The Stable Wage Distribution in Japan, 1982-2002: A Counter Example for SBTC?

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Abstract

The wage distribution has been almost stable in Japan for the last two decades, contrary to findings in the USA, Canada, and the UK. The change in the wage distribution during this period was almost completely caused by a distributional change in workers' attributes. This implies that skill prices were very stable between 1982 and 2002. Both demand and supply for skilled workers have increased because of a skill- biased technical change, and a rise in the number of college-educated workers induced by educational policy changes and the aging of the population. In the balance of the shifts in demand and supply, the skill price has been stable. After netting out the effect of the supply increase of skilled labor, we robustly find evidence for skill- biased technical change.

JEL Classification: J23; J31

Keywords: Wage Distribution; Return to Education; Skill Prices; Skill-Biased Technical Change; Japan

1 Introduction

The Liberal Democratic Party, the ruling party of Japan, lost miserably in the lower house election of July 2007. Political analysts claim that concern about increased wage inequality led voters to go against the Liberal Democratic Party, which advocates market reform by abolishing government regulations. The TV program "Working Poor" by NHK reported on the lives of poor families and attracted public attention (NHK (2007) for the book summary). Media repeatedly report on the lives of the poor, and "inequality (*Kakusa)*" or "lower class (*Karyū*)" have become buzz words in Japanese society.

Contrary to the national concern about wage inequality, rigorous statistical studies continue to find a surprisingly stable wage structure in Japan (Genda (1998), Shinozaki (2002), Ohtake (2005), Kambayashi et al. (2007)). These studies are based on the *Basic Survey of Wage Structure*, which collects individual workers' information from payroll records via a random sampling of establishments. Critics have pointed out that wage inequality does not show up in these studies because inequality has increased at the margin of non-standard workers (part-time workers, contingent workers, and workers other than full-time, permanent workers), who consisted of 1/3 of the labor force as of 2007, according to the Labor Force Survey.

Examining Japan's wage inequality is interesting from an international perspective as well. English-speaking countries experienced an increased wage dispersion throughout the 1980s and the 1990s, as reported by Autor et al. (2008) for the US, Goos and Manning (2007) for the UK, and Boudarbat et al. (2003) for Canada. There remains a controversy regarding the reason why wages have been dispersed, however. One strand of scholars claims that the observed wage dispersion had been caused by skill-biased technological change.[1] In contrast, another other strand of scholars claims that changes in wage-setting institutions, such as the falling real minimum wage or the unionization rate, are critical determinants of wage dispersion.[2]

To address this controversy, it would be useful to measure the effect of technical change on the wage structure in the other developed countries that presumably have experienced the same technological change. However, some continental European countries have very rigid, centralized wage- setting mechanisms, and the effect of the demand shift appears at the margin of employment rather than wage (Fitoussi (1994)). In fact, Koeniger et al. (2007) report that labor market institutions explain an important portion of the change in wage inequality. According to the index reported in Koeniger et al. (2007), Japanese labor market institutions engage less in wage setting than those of continental European countries. Thus, Japan is arguably an ideal testing ground for the demand-supply framework of the labor market.[3]

[1]Katz and Murphy (1992), Murphy and Welch (1992), Bound and Johnson (1992), and Autor et al. (1998) for classic works and Autor et al. (2008) and Goos and Manning (2007) for recent works.

[2](DiNardo et al. (1996), Lee (1999), and Card and DiNardo (2002))

[3]The Spring Offensive (*Shunto*) is an important wage-setting institution in Japan that consists of the collective wage bargaining between the federation of labor unions and the federation of management. The contract period is one year, which is shorter than the typical contract in the US. The synchronized bargaining prevents a sluggish wage adjustment caused by coordination failures among unions. Ito (1992) pointed out that

The purpose of this paper is to describe the change in Japan's wage distribution based on the household survey, the *Basic Survey of Employment Structure*, which covers all types of workers regardless of contract form. Furthermore, we apply a simple demand-supply framework to the Japanese labor market and explain the change in the wage distribution within that framework.

The analysis of *Basic Survey of Employment Structure* reveals that Japan's wage distribution was very stable between 1982 and 2002. Workers located at all percentiles in the wage distribution evenly experienced about a 30-percent real wage gain during the period. Moreover, the non-parametric estimation of the wage distribution reveals that the wage distribution in 2002 would be almost identical to that of 1982 if the workers' composition had been that of 1982. This evidence indicates that skill price was stable between 1982 and 2002.

An examination of workers' characteristics reveals a rapid increase of college-educated and older workers. The increase in college-educated workers was largely caused by a change in the government's higher-education policy. As a result of this policy change and population aging, the supply of skilled workers had increased exogenously. Given this exogenous supply shift, the degree of demand shift is backed out, assuming the CES production technology, as in Card and Lemieux (2001). The analysis results reveal that

"This annual synchronized contract negotiation makes wage adjustment more flexible in Japan than in other countries."

the return to skill stayed constant regardless of the supply increase of college-educated workers because the relative demand for college graduates to high-school graduates had increased during the period. The estimated elasticity of substitution between college graduates and high-school graduates is similar to estimates for the US or the UK.

Overall, the Japanese economy has experienced skill-biased technological change, but the exogenous increase in high-skill workers that occurred simultaneously prevented wage dispersion. A simple demand-supply framework well explains Japan's wage- distribution trend.

2 Japan's Wage Distribution

2.1 Data

The Employment Status Survey (ESS, *Shugyō Kōzō Kihon Chōsa*) for the years 1982, 1987, 1992, 1997, and 2002 is used in this study. The ESS is conducted every 5 years on household members age 15 or older in approximately 440,000 households dwelling in sampled units that cover the complete population.[4] The survey collects information on household members and each member's labor force status on October 1 of each survey year.

This study utilizes micro data and extracts information on age, educational attainment, employment status, annual work days, weekly work hours, and annual income from the main job during the previous year. The file con-

[4]Foreign diplomats, foreign military personnel and their dependents, persons dwelling in camps or ships of the Self Defense Force, and persons serving sentences in correctional institutions are excluded.

tains about 1 million individuals with a half-million males and a half-million females for each year that the survey was conducted. The analysis sample is restricted to those ages 22-59. Self-employed workers are included, but family workers are excluded from the analysis sample. Family workers are dropped from the analysis sample because it is difficult to measure the income of these workers. The sample is further restricted to observations with a valid age, educational background, and employment status. Those without job tenure conditioned on being employed are dropped.

Regarding the construction of variables, we transformed the highest educational attainment into a continuous variable. For junior high- school graduates and high-school graduates, 9 and 12 years of education are assigned, respectively. Fourteen years of education is assigned for junior-college and technical-college graduates, and 16 years of education is assigned for 4-year college graduates and graduate-school graduates. The survey records annual earnings in ranges.[5] These ranges are transformed into a continuous variable by using the center value for each range. For the highest open-bracket range, the lowest value for the range is assigned for each year. Weekly work hours and annual work days also are recorded in ranges, and we transformed them

[5]The annual income ranges denominated by thousand yen are: 500 or less, 500-990, 1,000-1,490, 1,500-1,990, 2,000-2,490, 2,500-2,990, 3,000-3,990, 4,000-4,990, 5,000-5,990, 6,000-6,990, 7,000-7,990, 8,000-8,990, 9,000-9,900, 10,000-14,900, and 15,000 or above for year 2002. The ranges for 1992 and 1997 are: 500 or less, 500-990, 1,000-1,490, 1,500-1,990, 2,000-2,490, 2,500-2,990, 3,000-3,990, 4,000-4,990, 5,000-6,990, 7,000-9,900, 10,000-14,900, and 15,000 or above. The ranges for 1987 and 1982 are: 500 or less, 500-990, 1,000-1,490, 1,500-1,990, 2,000-2,490, 2,500-2,990, 3,000-3,990, 4,000-4,990, 5,000-6,990, 7,000-9,900, 10,000 or above.

into continuous variables using the same rule.[6]

Constructing the hourly wage from these brackets could result in a biased estimate of the true hourly wage, but what we care about is the change in the hourly wage over time rather than the wage level. The ranges of the brackets for work days are consistent over the years, as are the ranges for weekly work hours. Regarding the annual income range, the change in the range of the brackets in the middle of the annual income distribution does not change the hourly wage if the annual income is uniformly distributed within the range. Although the uniform distribution assumption is likely to be violated, the bias resulting from this would be minimal.

