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Regional patterns of employment changes of less-educated men in Japan: 1990-2007*

Yukiko Abe**

Graduate School of Economics and Business Administration,
Hokkaido University

Keiko Tamada***
Faculty of Economics,
Fukuoka University

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** Corresponding author. Graduate School of Economics and Business Administration, Hokkaido University, Kita 9 Nishi 7, Kita-ku, Sapporo, 060-0809 Japan. Phone +81-11-706-3860, Fax +81-11-706-4947, Email: abey@econ.hokudai.ac.jp
*** Faculty of Economics, Fukuoka University, 8-19-1, Nanakuma, Johnan, Fukuoka, 814-0180 Japan. Phone +81-92-871-6631 Ext.(4222), Fax +81-92-862-4431, Email:ktamada@econ.fukuoka-u.ac.jp

Abstract

We investigate regional patterns in employment of less-educated men in Japan from 1990 to 2007. The employment-population ratio of junior high school graduate men (9 years of compulsory schooling) decreased from 1990 to 2007. Wage growth across regions had a unique pattern during this period: it was high in the low-wage regions in the 1990s but high in the high-wage regions in the 2000s. We use these regional variations in wage growth to identify the labor supply elasticity of less-educated men. The estimated elasticity of the employment-to-population ratio of junior high school graduate men is around 0.15.

JEL classifications: J21, R11

Keywords: Regional wage growth, Labor supply elasticity

1 Introduction

During the last two decades, labor force participation of less-educated men and women fell in Japan. Among junior high school graduate men aged 25-59, the employment-population ratio (E-P ratio) was 0.915 in 1990, was 0.854 in 2000, and reached 0.830 in 2007. The participation rate of junior high school graduate women declined from 0.623 in 1990 to 0.601 in 2000 and to 0.590 in 2007, in spite of the fact that participation of women with senior high school education or higher had been rising.

The regional pattern in wage growth from 1990 to 2007 had been quite unique. In the 1990s, wage growth had been higher in the low-wage regions than in the high-wage regions. However, in the early to mid-2000s, the opposite was true: wage growth was higher in the high-wage regions than in the low-wage regions.

Although the E-P ratio of less-educated men seems to have been falling continuously overall, how such patterns possibly differ across regions is not well-known. Furthermore, the Japanese economy went through rather significant business cycle movement from 1990 to 2007, and as a result, wage growth differed in a unique way across regions and across time. In this paper, we use these regional variations in wage growth to identify the labor supply elasticity of less-educated men. Then using the estimates, we assess whether the recent decline in employment of this group is a response to falling wages.[1] For that purpose, aggregate data of participation and microdata of wages are used.

Understanding the causes of the fall in participation by less-educated men has important policy implications. If the decline in employment is understood as a labor supply response to falling wages, as in the case of studies using American men (e.g., Juhn 1992), then policies aimed at changing the after-tax wage rate for low-wage workers would be expected to raise participation. If, on the other hand, the decline in participation cannot be understood as a supply response to falling wages, then other factors are likely to have played a role. Analysis at the regional level is also important because, employment of the less educated comprises one of the important aspects concerning regional disparities in economic well-being.[2]

Using the repeated cross sectional data, we find that the extensive-margin labor supply elasticity of less-educated men is around 0.15. Given this estimate, the secular decline in the E-P ratio of this group cannot be explained as a labor supply response to low wage growth. As a result, the possible causes for the decline are (a) leftward shifts of the labor supply curve or (b) people not attaining their desired labor supply choices

[1] Although several studies have looked at the regional differences in unemployment in Japan in the 1990s (e.g., Ohta 2005; Yugami 2005), we are not aware of any research that examines the effects of differential wage growth across regions on labor force measures.

[2] In Japan, regional disparities in employment are larger for the less educated than for the highly educated.

and being off the labor supply curve (involuntarily unemployed). This is in contrast with the findings in the U.S. literature in which it has been argued that falling wages caused less-skilled men to reduce participation (Juhn et al. 1991, Juhn 1992).

This article is organized as follows. In Section 2, background for the analysis is provided. In Section 3, the data used in the analysis are explained. Section 4 presents facts on the migration patterns of cohorts, which are important for estimation of wage elasticity. In Section 5, employment patterns across regions from 1992 to 2007 are shown as raw tabulations. Estimates of labor supply elasticity are reported in Section 6. Section 7 concludes.

2 Background

Several previous studies have examined the relationships between participation and wages using cross sectional data for the United States, based on a labor supply framework. Juhn et al. (1991) and Juhn (1992) estimate the relationships between the E-P ratio and wages for men from 1968 to 1988 when the participation of less-educated men fell significantly. Juhn (1992) reports that the wage elasticity of participation of less-educated men is positive and significant, and furthermore, the wage change explains most of the fall in participation of white men. Pencavel (2002) estimates labor supply elasticity for men using data from 1968 to 1999. He shows that the estimates for intertemporal substitution elasticity are positive while those for uncompensated elasticity are negative, and argues that estimates obtained by Juhn et al. (1991) and Juhn (1992) are close to intertemporal substitution elasticity. While these studies tend to find large positive wage elasticity of less-educated men, Devereux (2003) reports some contradictory evidence based on estimates using regional variations in wage growth. He finds that the magnitude of elasticity estimates is sensitive to specifications and that men’s wage elasticity is small in his preferred specifications.

Studies that relate regional variations in wage growth to participation in the United States include Juhn et al. (1991) and Devereux (2003, 2004). Our specification in this article is close to theirs because we relate regional differences in employment growth to regional variations in wage growth.

One study closely related to our work is that of Kuroda and Yamamoto (2008), in which the authors estimate wage elasticity of labor supply using aggregate data for Japan. Our framework differs from that of Kuroda and Yamamoto in several ways. First, we analyze the extensive margin of labor supply by education level, and our analysis is restricted to men. While focusing only on extensive margin is certainly a limitation, it comes with a substantial benefit in that we are able to analyze the data disaggregated by education.[3] Kuroda and Yamamoto (2008) use data aggregated over education levels. The level and time-series variations for employment differ sharply depending on education (Abe 2009). Furthermore, the elasticity at the extensive margin is of interest in a policy context (e.g., Saez 2002).

Second, our analysis is more focused on regional patterns of employment than that of Kuroda and Yamamoto (2008). We exploit the unique wage growth patterns in the 1990s and 2000s in estimating labor supply elasticity. In addition, we explicitly show the differing employment patterns in the high-wage and low-wage regions.

Finally, our specification estimating the impact of wage growth on changes in the E-P ratios does not include many of the control variables Kuroda and Yamamoto (2008) employ, such as year dummies, population share, or regional industrial structure.[4] Aside from wage growth, we include only age dummies in the first-difference specification. Our specification is close to many of the labor supply

[3] In empirical labor supply literature, education is considered an important piece of information. There are arguments over whether or not education should be included in the labor supply equation (e.g., Pencavel, 2002). However, even in the case when it is not included in the labor supply equation, it is used as an important instrumental variable (IV) for predicting wage. In this article, we take the approach that education directly affects labor supply. Separate estimation by education is also motivated by the fact that the value of labor supply elasticity could differ across skill levels. For example, Juhn (1992) shows that participation is more elastic to wage for workers at the lower end of the wage distribution.

