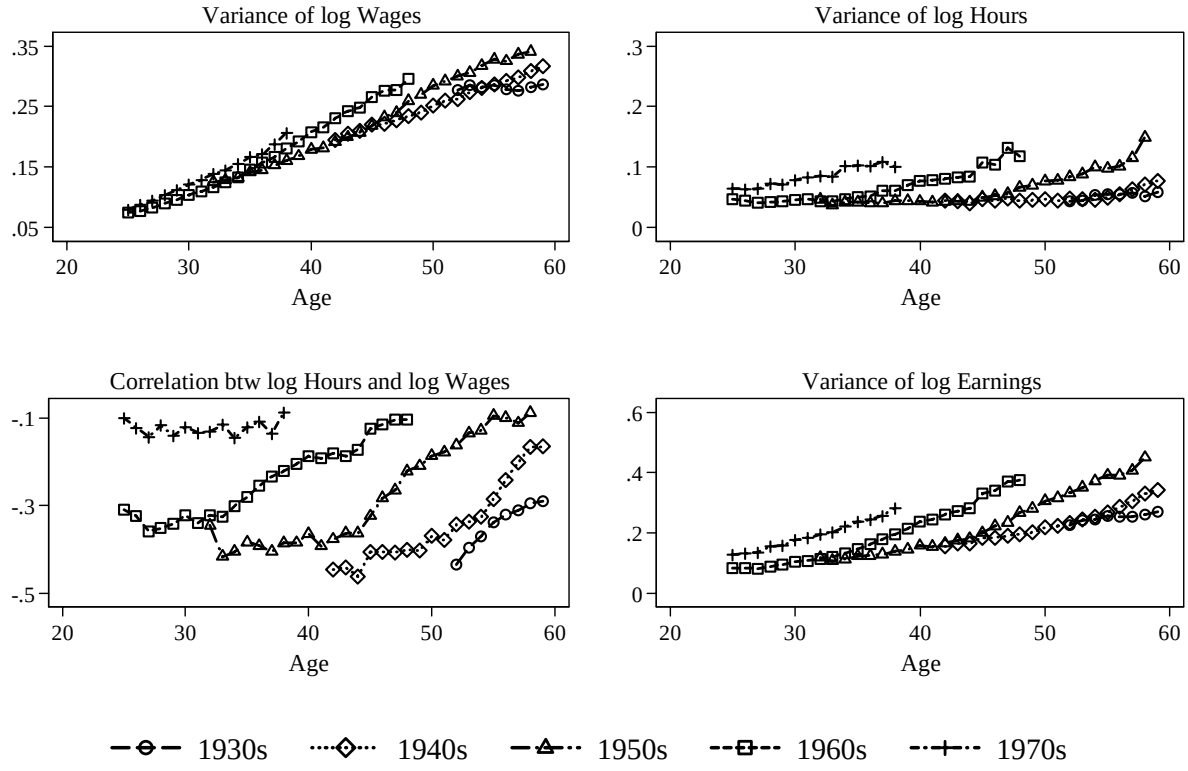


Figure A7: Life Cycle Inequality

(a) Men



(b) Women