The critical change of the brackets for our purpose is the increase in the largest range from 10 million or above to 15 million or above from 1987 to 1992. If a disproportionately large number of individuals earns more than 15 million, conditional on earning more than 10 million,[7] the change of these brackets increased the wage dispersion in 1992 and after, even if the underlying wage rate had not changed.

To avoid this issue, we imputed those who might have earned more than 15 million in 1982 and 1987 by the following procedure. First, we calculated

[6] The ranges of annual work day are: less than 50, 50-99, 100-149, 150-199, 200-249, and 250 and more for all survey years. The ranges of work hours are: less than 15, 15-21, 22-34, 35-42, 43-48, 49-59, and 60 and more for 1987; less than 15, 15-21, 22-34, 35-42, 43-45, 46-48, 49-59, and 60 and more for 1992; less than 15, 15-21, 22-34, 35-42, 43-48, 49-59, and 60 and more for 1997; less than 15, 15-19, 20-21, 22-34, 35-42, 43-48, 49-59, and 60 and more for 2002.

[7] In fact, we do not find this in our 1992 sample, as the proportion was 0.27 for males and 0.30 for females.

the proportion of people who earned more than 15 million conditional on earning more than 10 million, using the 1992 sample by sexes. Let us call this proportion $p_{>15}$. Second, we ran separate probit regressions for both sexes, whose dependent variable is the dummy variable indicating earning more than 15 million, and the independent variables, which are education, experience, its squared, tenure, and its squared, using the individuals who earned more than 10 million in 1992 as the analysis sample. Third, we assigned 15 million earnings for the $p_{>15}$ proportion of people who earned more than 10 million in 1987 based on the predicted probability to earn more than 15 million, using the probit coefficient of 1992 for both sexes. Hourly wage is calculated based on these imputed annual earnings.

All the wages are deflated by the consumer price index of the Ministry of Internal Affairs and Communications (*Soumusho*). Employed workers in this study include those who worked with and without a term contract (*Rinji Rodosha and Joyo Rodosha*) and all other types of employment (regular employees, part-time employees, *arubaito*, temporary (dispatched) employees, short-term contract employees, and others). Aggregate variables used in section 3 are constructed from the micro sample described above.

2.2 Trends in the Wage Distribution

Figure 1 Panel A reports that the wage differential between the 90th and 50th percentiles among males increased between 1987 and 1992, but stayed constant afterward until 2002. The difference between the 50th and 10th percentiles was stable until 1997, but increased slightly between 1997 and 2002. The trend for the upper-tail distribution contrasts with the trend for the US, where the 90/50 difference has constantly increased throughout the 1980s, 1990s, and early 2000s. The trends for female employees reported in Figure 1 Panel B indicate almost stable 90/50 wage differentials and narrowing 50/10 wage differentials.

Figure 2 Panel A reports the wage-rate growth for each percentile of the wage distribution between 1982 and 2002. The diagram is slightly upward-sloping among males, which implies that male employees at higher percentiles experienced higher wage growth than those at lower percentiles. In contrast, women located at the lower percentiles of the distribution experienced higher wage growth than women located at the higher percentiles of the wage distribution. Figure 2 Panels B to E are the same figures for the 1982-1987, 1987-1992, 1992-1997, and 1997-2002 periods. The basic findings are consistent across analysis periods. It is notable that male workers experienced negative real wage growth between 1997 and 2002. This is a result of the severe economic recession during this period.

The upper tail of the wage distribution grew at a faster pace than the lower tail. This can be explained by either the rapid growth of skill endowment among skilled workers or an increase of the skill price. To distinguish these two hypotheses, we apply the DiNardo, Fortin, and Leimiuex's non-parametric estimation to the data (DiNardo et al. (1996)). The wage distributions of 1982 and 2002 are estimated through a Naradaya-Watson non-parametric density estimator. Then we calculate the counter-factual wage distribution that would have prevailed in 2002 if the workers' skill composition had been that of 1982 and the skill price had been that of 2002. The counter- factual wage distribution is expressed as:

$$\begin{aligned} f^{2002}_{x=1982}(\ln w) &= \int f^{2002}(\ln w|x)h(x|t=1982)dx \\ &= \int \theta f^{2002}(\ln w|x)h(x|t=2002)dx, \end{aligned} \quad (1)$$

where $\theta = \frac{P(t=1982|x)}{1-P(t=1982|x)}\frac{1-P(t=1982)}{P(t=1982)}$. The propensity score $P(t=1982|x)$ is estimated by Probit, using years of education, years of potential job experience, its squared, years of job tenure, and its squared as explanatory variables (x).

The non-parametric estimation results for males appear in Figure 3 Panel A. A simple comparison of the 1982 and 2002 distributions reveals that the distribution as a whole shifted to the right and the degree of shift was larger in the upper tail of the distribution. This finding is consistent with the findings from an examination of wage growth by percentiles. However, if the workers' composition in terms of observable characteristics x is that of 1982, the wage distribution under the skill price of 2002 would have been almost identical to the actual wage distribution of 1982. This finding implies that the shift of the wage distribution from 1982 to 2002 was caused by a change in the workers' skill composition, while the skill price remained almost constant.

To confirm the skill upgrading of the Japanese work force and the constancy of skill price, the descriptive statistics of the analysis sample and the wage regression coefficients are reported in Tables 1 and 2, respectively. Table 1 reports the mean values of years of education, potential experience, and tenure. These values steadily increased between 1982 and 2002 for both males and females. The wage regression coefficients reported in Table 2 are stable over the years. If there is any change in the wage structure, the return to education has fallen slightly for both sexes and the potential experience - log wage profile gets flatter and less concave. These changes are not significant in their magnitude, though.

2.3 Supply Increase of 4-Year College Graduates

The fraction of 4-year college-educated workers increased steadily since 1982, as reported in Table 1, but the degree of increase is not uniform across age groups. Figure 4 summarizes the 4- year college-advancement rate that is defined as the number of students start attending 4 year college divided by the number of junior high school graduates 3 years before.[8]

The male and female 4-year college advancement rates move almost parallel except for during the period between 1976 and 1990. The male and female college advancement rates monotonically increased until 1975 since 1954.[9] This steady increase was caused by the Ministry of Education's policy change, which expanded the college capacity under pressure from politicians and industry leaders, as documented by Pempel (1973).

[8] Roughly speaking, the Japanese education system consists of 6 years of primary school, 3 years of junior high school, and 3 years of high school education. After graduating from high school, students have the choice to advance to a 4-year college, a 2-year junior college, or an occupational training school.

[9] An exception is the sudden jump in 1964 because the 1946 cohort is smaller than adjacent cohorts because of the war.

The four-year college advancement rate for males declined steadily during the period between 1976 and 1990, while the trend for females was almost stable. During this period, the Ministry of Education became reluctant to expand the college capacity because of its limited fiscal ability. In particular, beginning in 1976, the Ministry of Education cut its subsidies to private universities that accepted more students than the official capacity (Higuchi (1994)). At the same time, the population size of 18 years old had increased because the second generation of Baby Boomers reached adulthood around this time.

The college advancement rate again increased after 1991. This is mainly because of the deregulation of the college standard set by the Ministry of Education. Right after the deregulation, the college capacity expanded tremendously, while the population size of 18 years old steadily declined throughout the period.

The above discussion of the college advancement rate implies that the college advancement rate's fluctuation was exogenously created by the Ministry of Education's higher education policy and the population size of 18 year olds. In a further analysis, we exploit this fluctuation of the college advancement rate as an exogenous supply shift of college-educated workers.

3 Explaining the Trend in the Return to Education

This section attempts to identify the shift of the relative demand curve of skilled workers to unskilled workers based on the skill price and quantity information. A further analysis in particular focuses on the wage differential between 4-year college graduates and high- school graduates because the number of 4-year college graduates increased exogenously between 1982 and 2002, and this exogenous supply shift is useful for identifying the demand shift.