[4] Some of these variables are the ones that affect the labor demand side and not the labor supply side. In a narrow sense, labor supply is affected by the demand side variables only through its impact on wages: Ham and Reilly (2002) explain this as wage being a “sufficient statistic” of demand-side factors in a labor supply model. The implication is that if we include wage variables in the labor supply equation, other demand side variables should not affect labor supply, as long as choices observed in the data are on the labor supply curve.

models estimated using the U.S. data (e.g., Pencavel 1998, 2002, Devereux 2003, 2007).

In terms of methodology, our analysis uses the grouped data estimation of labor supply models: this approach typically takes a two-step procedure in which the cell-mean is obtained from microdata in the first stage and cell-level labor supply measures are regressed on cell-mean wages and other cell-level covariates in the second stage. Numerous empirical studies on labor supply use this methodology (e.g., Angrist 1991; Blundell et al. 1998; Pencavel 1998; 2002; Devereux 2003; 2004; 2007).[5] The primary motivation in these studies for using the grouped data approach is to address the problem of measurement error in hourly wages. In our case, however, the grouped data approach is employed because of the lack of microdata. The published aggregate data allow us to obtain the counterpart of cell-mean data.

3 Data

3.1 Employment data

The employment data used in this article are from the published version of the Employment Status Survey in 1992, 1997, 2002, and 2007 (ESS, Statistics Bureau, Ministry of Internal Affairs and Communications of Japan). We use data classified by

[5] Empirical analyses of labor markets using cell-mean data are also common in other contexts: e.g., Bound and Holzer (2000), Borjas (2003).

education (junior high school graduates, senior high school graduates, junior college graduates, and university graduates or above), age group (5-year intervals) and sex for 47 prefectures. In order to minimize the possible impact of school enrollment at young ages and retirement at old ages on participation, we focus on men aged 25-59. As a measure of participation, we use the E-P ratio, which is the number of workers divided by population. The workers here include all types of employment, including wage and salary earners and the self-employed.

The sampling errors of prefecture-level cell-mean data on employment and wages of junior high school graduate men are large because the sample sizes are small for some of the cells. It is reasonable to pool prefectures into a small number of groups in order to reduce the sampling error. In this article, we use the minimum wage ranks (consisting of four groups) to categorize prefectures. With the minimum wage rank, prefectures are classified into groups according to wage levels.

In the following analysis, 47 prefectures are classified into the high- and low-wage regions based on the four minimum wage ranks (A to D) in 1990.[6] The classification in 1990 is referred to as the “minimum wage rank” in the rest of the article.

[6] The minimum wage ranks are the classification of prefectures used for the minimum wage setting in Japan; see Kawaguchi and Yamada (2007) for a detailed explanation of minimum wage setting and the minimum wage ranks. The classification of prefectures into minimum wage ranks is shown in Table A1.

The Rank A region is the set of highest-wage prefectures, while the Rank D region corresponds to the lowest-wage prefectures.

3.2 Wage data

For wages, we use microdata of the Basic Survey of Wage Structure (BSWS, Ministry of Health, Labour and Welfare of Japan) for years 1992, 1997, 2002, and 2007. We aggregate the microdata to the cell level, in which the cells are defined by prefecture, sex, education, and age group, so that they match the employment data. We use wages for male full-time employees because information on education is available only for full-time employees in the BSWS. Full-time hourly wage is defined as monthly earnings divided by total monthly hours, where the monthly earnings are monthly salary (shoteinai kyuyo) plus the one-twelfth of bonus payment from the previous year, and the total monthly hours are the sum of regular hours plus overtime hours.[7] The mean hourly wage for each cell is used as the wage measure. The reason we do not analyze women in this paper is that, when the sample is restricted to junior high school graduate full-time working women, the sample sizes for some cells are too small, with some being less than 5.

[7] This measure of hourly wages is used in Kambayashi et al. (2008).

4 Residential pattern of cohorts

In the subsequent analysis, we track the labor force experiences of people with the same level of education living in the same prefecture for several points in time. One might have thought that in the presence of migration, a regional variable cannot be used to define the "cohort" in using repeated cross sectional data: that is, a combination of sex, birth year, education, and the place of residence cannot be used to define a cohort in order to trace the lifecycle experiences of the fixed group of people. However, as shown in this section, the proportion of people (for fixed birth year and education) who reside in particular regions was remarkably stable from 1992 to 2007.

Let p_{rsc} be the fraction of people who reside in region r among the population with birth year group c and education level s, thus:

$$p_{rsc} = \frac{N_{rsc}}{N_{sc}},$$

where N_{rsc} is the number of people with education level s and birth cohort c who reside in region r, and N_{sc} is the total number of people whose education level is s and the birth year c (the sum for all regions). The p_{rsc}'s for men are calculated using cross sectional data of the ESS from 1992 to 2007 for those born between 1943 and 1977 (5-year intervals). They are plotted against age in Figure 1, with r equal to the

Rank A and Rank D region for junior high school graduates and senior high school graduates.[8] The lines in Figure 1 are connected for each cohort so that they show the proportion of people who lived in region r at each age. The height of the vertical axes is the same for all figures.

Figure 1 shows two interesting patterns. First, the lines that connect the proportion of living in the Rank A or Rank D region after age 30 are almost flat, implying that net migration after age 30 is small. This gives us confidence that the impact of migration is small and that tracing employment behavior at the regional level is a reasonable approximation of lifecycle experiences of the same set of people. Second, up to cohorts born in 1957, the fraction of junior high school graduate men who live in the Rank A region (the highest-wage region) had fallen. However, for cohorts born after 1958, the fraction residing in Rank A region rose continuously until those born in 1972. In other words, the cohort born in 1958-1962 is the “turning point” cohort in that the propensity to live in the high wage area reversed the tendency that had been observed until then.[9]

To evaluate the stability of the population across the regions (defined by the

[8] The distribution over regions defined in other ways (such as large metropolitan areas) has similar inter-cohort differences and stability over years. We use the minimum wage rank grouping because it is simple. The fractions of people living in Rank B and Rank C regions show stability in the same sense, although they are not shown here.

[9] In Figures 1 and 2, the profiles for cohorts born before the turning point cohort are drawn in dotted lines and those for the turning point cohort and cohorts born after it are drawn in solid lines.

minimum wage rank), we run regressions in which the proportion of residing region r is the dependent variable and the cohort dummies and age are the independent variables. The results are shown in Table 1. If the population distribution is stable for the same cohort across years, then the coefficient of age should be close to zero, and the coefficients of cohort dummies should explain the variation in the dependent variable (if there are inter-cohort variations).[10] Results presented in Table 1 show that this is indeed the case: the coefficient of the age variable is very close to zero (the absolute value of the age/10 variable never exceeds 0.004, implying that in 10 years, the proportion of those living in each region changes less than 0.4 percent). For junior high school graduate men, the cohort dummies and linear age explain more than 95 percent of the variations in data when r corresponds to Rank A and Rank D. Given this evidence, we define cohort by birth year and region of residence in the rest of the paper, and estimate labor supply elasticity.

