# Long-Term Changes in the Wage Structure of Taiwan (Preliminary)

Stacey H. Chen*

June 8, 2012

**Abstract**

In this paper we document long-term changes in the wage structure of Taiwan over the past 33 years: (1) Hourly wages have been stagnating at the lower tail of wage distributions of Taiwanese men since the 1990s, about one decade earlier than their female counterparts. This leads to a decline in gender wage gaps, especially for the lower tail. (2) Evolution of hourly wage within cohorts by percentile across time shows inter-cohort stagnation has emerged since the middle age of the 1950s birth cohort; all of the younger cohorts have made no progression after mid-30s or younger, compared to their previous cohorts. (3) Secondary school education greatly expanded in Taiwan during the 1990s. Within those 10 years, the number of academic

*Chen: Associate Research Fellow, Academia Sinica, 128 Academia Road Section 2, Taipei, Taiwan R.O.C., chens@nber.org. Thanks Ming-Jen Lin for thoughtful comments and suggestions. I am also grateful to Davis Liu for research assistance.

high schools almost doubled. (4) However, the trends of educational wage differentials for secondary education does not reflect the great expansion, leaving other other factors such as shifts in labor demands a possible explanation for the wage stagnation.

# 1 Introduction

In 2011 Taiwan has the world's lowest birth rates, falling below one baby per woman. Without governmental enforcement of birth control such as China's One Child policy, average family size in Taiwan has been declining rapidly since 1970s. Most of Taiwanese families in the past had at least two children but not any more. With the great fertility drop and the rapid transition of family composition, average family members are now much fewer and older.

This drastic transition in family composition has significant implications for income inequality of Taiwan (Fei, Ranis and Kuo 1979). Deaton and Paxson (1994) have noted that within-cohort inequality of household income rise with age in Taiwan, like those in U.S. and Great Britan. Consistent with this, Chu and Jiang (1997) suggested that family income inequality in Taiwan at least until the mid 1990s was driven largely by the shift in age-specific composition of family members over years and across cohorts. No wonder Kuznets (1989, p230) said "it makes little sense to talk about inequality in the distribution of income among families or households when the sizes of the underlying units have significant variation." Previous studies attempted to resolve this by controlling for endogenous family size. However, this might have understated the residual wage inequality because fertility is an individual choice, which truncates the distribution of potential wages. To separate the non-secular changes in wage inequality from the structural changes in family size and composition, contemporary analysis on income equality has used individual earnings as measure of inequality, not family income.[1]

[1]Important examples include Katz and Autor (1999), Acemoglu (2002), Piketty and

One of the most pressing economic issues in Taiwan today is wage stagnation. Pay and salaries have been lagging in recent decades, prior to the recent financial crisis, but little systematic analysis showed how and when the stagnation started in Taiwan. Many social observers have speculated that the educational expansions took some of the blame for the stagnation but little systematic analysis has been done.

Using Manpower-Use Survey of all survey years starting 1978, I first document the phenomenon of wage stagnation. Gender wage gaps declined because wage rates of male workers at the lower tail started stagnated during the early 1990s, about one decade earlier than that of their female counterparts. This leads to a rapid decline in gender wage gap from mid 1990s to 2010. Then I show a drastic stagnation arises for cohorts born after 1970s; there is almost no inter-cohort progression from 1970s to 1980s and afterwards, given the same age.

Many social observers have argued that the recent wage slowdown was caused by large expansions in education in the past two decades, including the great expansion in secondary education during the 1990s and in high education during the late 1990s. Those expansions should have suppressed the relative wage of skilled workers who were born during the 1970s, and the educational wage differentials should have been decreased. However, the starting hourly pay of this cohort is not lower, though does grow slower, than that of older cohort. The educational wage differentials of younger workers increased since mid 1995. This suggests that other factors, such labor demand or international migration, play an important role in explaining Taiwanese

Saez (2003), Autor, Katz and Kearney (2008), and Lemieux (2008).

wage stagnation over the past decades.

The paper is organized as follows. Section 2 describes our data sources and variable definitions. Section 3 documents the trends of wage distributions in the past 33 years. Section 4 describes the scale and timing of high school expansion in Taiwan. In Section 5 we investigate the link between high school expansion and declining educational premiums. Section 6 concludes.