3.1 Trends in the Quantity and Price of Educated Workers

We first overview the trends in the quantity and price of 4-year college graduate workers relative to high-school graduate workers. The quantity is measured by (average work hour per week) $\times$ (average annual work days/52) $\times$ (number of workers). Figure 5 Panel A summarizes the relative quantities of 4-year college graduates to high-school graduates by age cohorts. For all age cohorts, the relative quantities of college graduates to high-school graduates increases, but the rates of increase are substantial for the age cohorts between 40-49. This rapid increase contrasts with the stagnation of the age 30-39 cohort. This non-uniform increase of the relative supply of college graduates is the product of a non-monotonic trend of the college advancement rate.

The quantity of 4-year college graduates relative to high-school graduates varies because of the compositional change of the population's educational background, the employment rate by education group, and the average annual number of work hours. Among these variations, the hours of work and the employment rate can be affected by demand factors through the wage rate.

The ratio of the quantity of 4-year college graduates and high- school graduates is decomposed as:

$$\ln(L_{cjt}/L_{hjt}) = \ln(N_{cjt}/N_{hjt}) + \ln(P_{cjt}/P_{hjt}) + \ln(\bar{h}_{cjt}/\bar{h}_{hjt}), \qquad (2)$$

where L_{ijt} stands for the total quantity of education group i, age group j in year t; N stands for the number of individuals; P stands for participation rate; and $\bar{h}$ stands for the average annual number of work hours. Figure 5 Panels B to D report the log difference of the number of 4-year college graduates and high-school graduates, the average number of annual work hours for each group, and the employment rate for each group. An examination of trends shows that much of the variation of the log difference in the quantity is induced by the variation of the number of 4-year college graduates relative to high-school graduates. This finding arguably assures that the quantity of 4-year college graduates relative to high-school graduates is induced by the government's higher education policy and the cohort's population size of 18 year olds.

Figure 5 Panel E reports the trends of the wage differential between 4-year college graduates and high-school graduates. The wage differentials basically become more narrow for all age cohorts, although the degrees of decline differ across age cohorts. The wage differential declined a lot for the age 40-49 cohort, but it stayed almost constant for the age 30-39 cohort. The location of each age cohort is in the reverse order of the relative supply. This could be interpreted as evidence for the imperfect substitution between age cohorts.

These skill price movements over time within an age cohort nicely correspond to the relative supply trends reported in Panel A. The wage differential had dropped for the age cohorts where the relative supply had increased. In contrast, for the age 30-39 cohort, whose relative quantity remained constant, the wage differential did not change much.

3.2 Method

We further analyze the demand shift for skilled workers relative to unskilled workers by controlling for the effect of the relative supply change on the wage structure. To attain this goal, we assume that firms maximize profit under a certain production technology and that this behavior generates the observations.

We assume that there are many firms in the market and each firm has the technology that is represented by the production function:

$$Q_t = [(\theta_{ct} L_{ct})^\eta + (\theta_{ht} L_{ht})^\eta]^{\frac{1}{\eta}}, \ \eta \leq 1, \tag{3}$$

where Q_t is the output in year t, L_{ct} is the aggregated labor input of college graduates in year t, and L_{ht} is that of high- school graduates. The parameters θ_{ct} and θ_{ht} represent the efficiency of college-graduate and high-school-graduate labor forces, respectively. The skill-biased technological change is represented by the increase of θ_{ct}/θ_{ht}. The elasticity of substitution between college graduates and high-school graduates is expressed as $\sigma_e = 1/(1-\eta)$.

The aggregated labor inputs for college graduates and high-school graduates are also presented in CES form:

$$L_{ct} = [\sum_j (\alpha_j L_{cjt}^{\rho})]^{\frac{1}{\rho}} \tag{4}$$

and

$$L_{ht} = [\sum_j (\beta_j L_{hjt}^{\rho})]^{\frac{1}{\rho}}, \tag{5}$$

$\rho \leq 1$, where j is the index for age cohort. The elasticity of substitution between age groups is $\sigma_a = 1/(1-\rho)$.

We assume that the product price is given as unity. From the firm's profit maximization condition, we obtain:

$$\frac{w_{cjt}}{w_{hjt}} = (\frac{L_{ct}}{L_{ht}})^{\eta-1}(\frac{\theta_{ct}}{\theta_{ht}})^{\eta}(\frac{L_{cjt}}{L_{hjt}}/\frac{L_{ct}}{L_{ht}})^{\rho-1}\frac{\alpha_j}{\beta_j}. \tag{6}$$

By taking the log, we can derive the estimated equation as follows:

$$\ln(\frac{w_{cjt}}{w_{hjt}}) = (1-\frac{1}{\sigma_e})\ln(\frac{\theta_{ct}}{\theta_{ht}})+\ln(\frac{\alpha_j}{\beta_j})-(1/\sigma_e)\ln(\frac{L_{ct}}{L_{ht}})-(1/\sigma_a)[\ln(\frac{L_{cjt}}{L_{hjt}})-\ln(\frac{L_{ct}}{L_{ht}})]. \tag{7}$$

When the workers of different ages are perfectly substitutable (i.e. $\sigma_a = \infty$, $\alpha_j = \alpha$ and $\beta_j = \beta$), the terms $[\ln(\frac{L_{cjt}}{L_{hjt}}) - \ln(\frac{L_{ct}}{L_{ht}})]$ and $\ln(\frac{\alpha_j}{\beta_j})$ drop. We parameterize the skill- biased technological change as $(1-\frac{1}{\sigma_e})\ln(\theta_{ct}/\theta_{ht}) = \gamma \times trend$. The effect of skill- biased technological change (i.e., change in

θ_{ct}/θ_{ht}) on the relative wage is small when college graduates and high-school graduates are close substitutes (i.e., σ_e is close to 1). The parameter γ is the reduced- form measure of skill-biased technological change. The relative productivity of 4-year college graduates to high-school graduates ,α_j/β_j, is constant across age groups if the speed of human capital accumulation is constant for both groups of graduates. To allow for the difference in the speed of skill accumulation, we try another specification that includes age-group dummy variables to capture the variation.

The relative quantity of 4-year college graduates to high-school graduates can be endogenous because it can be a response to the relative wage change. As discussed in the previous section, the relative labor quantity can be decomposed into the relative population, relative hours of work, and the relative participation rate. Among these components, the relative population of college graduates to high- school graduates can be considered as exogenous because the fraction of people in a cohort who graduate from a 4-year college is mainly determined by the government's higher education policy and the cohort's population size. Thus we exploit the relative population of 4-year college graduates to high-school graduates as an instrumental variable for the relative labor quantity of 4-year college graduates to high-school graduates.

3.3 Results

Table 4 reports the estimation results for the specification that assumes the perfect substitutability between age groups within an education category.

Column 1 reports the results of the OLS estimation. The estimate implies that the elasticity of the substitution between college graduates and high-school graduates is estimated around 1.0. This estimate is smaller than the estimate reported by Autor et al. (2008) for the US, which is 1.57. The coefficient for the time trend implies that the wage gap would have grown at 2 percent per year if the supply of college graduates relative to high-school graduates remained constant. The IV estimation renders a slightly smaller coefficient for the college/high school ratio (slightly larger elasticity of substitution) and the implied elasticity of substitution is 1.47, which is close to the US estimate by Autor et al. (2008). Again, the positive coefficient for the time trend implies that a skill-biased technical change had occurred during the period.

Table 5 reports the results of the estimation that allows for the imperfect substitutability between age groups. Columns 1 and 2 report the OLS and IV estimation results for the specification without the age category dummy variables. For both the OLS and IV results, the coefficient for own (age-specific) supply minus the aggregate supply is negative and statistically significant. This result implies that a relatively larger supply of college graduates for a cohort than the average across cohorts results in a smaller return to education for the cohort. The elasticity of substitution across age groups is estimated to be around 1.7. As for the coefficients for the aggregate supply index, the estimates are imprecise for both the OLS and IV estimations. Both estimates, however, roughly indicate that college graduates and high-school graduates are imperfectly substitutable and the implied elasticity of substitution is around 1.2. The coefficients for the trend terms are positive, but imprecise. The coefficients for the trend terms implies that the wage gap between college graduates and high school graduate grow about 2 percent annum, holding the relative supply constant. The imprecise estimates for the aggregate supply index and the time trend are a result of the almost monotonic increase of the aggregate supply index.