5 Patterns of employment across regions from 1992 to 2007: Raw tabulations

To gauge the regional patterns in employment, we begin with a simple tabulation of the E-P ratios by education, age group, and region. In Figure 2, the E-P

[10] Of course, if inter-cohort variations are small, cohort effects should be close to zero. However, Figure 1 suggests that inter-cohort variations are possibly large.

ratios are plotted against age, by education and birth year, for the four regions of the minimum wage rank. The lines are connected for each cohort (defined by sex, education, and birth year) so that they correspond to lifecycle experiences of the E-P ratio.[11] The subsequent analysis is based on junior high school graduate men, but for the purpose of comparison, the E-P ratios of the cohorts of senior high school graduate men (12 years of schooling) are shown as well. The notable pattern from Figure 2 is that the E-P ratio of junior high school graduate men fell as cohorts aged, for many of the older cohorts. There are also significant across-cohort variations in the E-P ratio: the cohort profiles for cohorts born later are generally located below those of earlier cohorts. In particular, the largest decline seems to have taken place from the cohorts born after 1953, although the patterns differ somewhat across regions.[12] For the purpose of estimating labor supply elasticity, the falling E-P ratio (with age) shown in Figure 2 is regressed on the wage changes during the same period.

[11] Figure 2 is drawn using the E-P ratio aggregated to the four minimum wage ranks, but the unit of observation in the regression analysis is at the prefecture level.

[12] These inter-cohort differences could be related to the residential distribution of junior high school graduates shown in Figure 1.

6 Estimation of labor supply elasticity[13]

6.1 Specification

We now turn to estimation of labor supply elasticity using prefecture-level cell-mean data. The unit of observation for the cell-mean data is a cell defined by education, birth year group (5-year intervals), and prefecture. In the following, we confine our attention to male junior high school graduates.

The specification we estimate is the following first-differenced form:

$$\Delta EPR_{jt} = \alpha \Delta LogWage_{jt} + X_j \varphi + u_{jt}, \qquad (1)$$

where ΔEPR_{jt} is the change in the E-P ratio between year t and year $t+5$ for cell j (j is defined by birth year and prefecture), $\Delta LogWage_{jt}$ is the log-difference in full-time hourly wages between t and $t+5$ for cell j (i.e., $\Delta LogWage_j = \ln(Wage_{j,t+5}) - \ln(Wage_{j,t})$, where $Wage$ is the hourly wage rate derived in the manner explained in Section 3.2), and X is a set of covariates (age dummies).[14] The first-differences, ΔEPR_{jt} and $\Delta LogWage_{jt}$, are obtained for the three time periods (change from 1992 to 1997, from 1997 to 2002, and from 2002 to 2007) for each cell

[13] Here and in the rest of the article, we use the words “insignificant” and “significant” to denote a statistical test at the 5% level.

[14] We deflate wages by Consumer Price Index (CPI). We also perform the analysis presented below using data deflated by prefecture-level regional CPI reported in the National Survey of Prices in 1992, 1997, 2002, and 2007 (the Statistics Bureau, Ministry of Internal Affairs and Communications of Japan) and find that the results are similar to the ones obtained using the wage data without regional CPI adjustment.

defined by prefecture and birth year group. The base group for the minimum wage rank dummies in is the Rank A region (the highest wage region). Regression equations are weighted by $\{(pop_{j,t})^{-1}+(pop_{j,t+5})^{-1}\}^{-1}$, where $pop_{j,t}$ is the population of cell *j* in year *t*.[15] The first-differenced specification in Eq. (1) is typical in empirical studies of intertemporal labor supply (e.g., MaCurdy 1981; Altonji 1986; Blundell and MaCurdy 1999; Pencavel 2002).

It is important to note that specification in (1) assumes that the data show outcomes of workers' optimal choice or on the labor supply curve. Therefore, we do not include variables that are unlikely to be included in the labor supply function. However, if the assumption of being on the supply curve is not valid and workers are forced to be off the supply curve, variables other than wage, income, or taste shifters may have explanatory power in explaining ΔEPR.

It must be kept in mind that sampling errors of the mean wage measures here are rather large, and sampling errors in the growth rates of the wages are even larger.[16] To account for measurement error in the wage growth variable, we use region dummy variables (the minimum wage rank dummies), period dummies (those for 1992-1997,

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[15] This weight is commonly used in the literature (e.g., Blau and Kahn, 2007).

[16] Since we work on cell-mean wage data of *junior high school graduates* of *each prefecture* for age groups defined in 5-year intervals, the number of wage observations is not large, even though the original BSWS sample is as large as 1 million. Therefore, measurement error in wages is a relevant issue here.

1997-2002, and 2002-2007), and their interactions as instruments.

In choosing these instruments, we exploit the unique wage growth patterns of less-educated workers in the 1990s and 2000s. As shown in Table 2 in Section 6.2, wage growth across regions had a unique pattern from 1992 to 2007: it was high in the low-wage regions in the 1990s but high in the high-wage regions in the 2000s. Therefore, period dummies for 1997-2002 and 2002-2007 (the base group is 1992-1997) and their interaction terms with minimum wage rank dummies have explanatory power for wage growth.[17]

Additionally, we use the share of employment of three industries (manufacturing, service, and agriculture) in each prefecture as instruments. If industries differ in wage growth and those differences drive the differential wage growth across regions but industry is unrelated to taste shifters, then industry composition shares serve as instrumental variables (under the assumption that the labor supply choices are on the supply curve).[18]

[17] The use of period dummies (or similar variables related to time) as IVs in estimating the labor supply equation is common in the literature (e.g., Angrist 1991; Devereux 2003, 2004).
[18] We also experimented with using cohort dummies as instrumental variables. Since age, cohort, and time are linearly dependent, some restriction has to be made in the first-stage regression. When we set some of the age coefficients to zero and include cohort dummies, the R^2 from the first stage regression increases only slightly, so we do not pursue using cohort dummies as instruments.