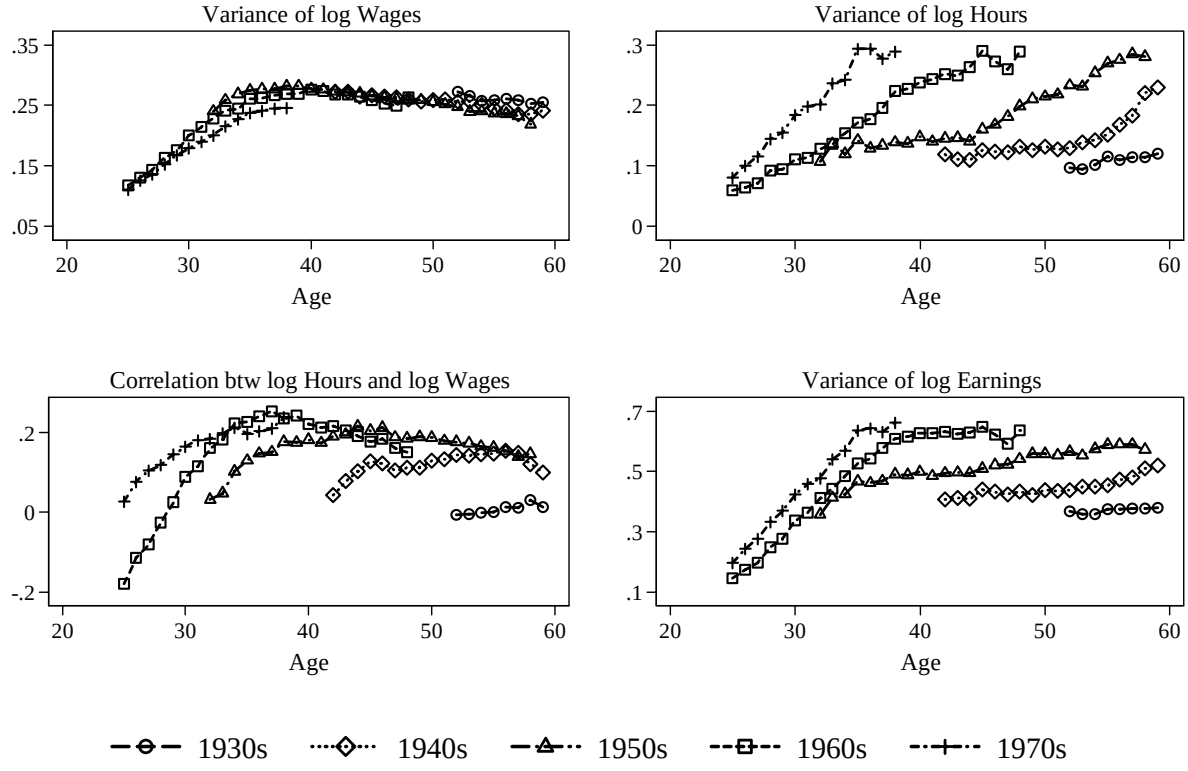


Figure A8: Life Cycle Inequality in Wages, after Controlling for Year and Cohort Effects