Columns 3 and 4 report the estimation results of the specification with the age dummy variables. This specification allows for different rates of productivity growth for college graduates and high- school graduates. Conditioning of the age categories significantly reduces the co-movement of the aggregate relative supply index and the time trend, and as a result, the coefficient estimates for the aggregate supply index and the time trend become much more precise. The implied elasticity of substitution between age groups becomes around 8. The coefficient for aggregate supply implies that the elasticity of the substitution between education groups is between 1.2 and 1.4. Most importantly, the coefficient for the linear trend term is positive and statistically significant for both the OLS and IV estimations. Again, the wage gap had grown about 1 to 2 percent per annum. This finding is consistent with the presence of skill-biased technical change.

Overall, the estimation results imply that the wage gap between college and high-school graduates would have dispersed if the supply of college graduates relative to high-school graduates had been constant between 1982 and 2002. The Japanese economy has experienced skill-biased technological change, but the rapid increase of college graduates prevented a widening wage gap between college graduates and high-school graduates.

4 Conclusion

This paper examined the change in Japan's wage distribution between 1982 and 2002 based on micro data from the *Basic Survey of Employment Structure*. An examination of the difference between the 90/50 percentiles and 50/10 percentiles reveals that the wage distribution was stable during this period. If there was any change of the wage distribution, the workers at the upper tail of the wage distribution had experienced more wage gain during the period. This change, however, is because of the skill upgrading of workers at the upper tail of the wage distribution. If the distribution of observed skills had been that of 1982, then the wage distribution in 2002 would be almost identical to the actual wage distribution of 1982. This implies that skill prices had been almost constant during the period.

We explained this stable skill price based on a simple demand and supply framework, focusing on the stable return to education . We first noted that the non-monotonic increase of the college advancement rate was mostly caused by the government's higher education policy and the population size of each cohort. An estimation of technology parameters based on the CES production function, which allows for imperfect substitutability between education groups and age cohorts, revealed that college graduates and high-school graduates are imperfectly substitutable and that workers belonging to different age categories are imperfectly substitutable. Moreover, the estimation results consistently indicate that the wage gap between college graduates and high-school graduates would have increased by 2 percent per annum if the relative supply of college graduates had been constant. This implies that Japan experienced skill-biased technological change between 1982 and 2002.

In sum, both the supply and demand of college graduates relative to high-school graduates increased between 1982 and 2002. The degrees of these shifts were almost identical, and consequently the equilibrium skill price remained stable. Thus, the stable wage distribution of Japan is not necessarily a counter example against Skill-Biased Technological Change (SBTC).

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Table 1: Descriptive Statistics of the Data Set for the Mincer Wage Equation Estimation

Panel A: Male

Variable	1982	1987	1992	1997	2002
Hourly Wage					
log (wage)	7.43	7.56	7.84	7.96	7.84
	(0.64)	(0.66)	(0.68)	(0.68)	(0.73)
Education	11.74	12.01	12.21	12.49	12.65
	(2.42)	(2.42)	(2.41)	(2.40)	(2.38)
Experience	23.62	24.31	25.38	25.41	26.54
	(13.66)	(13.74)	(14.39)	(14.62)	(14.69)
Tenure	14.63	15.13	15.68	15.79	16.45
	(11.43)	(11.75)	(12.38)	(12.68)	(13.53)
# of Obs.	280986	273907	345390	328204	285690

Panel B: Female

Variable	1982	1987	1992	1997	2002
Hourly Wage					
log (wage)	6.85	6.99	7.25	7.40	7.38
	(0.70)	(0.70)	(0.70)	(0.69)	(0.71)
Education	11.42	11.69	11.94	12.24	12.47
	(1.99)	(1.96)	(1.95)	(1.93)	(1.93)
Experience	21.23	21.66	22.70	23.13	24.22
	(14.01)	(13.91)	(14.36)	(14.43)	(14.37)
Tenure	8.39	8.62	9.02	9.39	10.18
	(9.01)	(9.14)	(9.62)	(9.91)	(10.78)
# of Obs.	143766	152159	210986	203723	186911

Note: Standard deviations are in parentheses.

Table 2: OLS Estimation of the Wage Equation

Panel A: Male

	(1)	(2)	(3)	(4)	(5)
	1982	1987	1992	1997	2002
Years of Education	0.092	0.093	0.094	0.086	0.085
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Experience	0.044	0.043	0.042	0.043	0.038
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Experience ^2 / 100	-0.076	-0.073	-0.072	-0.072	-0.064
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tenure	0.032	0.033	0.028	0.030	0.034
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure^2 / 100	-0.050	-0.052	-0.040	-0.042	-0.052
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	5.580	5.656	5.950	6.122	6.020
	(0.007)	(0.008)	(0.007)	(0.007)	(0.008)
Observations	280986	273907	345390	328204	285690
R-squared	0.27	0.27	0.27	0.28	0.24

Panel A: Female

	(1)	(2)	(3)	(4)	(5)
	1982	1987	1992	1997	2002
Years of Education	0.098	0.096	0.097	0.096	0.095
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Experience	0.006	0.003	0.001	0.003	0.006
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Experience ^2 / 100	-0.019	-0.013	-0.010	-0.014	-0.015
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tenure	0.043	0.045	0.042	0.045	0.038
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure^2 / 100	-0.077	-0.082	-0.072	-0.077	-0.070
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	5.479	5.622	5.896	5.985	5.933
	(0.014)	(0.014)	(0.012)	(0.012)	(0.014)
Observations	143766	152159	210986	203723	186911
R-squared	0.14	0.14	0.14	0.16	0.13

Note: Standard errors are in parentheses.

Table 3: Descriptive Statistics of the Data Set for the Relative Wage Equation Estimation: 1982, 1987, 1992, 1997, 2002.

Variable	Obs.	Mean	Std. Dev.
(Variables used in Table2)			
log (college/high relative annual hours of work)	5	-0.99	0.18
log (college/high hourly wage differential)	5	0.41	0.03
log (college/high relative population)	5	-1.22	0.20
log (college/high relative employment rate differential)	5	0.15	0.18
(Variables used in Table3)			
log (college/high relative annual hours of work)	20	-1.02	0.37
log (college/high hourly wage differential)	20	0.47	0.20
log (college/high relative population)	20	-1.25	0.40
log (college/high relative employment rate differential)	20	0.16	0.06
log (college/high relative annual hours of work within age groups) – log (college/high aggregate relative annual hours of work)	20	-0.03	0.32
log (college/high relative population within age groups) – log (college/high aggregate relative population)	20	-0.03	0.33

Table 4: Regression Models for the College/High School Log Hourly Wage Gap, 1982-2002

	(1)	(2)
	WLS	WIV
College/High School Relative Supply	-0.98	-0.88
	(0.12)	(0.14)
Trend	0.02	0.02
	(0.00)	(0.00)
Constant	-0.81	-0.68
	(0.14)	(0.18)
Elasticity of Substitution	1.02	1.47
Observations	5	5
F-value of excluded instrument		1.19 (0.39)
Test for endogeneity		1.15 (0.28)
R-squared	0.98	