6.2 Wage growth from 1992 to 2007: First stage regression results

We begin with the examination of wage growth pattern during the sample period, which serves as the identifying assumption in estimating labor supply elasticity. To gauge the pattern of wage growth by region, the first stage regressions for the IV regression are shown in Table 2. The base group for the period is 1992-1997; thus, the minimum wage rank dummies capture the regional differences in wage growth during 1992-1997, while the interaction terms of period dummies and region dummies pick up similar effects in other periods. The first-stage regressions show clearly that wage growth had been different across period and across region. Wage growth was higher in the low-wage regions in the 1992-1997 period: the coefficient of Rank D dummy, which measures regional wage growth in the base period in the Rank D region, is positive and significant, meaning that wage growth was higher in the low-wage region after controlling for period effects and age effects. On the other hand, wage growth was higher in the high-wage areas from 1997 to 2007: the coefficients for the interactions of Rank D dummy and period dummies for 1997-2002 and for 2002-2007 are both negative and statistically significant. We use these contrasting patterns in wage growth for the 1992-1997 period and the 1997-2007 period and see whether the E-P ratios of this group responded to the unique wage changes.

6.3 Estimation of labor supply elasticity

We now turn to the estimation results for labor supply elasticity. Equation (1) is estimated by weighted least squares (WLS) as well as IV regressions. We use two different sets of IVs: (a) period dummies, three dummy variables for the minimum wage rank, and the interactions of period dummies and minimum wage rank dummies, and (b) the variables in (a) plus industry composition of each prefecture.[19] For industry composition variables, we use the share of manufacturing, agricultural, and service industry workers among workers for each prefecture, from aggregate data of the ESS. These are the industries for which the regional variations are large. Results are reported in Table 3. Specifications differ in what is included in the X variables and the set of IVs. The WLS estimates are small in size, but the IV estimates are larger, possibly reflecting measurement error in the mean wage variable.

The elasticities estimated from the WLS regressions are 0.1 or smaller, while those from the IV regressions range between 0.15 and 0.18. These are somewhat lower than

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[19] A possible concern for using the IV procedure is the problem of weak instruments. Among the IV regressions, we consider the one that uses interactions of minimum wage rank dummies and year dummies as the preferred specification. For this specification, the R^2 coefficient from the first stage regression is about 0.48 and the F-statistic is above 35. As a check for the instruments are orthogonal to the error term, the overidentification test statistics are reported in Table 3. Mostly, the p-values of the test statistics are around 0.05. Considering that these tests tend to reject the null hypothesis too often, we believe the instruments are appropriate.

the elasticity estimates of less-skilled men reported in Juhn et al. (1991), which ranges from 0.2 to 0.35 (Juhn et al. (1991); Table 9).

6.4 Do wage changes explain the recent fall in employment by the less educated?

In the U.S. literature, the falling employment of the less educated is largely attributed to declining wages for these workers (e.g., Juhn 1992). Is the falling employment of less-educated men in Japan understood as labor supply responses to falling wages? Since the coefficient of the constant term in Eq. (1) is negative in all of the specifications reported in Table 3, it is clear that the E-P ratio of junior high school graduate men fell for reasons other than wages. To see whether the magnitude of the wage impact differs systematically across period and region (defined by the minimum wage rank), we calculate the actual changes in the E-P ratio and the changes predicted from wage growth. Specifically, we calculate the mean of $\hat{\alpha}\Delta LogWage_{jt}$, take the average for each period-region, and then compare it with the actual change for that period-region. The results are shown in Figure 3. Several points are noteworthy. First, wage growth was positive until 2002 but negative for three regions in the 2002-2007 period. Thus, the mean ΔEPR predicted by wage growth is positive for 1992-1997 and 1997-2002 but slightly negative for 2002-2007. Second, while the predicted changes are always higher than the actual changes (the lines for predicted ΔEPR are always located above the actual ΔEPR for all period-region groups), the difference between the predicted change and actual change is not uniform across period and region. The difference is especially large for the Rank D region in 1997-2002. A possible interpretation of this phenomenon may be that the demand for less-skilled workers was weak in the Rank D region but the wage changes did not fully reflect the weak demand until the mid-2000s. Weak demand conditions resulted in a large decline in the E-P ratio in the Rank D region during the 1997-2002 period, followed by a wage decline in the 2002-2007 period. After the wage decline, the discrepancy between the predicted ΔEPR and actual ΔEPR in the Rank D region narrowed, although it is still true that the predicted ΔEPR is lower than the actual change.

Given the evidence shown in Figure 3, the reasons for the fall in participation of less-educated men in recent decades have to be found somewhere other than wages.[20] One possibility is the leftward shifts in the labor supply function. The other possibility is that our assumption that the workers are on the labor supply curve is incorrect: for instance, if people would like to supply labor as the predicted ΔEPR suggests but are involuntarily unemployed, the actual ΔEPR falls short of the predicted ΔEPR. We

[20] This contrasts the results in Juhn (1992). She reports that wage decline explains most of the employment decline for white men and about a half of the employment decline for black men.

note that the causes for the differences are likely to differ across region and period, since Figure 3 clearly show that the differences between the actual and the predicted ΔEPR differ across region and time period.

To check the robustness of our findings, we perform analyses similar to those reported in Sections 4, 5, and 6 using the aggregate employment data from the Census in 1990 and 2000 (for which information on respondents' education is collected) and the BSWS data in 1990 and 2000.[21] The residential patterns and changes in participation are similar to the ones in the ESS data (Appendix B), which means that the patterns of regional migration and the decline in the E-P ratio reported in Sections 4 and 5 are robust.

Since our Census data consist of only two time periods, there is only one first-difference for each combination of prefecture and age group. Therefore, the period dummy and its interactions with region dummies cannot be used as instruments; thus, only the WLS regressions are estimated. The results are reported in Table B1. The WLS estimates from the Census data are close to the WLS estimates from the ESS data.

[21] The Census data are assembled by the Statistics Bureau, Ministry of Internal Affairs and Communications of Japan.

7 Conclusion

In this article, we investigate the regional patterns of wage growth and changes in employment in Japan from 1990 to 2007. The low-wage regions experienced higher wage growth in the 1990s but lower wage growth in the 2000s. Using aggregate data of the ESS from 1992 to 2007, we find that the extensive-margin labor supply elasticity of less-educated men is around 0.15. Given this estimate, the secular decline in the E-P ratio of this group cannot be explained as a labor supply response to low wage growth.

It is of interest to compare our results with those obtained in previous studies using the U.S. data. Juhn (1992) emphasizes the role of declining wages for the employment decline of the less-educated in the United States during the 1980s. She concludes that wage declines for the less-educated in the 1980s account for almost all decline in labor market participation for white men and about half of the participation decline for black men. Unlike the evidence reported by Juhn (1992), this article shows that it is hard to interpret the employment decline of the less-educated as a labor supply response to falling wages in Japan. While the E-P ratio of the less educated fell from the 1990s to the mid-2000s, the extent to which the fall in employment is caused by wage changes is limited.

Appendix A: Classification of prefectures to the minimum wage ranks

The minimum wage rank classification is shown in Table A1.

Appendix B: Summary of the results using Census

We perform similar analyses reported in Sections 4 to 6 of this article using the Census in 1990 and 2000, the alternative aggregate data. The residential pattern from the Census data (Figure B1) and the regional pattern of the E-P ratios from the Census data (Figure B2) are similar to those of the ESS data. The WLS estimates of labor supply elasticity are shown in Table B1.