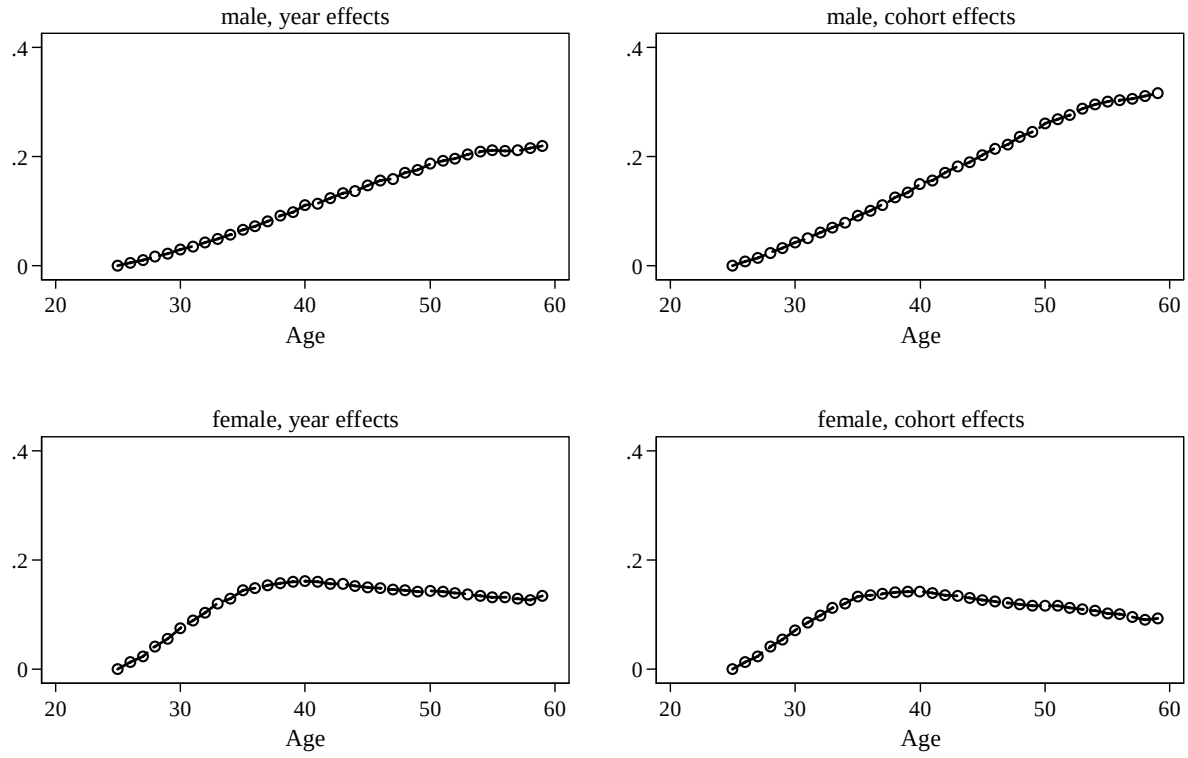
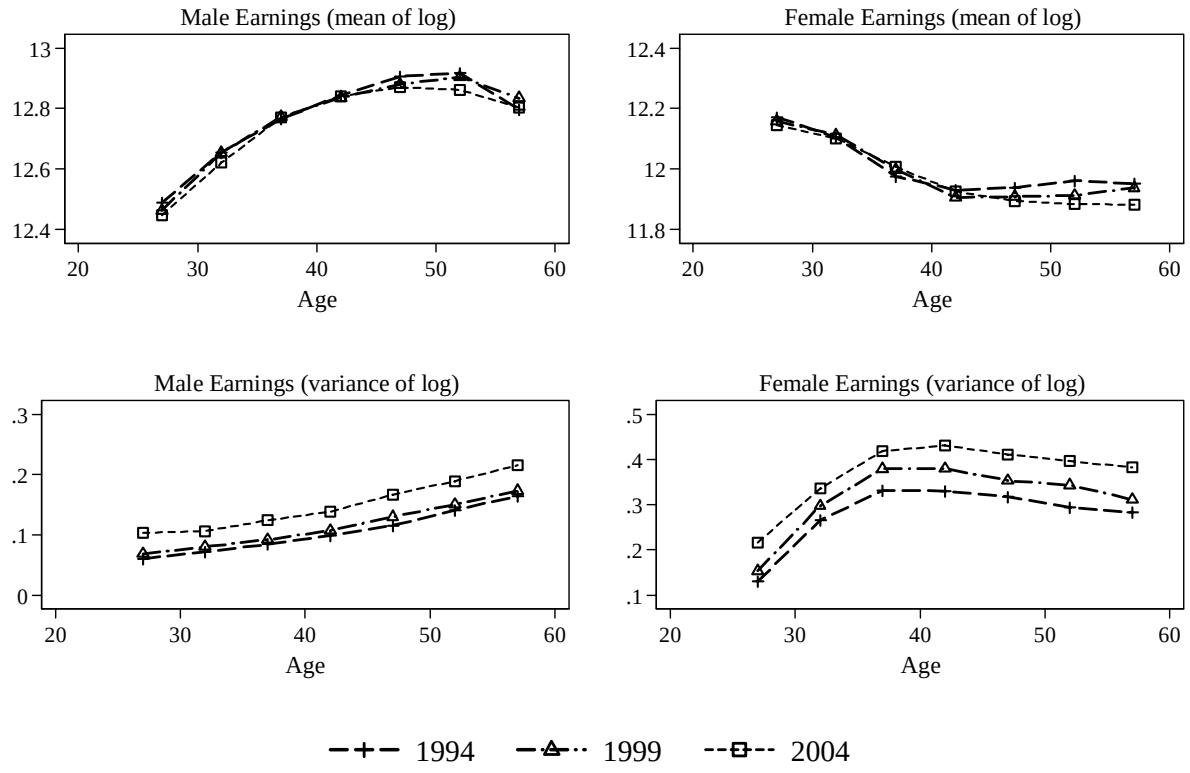


Figure A9: Comparison of Life-Cycle Mean and Variance of Earnings by Gender in the BSWS and NSFIE

(a) BSWS



(b) NSFIE