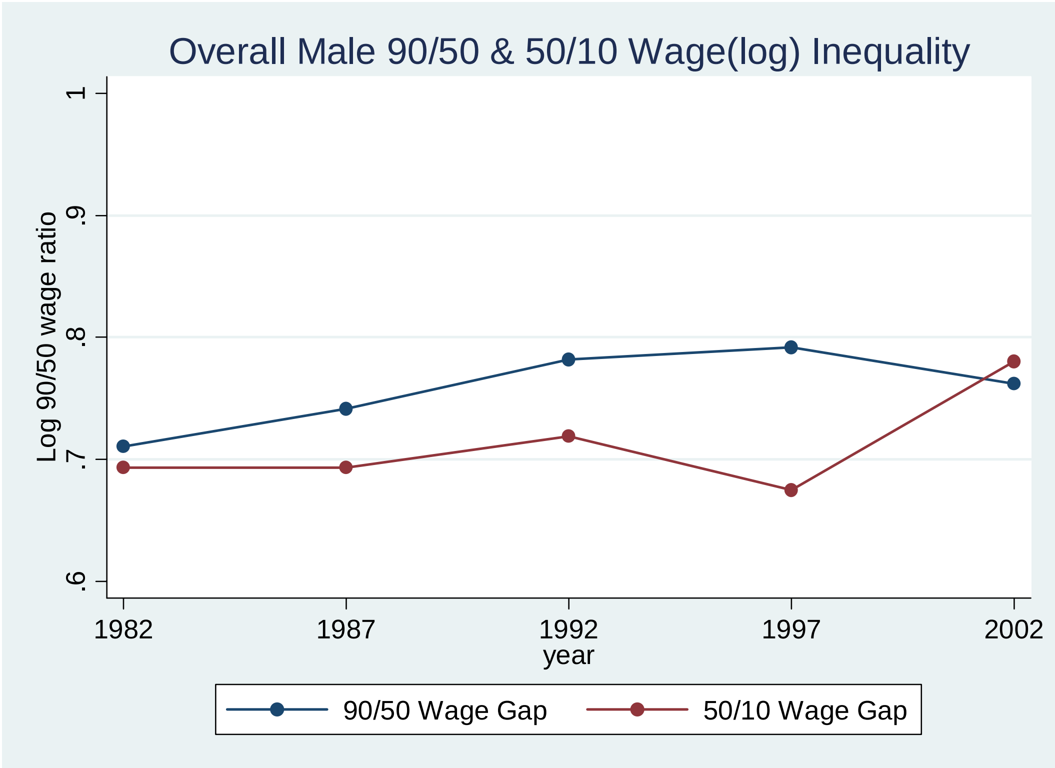
Note: Standard errors are in parentheses. Inverses of the estimated sampling variance of college/high school log hourly wage differentials are used as weights. IV is College graduates / High School graduates relative population.

Table 5: Regression Models for the College/High School Log Hourly Wage Gap by Potential Experience Group, 1982-2002

	(1) WLS	(2) WIV	(3) WLS	(4) WIV
Own Supply Minus Aggregate Supply	-0.58	-0.59	-0.11	-0.13
	(0.06)	(0.05)	(0.08)	(0.06)
Aggregate Supply	-0.90	-0.85	-0.85	-0.72
	(0.84)	(1.22)	(0.30)	(0.40)
Trend	0.021	0.020	0.017	0.015
	(0.019)	(0.027)	(0.007)	(0.009)
Dummy for 30-39 years old			0.20	0.20
			(0.02)	(0.02)
Dummy for 40-49 years old			0.35	0.34
			(0.04)	(0.04)
Dummy for 50-59 years old			0.42	0.41
			(0.06)	(0.05)
Constant	-0.63	-0.58	-0.79	-0.62
	(1.01)	(1.48)	(0.36)	(0.48)
Elasticity of Substitution between Age Groups	1.72	1.69	9.09	7.69
Elasticity of Substitution between Education Groups	1.11	1.18	1.18	1.39
Observations	20	20	20	20
Test statistics for instrument validity (P value)		7.44		7.45
		(0.01)		(0.01)
Test statistics for endogeneity (P value)		1.91		1.82
		(0.38)		(0.40)
R-squared	0.87		0.99	

Notes: Standard errors in parentheses. Instrument variables used in columns 2 and 4 are “own population minus aggregate population” and “aggregate population.” Inverses of the estimated sampling variance of college/high school log hourly wage differentials are used as weights.

Figure 1: 90/50 and 90/50 weekly wage inequality, 1982-2002



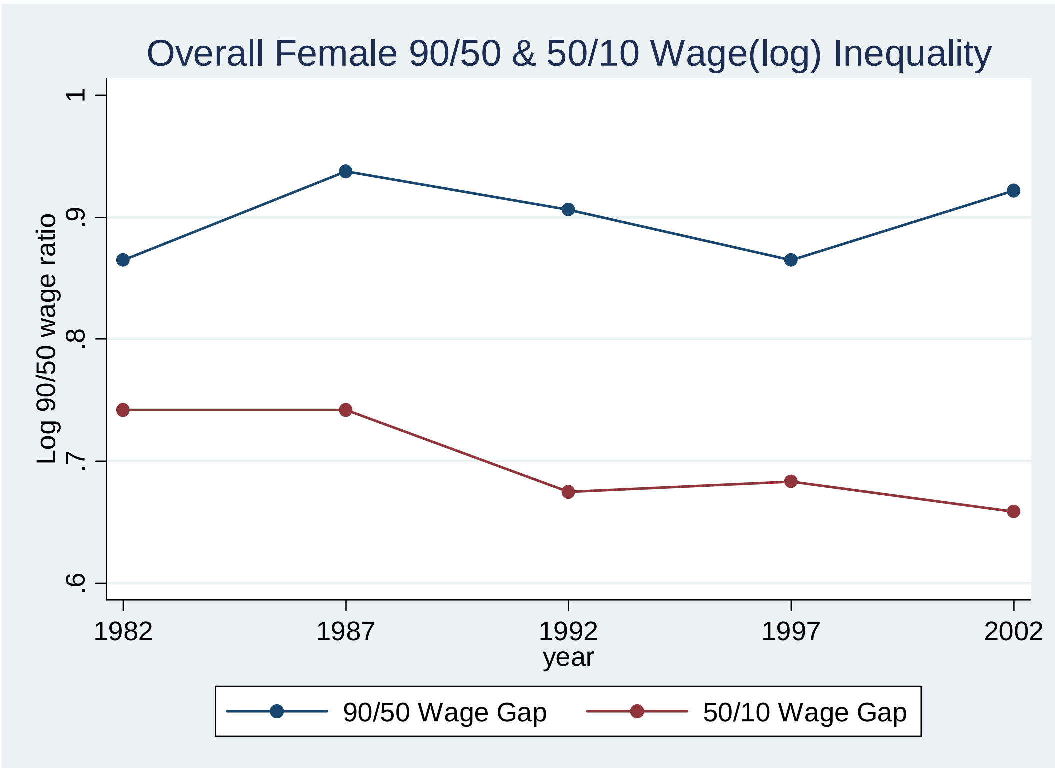
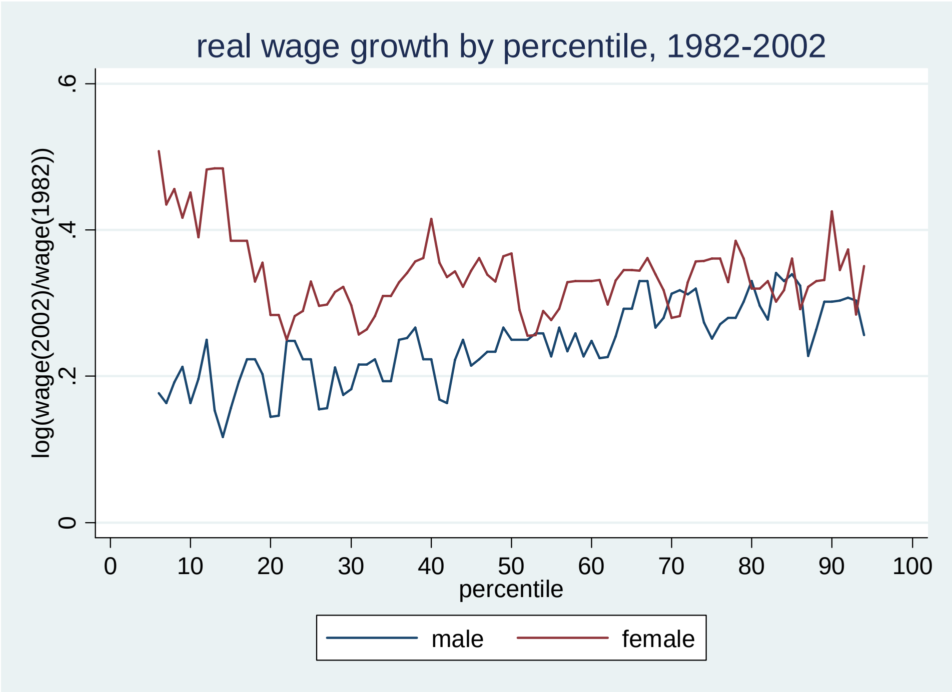
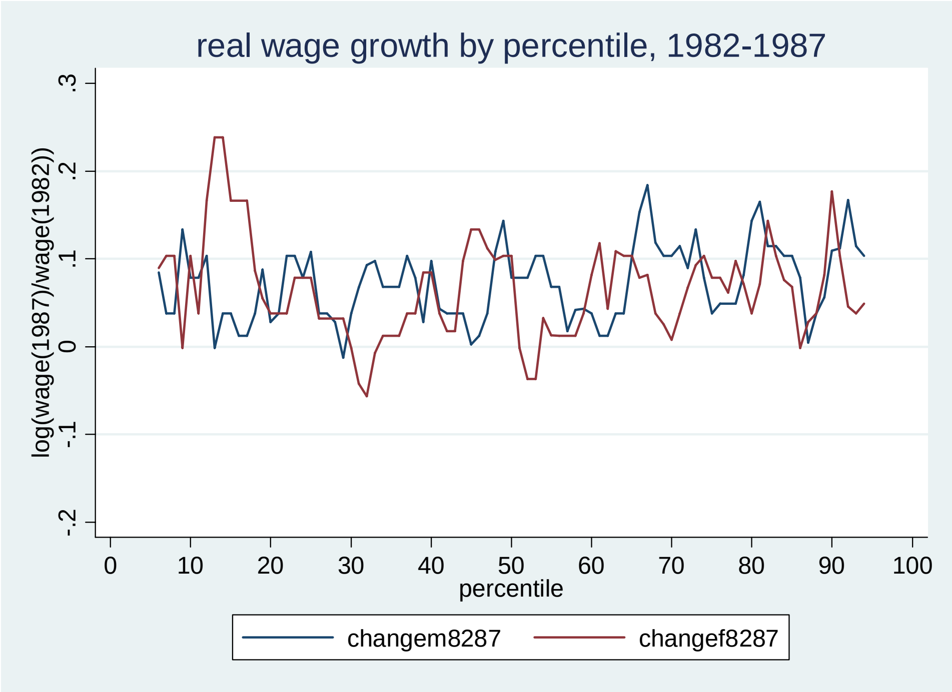