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Table 1: Residetial pattern of cohorts: Junior High School Graduate Men
Dependent variable = Fraction of people who reside in region j among the population (P_{rsc})

	(1)	(2)	(3)	(4)
	Rank A	Rank B	Rank C	Rank D
Dummy for born 1948-1952	-0.026**	-0.029**	0.011**	0.044**
	(0.004)	(0.004)	(0.003)	(0.003)
Dummy for born 1953-1957	-0.047**	-0.048**	0.010*	0.085**
	(0.005)	(0.005)	(0.004)	(0.004)
Dummy for born 1958-1962	0.005	-0.028**	-0.020**	0.043**
	(0.007)	(0.007)	(0.006)	(0.006)
Dummy for born 1963-1967	0.027**	0.014	-0.013	-0.029**
	(0.008)	(0.008)	(0.007)	(0.007)
Dummy for born 1968-1972	0.031**	0.037**	-0.026**	-0.042**
	(0.009)	(0.008)	(0.007)	(0.007)
Dummy for born 1973-1977	0.012	0.018	-0.005	-0.025**
	(0.010)	(0.010)	(0.008)	(0.008)
Dummy for born 1978-1982	0.018	-0.023	0.007	-0.002
	(0.014)	(0.014)	(0.012)	(0.012)
Age(/10)	-0.003	-0.003	0.003	0.004
	(0.003)	(0.003)	(0.003)	(0.002)
Constant	0.211**	0.323**	0.278**	0.188**
	(0.017)	(0.016)	(0.014)	(0.014)
R-squared	0.95	0.95	0.89	0.99

Note:The sample sizes are 25.
Base group for cohort dummies is birth year 1943-1947.
All regressions are weighted by the weight explained in the text.
Standard errors in parentheses.
* significant at 5%; ** significant at 1%.

Source: Authors' calculation from the ESS (1992, 1997, 2002, 2007).

Table 2: First stage regression: Wage growth: Junior High School Graduate Men
Dependent variable =$\triangle \text{Logwage}_{jt}$

	(1)	(2)
	WLS	
1997-2002 dummy	-0.031	-0.031
	(0.020)	(0.020)
2002-2007 dummy	-0.065*	-0.065*
	(0.029)	(0.029)
Rank B	0.007	0.008
	(0.020)	(0.022)
Rank C	0.029	0.036
	(0.018)	(0.022)
Rank D	0.063**	0.077**
	(0.019)	(0.025)
Rank B*(1997-2002 dummy)	-0.019	-0.020
	(0.024)	(0.024)
Rank C*(1997-2002 dummy)	-0.037	-0.037
	(0.023)	(0.023)
Rank D*(1997-2002 dummy)	-0.076**	-0.076**
	(0.023)	(0.023)
Rank B*(2002-2007 dummy)	0.011	0.011
	(0.030)	(0.030)
Rank C*(2002-2007 dummy)	-0.043	-0.043
	(0.029)	(0.029)
Rank D*(2002-2007 dummy)	-0.079**	-0.079**
	(0.029)	(0.029)
Manufucturing industry share		0.074
		(0.088)
Service industry share		0.067
		(0.240)
Agriculture industry share		-0.185
		(0.258)
Aged 30-34	0.015	0.015
	(0.012)	(0.012)
Aged 35-39	0.015	0.015
	(0.013)	(0.013)
Aged 45-49	-0.017	-0.017
	(0.009)	(0.009)
Aged 50-54	-0.049**	-0.049**
	(0.011)	(0.011)
Aged 55-59	-0.088**	-0.088**
	(0.014)	(0.014)
Constant	0.096**	0.063
	(0.018)	(0.078)
R-squared	0.484	0.486

Note: The sample sizes are 658.
Base groups are age 40-44 for age dummies and Rank A for minimum wage rank dummies.
The unit of observation is a cell defined by perfecture, period, and age group.
There are three period for the first difference in wages: 1992-1997, 1997-2002, 2002-2007. The base period is 1992-1997.
$\triangle \text{Logwage}_{jt}$ are deflated by CPI.
All regressions are weighted by the weight explained in the text.
Robust standard errors in parentheses.
* significant at 5%; ** significant at 1%.

Source: Authors' calculation from the ESS (1992, 1997, 2002, 2007) and the BSWS (1992, 1997, 2002, 2007).

Table 3: Employment changes and wage growth: Junior High School Graduate Men
Dependent variable = E-P ratio$_{j(t+5)}$-E-P ratio$_{jt}$

	(1)	(2)	(3)	(4)	(5)	(6)
	WLS	WLS	IV	IV	IV	IV
ΔLogwage$_{jt}$	0.090**	0.050	0.158**	0.136	0.160**	0.144
	(0.030)	(0.037)	(0.043)	(0.081)	(0.043)	(0.081)
Aged 30-34		-1.E-04		-0.001		-0.002
		(0.014)		(0.014)		(0.014)
Aged 35-39		-0.002		-0.002		-0.002
		(0.011)		(0.011)		(0.011)
Aged 45-49		-0.006		-0.005		-0.005
		(0.008)		(0.008)		(0.008)
Aged 50-54		-0.024*		-0.017		-0.016
		(0.009)		(0.012)		(0.012)
Aged 55-59		-0.011		0.001		0.002
		(0.011)		(0.016)		(0.016)
Constant	-0.036**	-0.026**	-0.039**	-0.033**	-0.039**	-0.034**
	(0.003)	(0.008)	(0.003)	(0.010)	(0.003)	(0.010)
R-squared	0.012	0.024	-	-	-	-
Elasticities	0.103	0.057	0.181	0.156	0.184	0.165
Mean	0.871					
χ^2 statistics for overidentifying restrictions (df)	-	-	27.89 (15)	17.78 (10)	30.87 (18)	21.45 (13)
P-value	-	-	0.022	0.059	0.030	0.065
Instruments	-	-	Minimum wage rank, Period dummies, Period dummies* Minimum wage rank, Age dummies	Minimum wage rank, Period dummies, Period dummies* Minimum wage rank	Minimum wage rank, Period dummies, Period dummies* Minimum wage rank, Age dummies, Industry Composition	Minimum wage rank, Period dummies, Period dummies* Minimum wage rank, Age dummies, Industry Composition

Note: The sample sizes are 658.
Base groups are age 40-44 for age dummies, and Rank A for minimum wage rank dummies.
The unit of observation is a cell defined by perfecture, period, and age group.
There are three period for the first difference in wages: 1992-1997, 1997-2002, 2002-2007. The base period is 1992-1997.
ΔLogwage$_{jt}$ are deflated by CPI.
All regressions are weighted by the weight explained in the text.
Elasticities are computed at the mean of 4 years.
Robust standard errors in parentheses.
* significant at 5%; ** significant at 1%.
Chi^2 statistics for overidentification restriction is the statistics against the null hypothesis that the instruments are valid.