Figure 2: Wage Growth by Percentiles

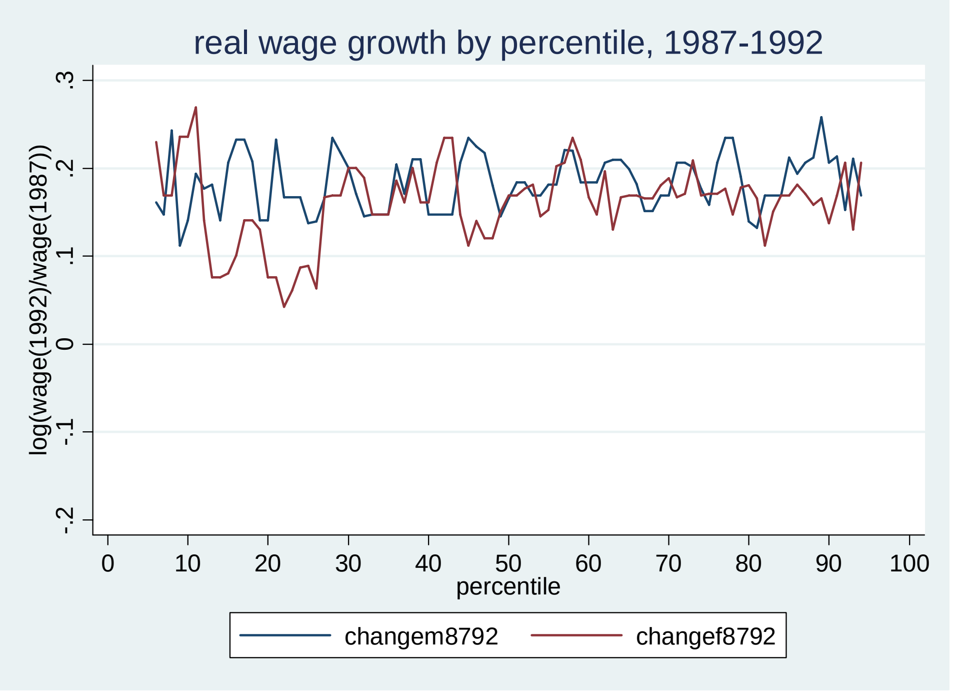
Panel A: 1982-2002



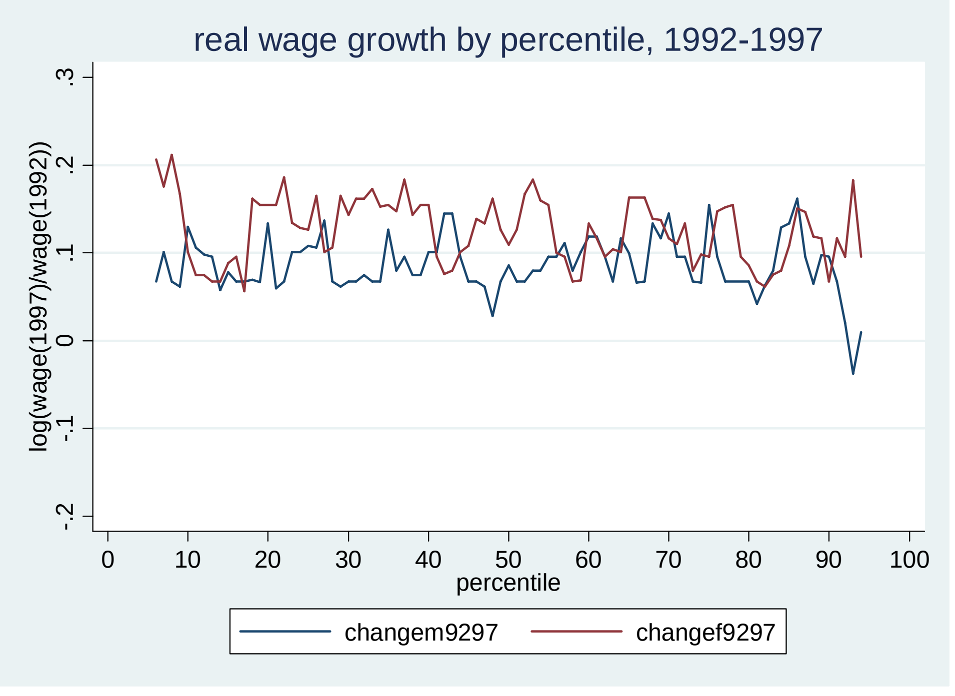
Panel B: 1982-1987



Panel C: 1987-1992



Panel D: 1992-1997



Panel E: 1997-2002

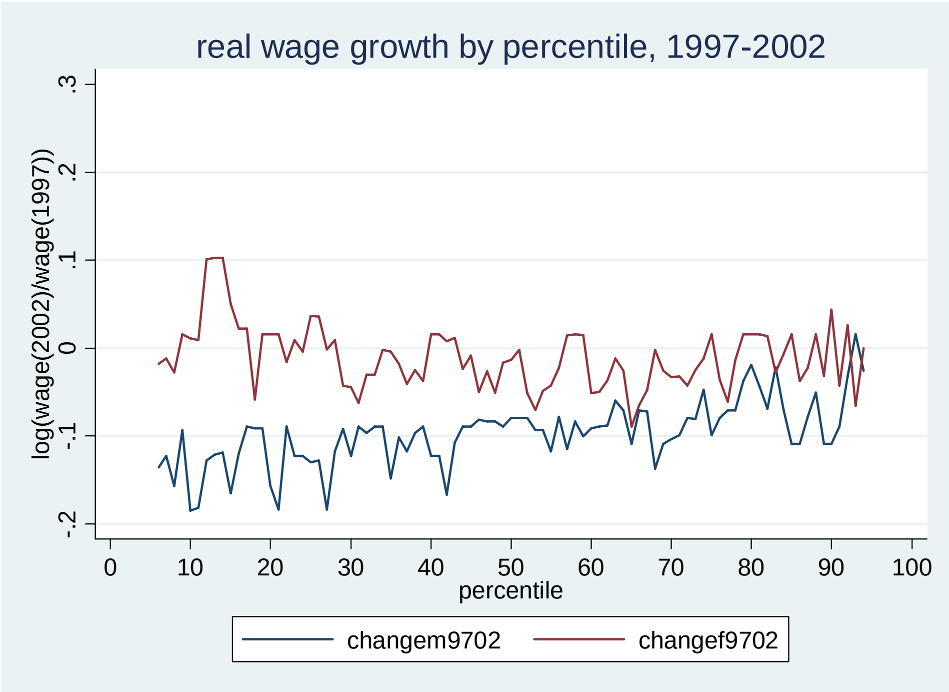
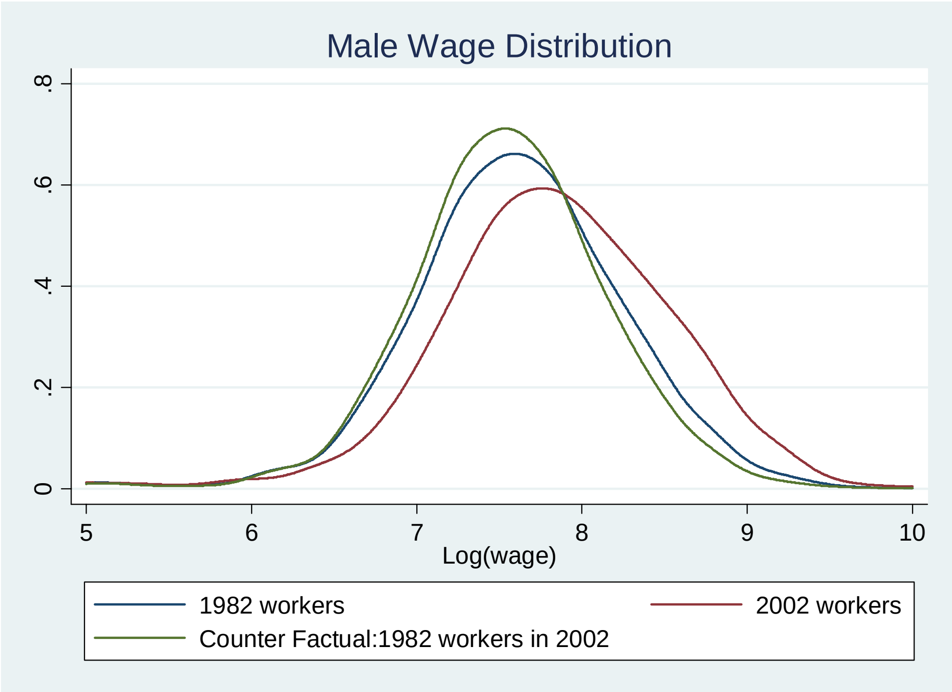


Figure 3: Kernel Density Estimation of the Wage Distribution and DFL Decomposition

Panel A: Male



Panel B: Female

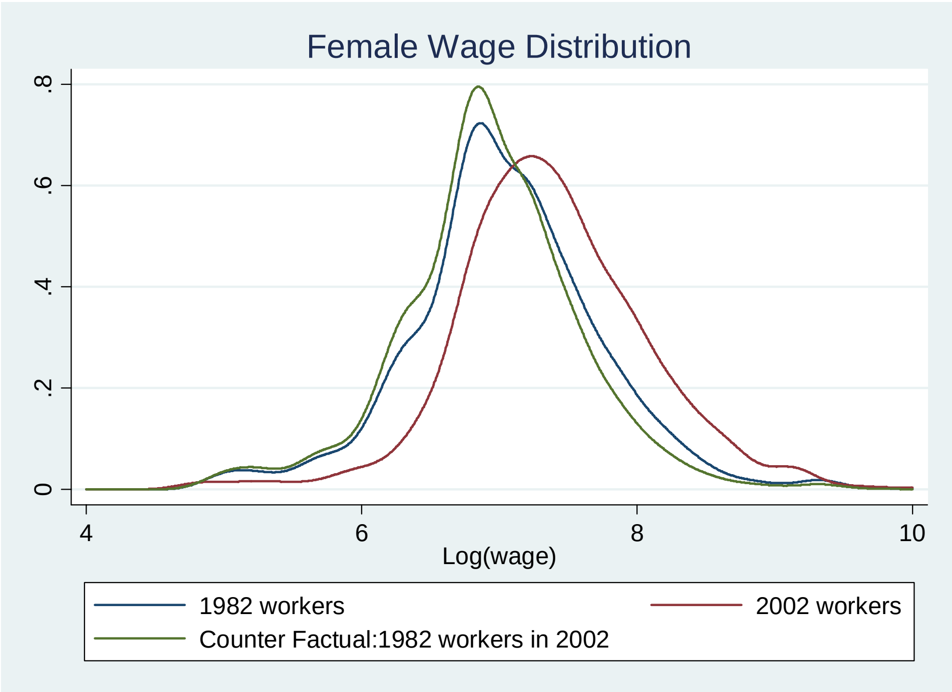


Figure 4: Post High-School Status of Graduates – Advancement Rate

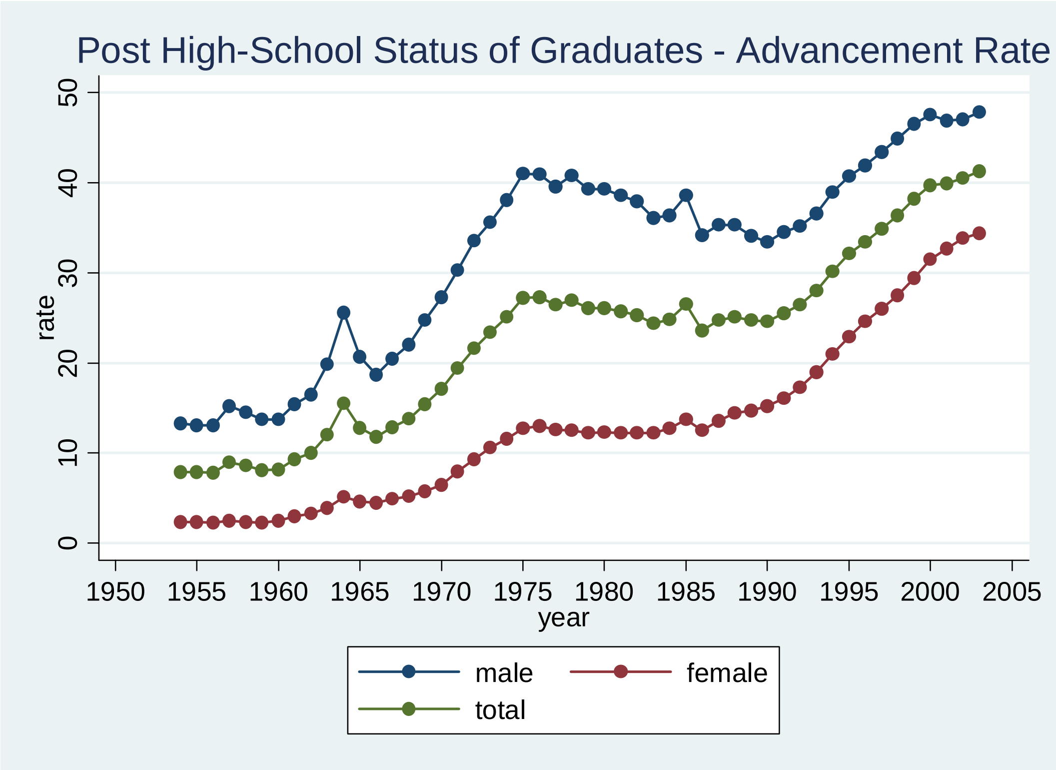
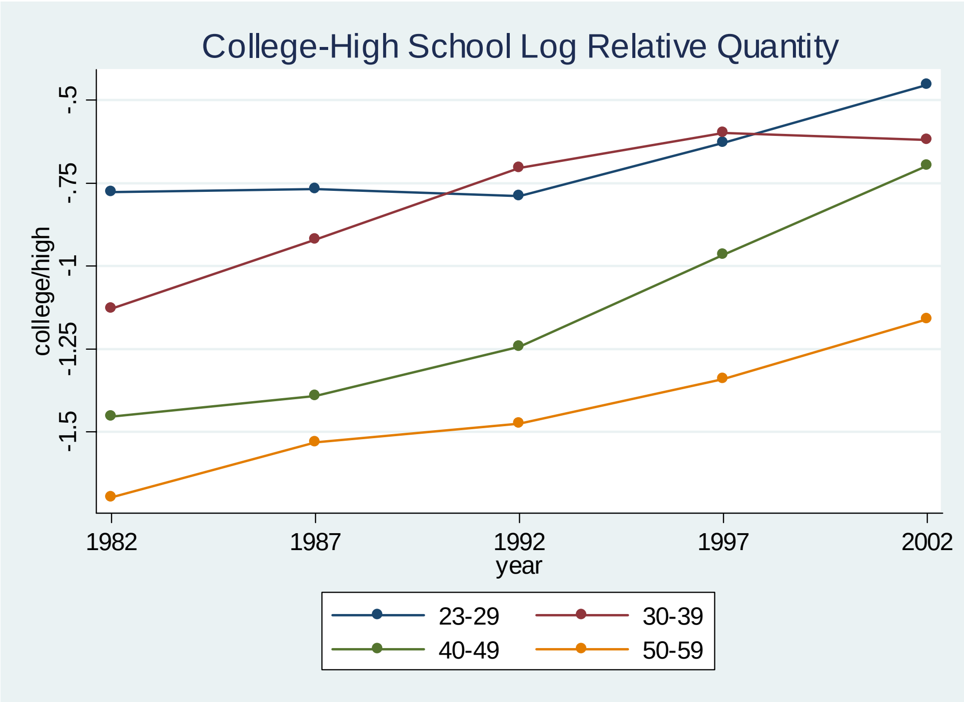
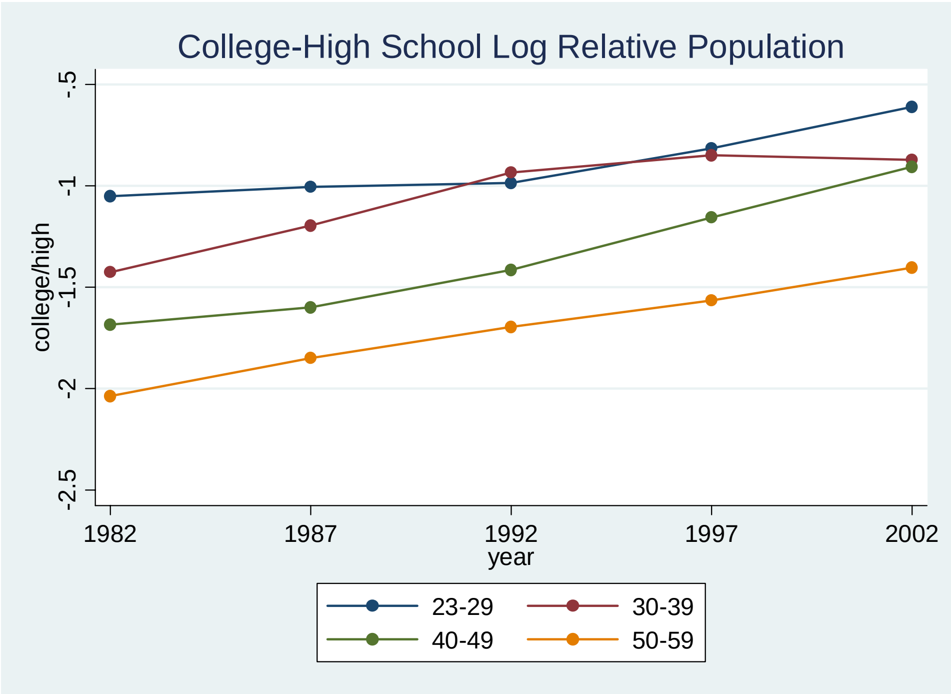


Figure 5: College/High School Relative Supply, Relative Population, Wage