Source: Authors' calculation from the ESS (1992, 1997, 2002, 2007) and the BSWS (1992, 1997, 2002, 2007).

Table A1: Minimum wage rank classification in 1990

Rank A	Tokyo, Kanagawa, Osaka
Rank B	Saitama, Chiba, Gifu, Shizuoka, Aichi, Mie, Kyoto, Hyogo
Rank C	Hokkaido, Ibaraki, Tochigi, Gumma, Niigata, Toyama, Ishikawa, Fukui, Yamanashi, Nagano, Shiga, Nara, Wakayama, Okayama, Hiroshima, Yamaguchi, Fukuoka
Rank D	Aomori, Iwate, Akita, Yamagata, Miyagi, Fukushima, Tottori, Shimane, Tokushima, Kagawa, Ehime, Kochi, Saga, Nagasaki, Kumamoto, Oita, Miyazaki, Kagoshima, Okinawa

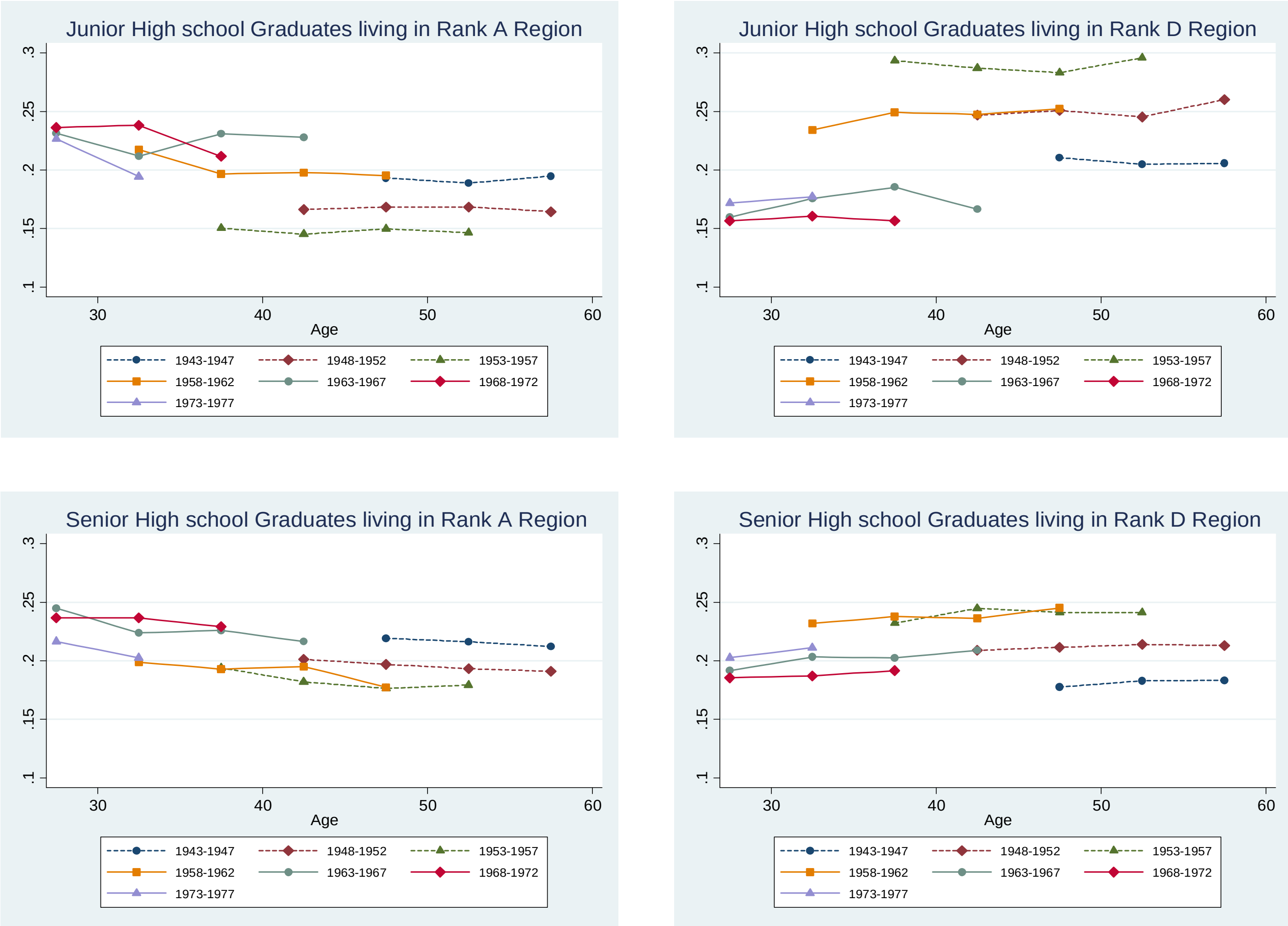
Table B1: Employment changes and wage growth: Junior High School Graduate Men
Dependent variable = E-P $ratio_{j(t+10)}$-E-P $ratio_{jt}$

	(1)	(2)
	WLS	WLS
$\triangle Logwage_{jt}$	0.111**	0.027*
	(0.017)	(0.014)
Aged 35-39		0.005
		(0.004)
Aged 45-49		0.001
		(0.004)
Aged 50-54		-0.003
		(0.004)
Aged 55-59		-0.029**
		(0.004)
Constant	-0.081**	-0.056**
	(0.004)	(0.004)
R-squared	0.275	0.589
Elasticities	0.120	0.030
Mean	0.923	

Note: The sample sizes are 235.
Base group for age dummies is aged 40-44.
$\triangle Logwage_{jt}$ are deflated by CPI.
All regressions are weighted by the weight explained in the text.
Elasticities are computed at the mean in 1990.
Robust standard errors in parentheses.
* significant at 5%; ** significant at 1%.

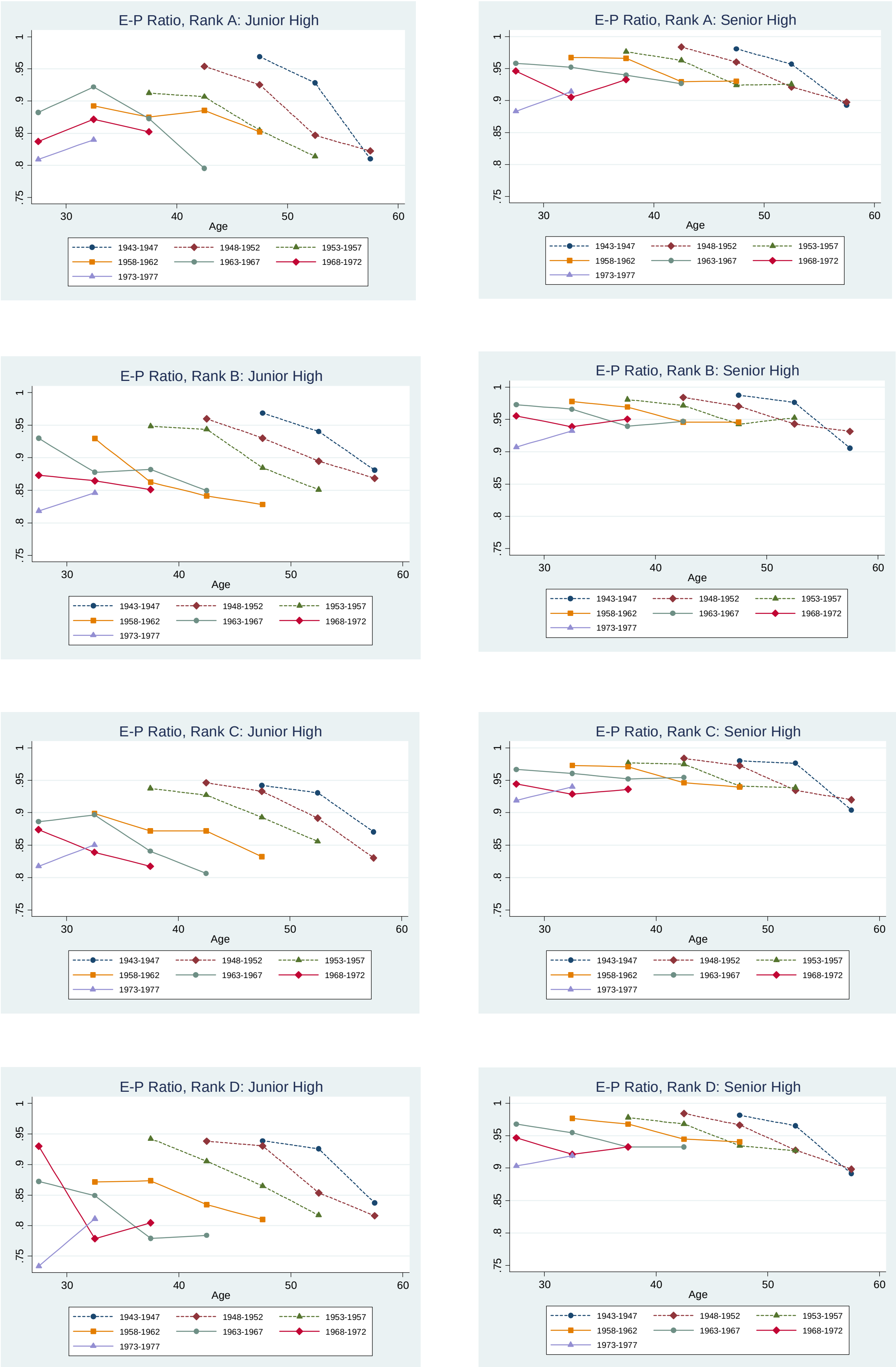
Source: Authors' calculation from Census (1990, 2000) and the BSWS (1990, 2000).

Figure 1: Residential pattern of cohort by education, region, and cohort: Men
Y axis: Fraction of people who reside in region j among the population (P_{rsc})



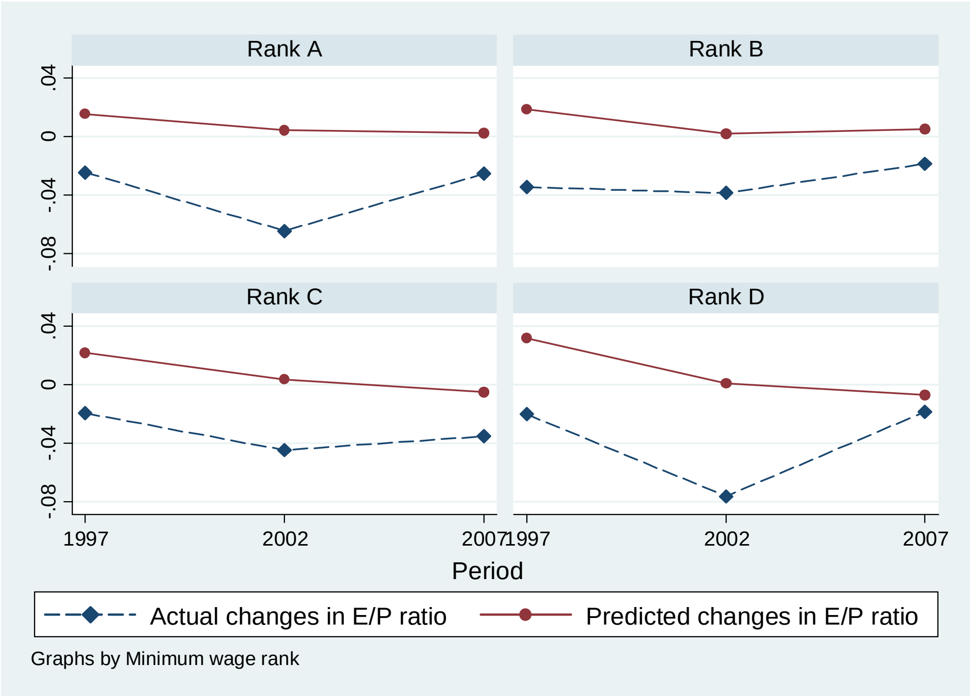
Source: Authors' calculation from the ESS (1992, 1997, 2002, 2007) .

Figure 2:The Employment-population ratios, by education, region, and cohort: Men



Source: Authors' calculation from the ESS (1992, 1997, 2002, 2007) .