Differential, and Employment-Rate Differential, 1982-2002

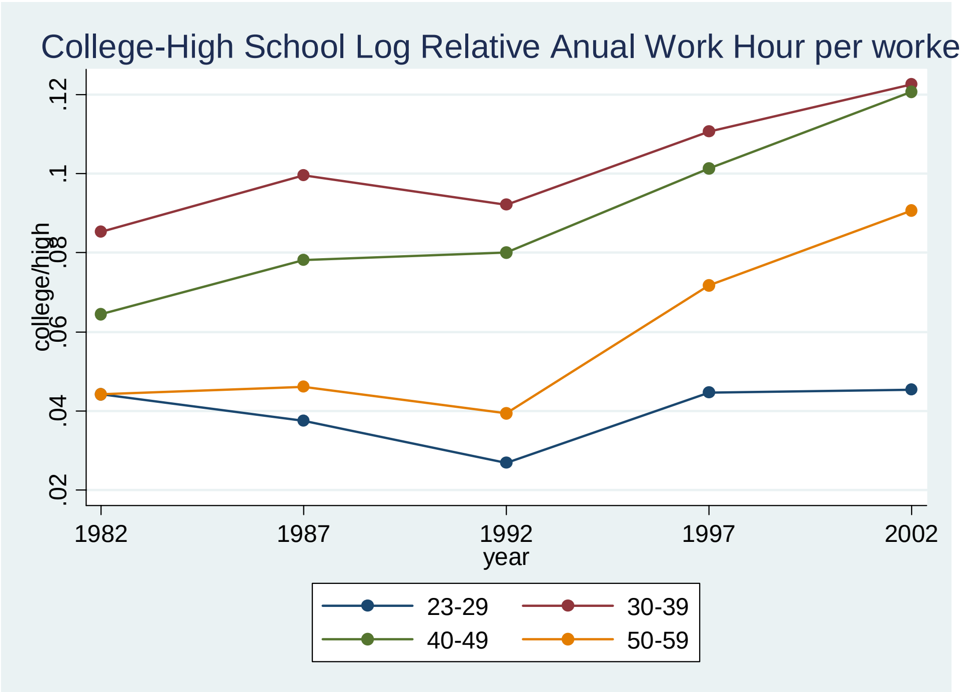
Panel A: Relative Quantity



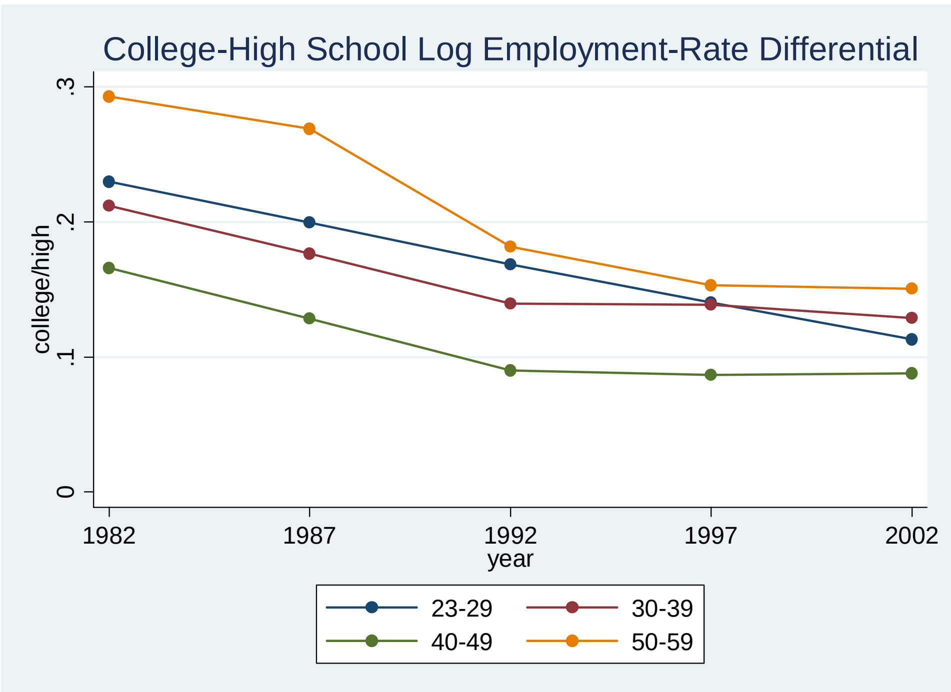
Panel B: Relative Population



Panel C: Relative Annual Hours of Work (log differential)



Panel D: Relative Employment Rate (log differential)



Panel E: Relative Wage Rate