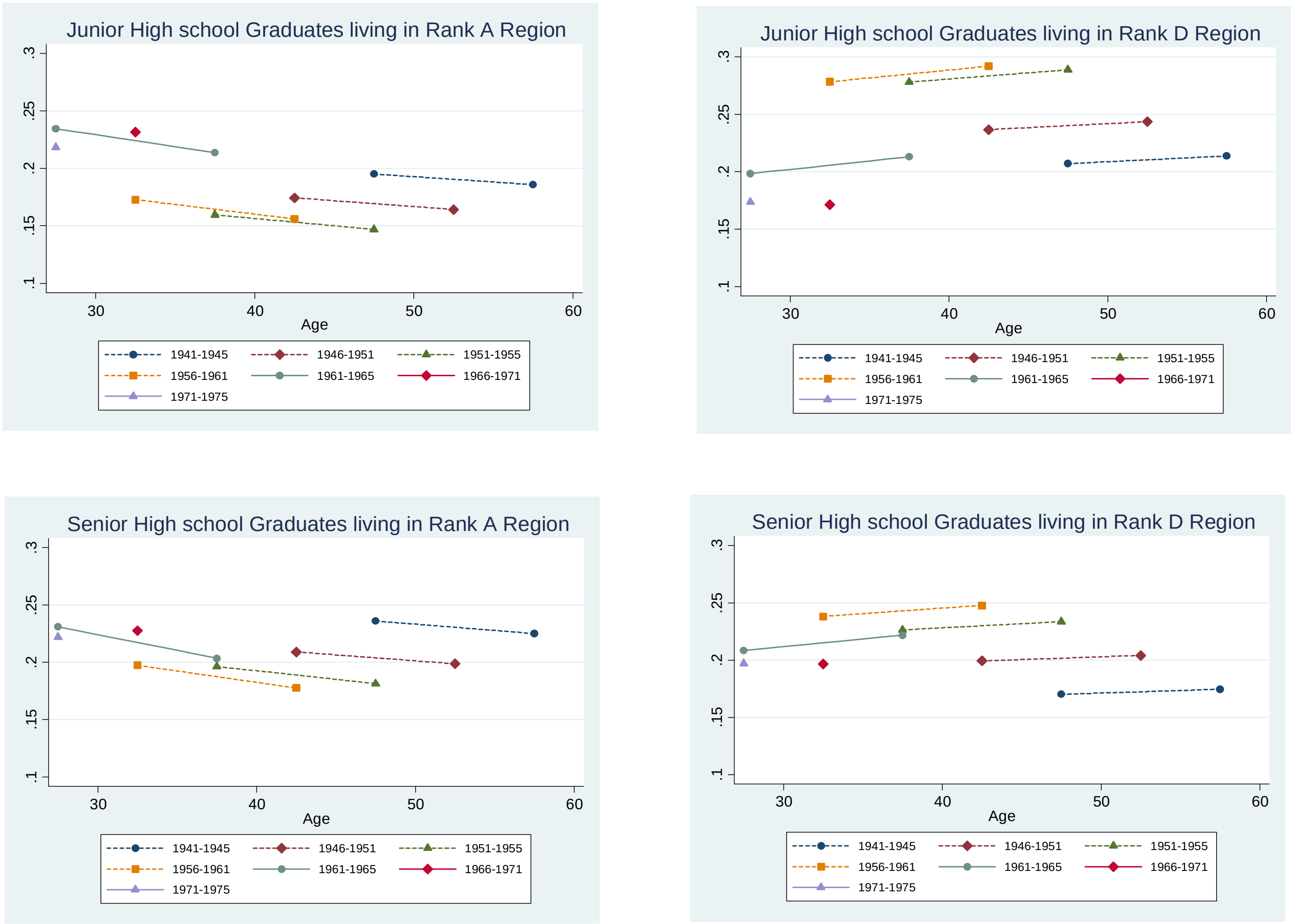
Figure 3: Predicted impacts of wage growth and actual changes in E/P ratio
By minimum wage rank and period



Note: The horizontal axis measures the year of the end of each 5-year period.
For instance, the outcome shown at "1997" is that for 1992-1997.

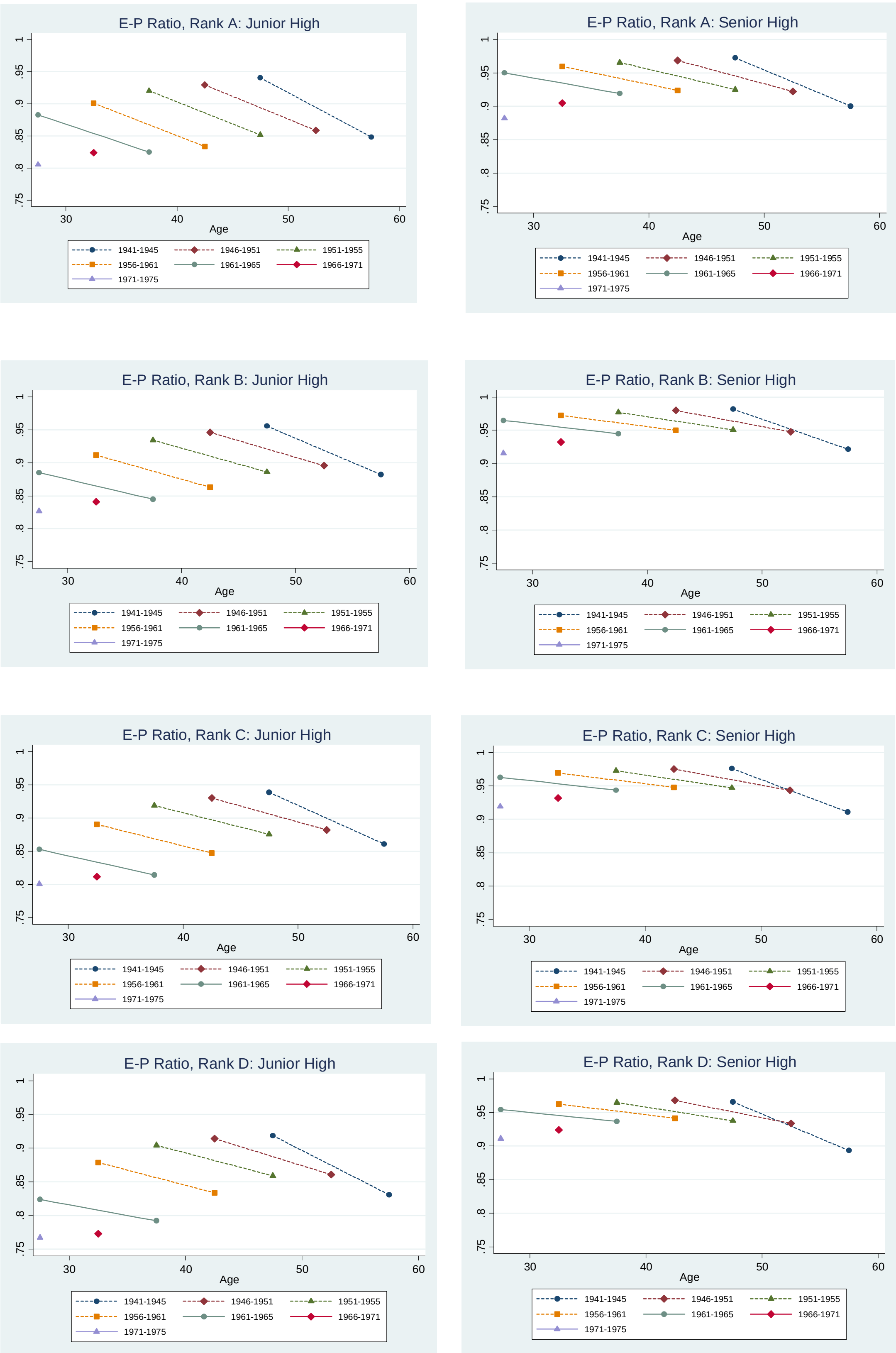
Source: Authors' calculation from the ESS (1992, 1997, 2002, 2007)
and the BSWS (1992,1997, 2002, 2007).

Figure B1: Residential pattern of cohort by education, region, and cohort: Men
Y axis: Fraction of people who reside in region j among the population (P_{rsc})



Source: Authors' calculation from Census (1990, 2000) .

Figure B2:The Employment-population ratios, by education, region, and cohort: Census, Men



Source: Authors' calculation from Census (1990, 2000) .