# 2 Data

Our analysis begins with plotting time series of wage variables using the Manpower Survey 1978-2010, which is a 2.6 percent of random sample of all households and group quarters by town and city, excluding military and correctional institutions. The survey started in 1962 but only after 1978 it was digitized with an improved sampling frame. It contains information about individual civilian earnings, education, employment, demographics, and hours of work of individuals at the age of 15 to 64. We include 848,363 full-time employees (at least 35 hours in the previous week of the survey day) in both public and private sectors, who had positive earnings and were 15 to 64 years old. Earnings are deflated by the Consumer Price Index, measured against the 2000 base year, so the wage levels in this paper are all in real terms.

We exclude individuals whose monthly wage is lower than half of the minimum wage or greater than the hourly wage of the top-coded given 35 hours of work a week. In our sample 428 individuals are top-coded. For sample selection we closely follow the Autor, Katz and Kearney (2006, 2008)

study. We have also experimented Chen and Hsu's (2001) sample selection rules, which exclude workers in public sectors or in agriculture, forestry, and fishing industry sectors. We find the overall trends in these two selected samples are similar although the contrast between upper- versus lower-tail wage inequalities (see the discussion below) which appears in the Autor, Katz and Kearney (2006) study would be less evident in Chen and Hsu's sample.

In this paper we study the trends in log hourly wages, instead of log monthly wages, in order to focus on changes in the wage distribution, putting aside the issues on changes in employment and work hours. We document the structural changes in the wage structure by gender or by education. The education system of Taiwan separates two paths starting at grade 7: one path preparing pupils for vocational education, and the other for university education. As a result, the number of years of education in one path is typically not equivalent to that in the other. Researchers wishing to use "the number of years of education" or "the highest grade completed" must impose various formulas to create a continuous education variable using the observed categorical variables.

As the imposed number of years of education might be misleading, we adopt self-reported education levels which include the following categories: (1) less than middle school, (2) middle school education, (3) vocational high school education, (4) general high school, (5) vocational college, and (6) university. For respondents in the post-2007 surveys, we add one additional category - postgraduate education because questionnaires of those year add the information about post-graduate education.

It's noteworthy that a large portion of respondents in our sample have less

education than middle school, although middle school education has become part of compulsory education since 1968. A possible explanation is that the school entry laws were not strictly enforced. In addition, for respondents prior to 2007 we cannot distinguish drop-outs from graduates since education completion information was not in the questionnaire.

# 3 Stagnation

After enjoying decades of a steady growth in *real hourly wages* (or briefly called "wage"), the upward trend started waning around the mid 1990s. Although wages grew together for all parts of the wage distribution between 1978 and 1996, the upward trend for male full-time workers at the median and the bottom 10th percentile ended in the early 1990s, about a decade sooner than that for the 90th percentile. Since the early 1990s, the lower tail of wage distributions for full-time workers remained nearly constant, while the top quintile continued to grow by about 25 percentage points. During the 2000s, the median wage and the 90th percentile of male workers even showed a slight decline. These findings are presented in figure 1.

A stagnation in median wage growth in the U.S. between around 1973 and mid-1990s has been intensively discussed, by, e.g., Katz and Autor (1999) and Acemoglu (2002). Guvenen and Kuruscu (2007, 2010) provided potential explanations for the wage stagnation of US. First, the increased investment in job training which reduces productivity because the work time is crowded out by increased time spent in on-job learning. Second, the changes in educational composition effects on the labor force, with high ability workers

choosing to enter university instead of the labor market. In this paper, I hope to examine those forces relating to educational investment, using high school opening and university expansion as sources of exogenous variation in education levels. Acemoglu (2002) has pointed out the importance of international trade and migration in explaining the changes in wage distributions, although those are not the focus of this paper.

## 3.1 A Decline in Gender Wage Gaps

The gender wage gap has been falling since the early 1990s, and the narrowing trend appears to be associated with a delayed stagnation of women's wage compared to men's. As figure 1 shows, compared to their male counterparts, female full-time workers at the lower tail (the median and the 10th percentile) saw a relatively greater growth in log hourly wage during the 1990s. While male full-time workers' log hourly wage started stagnating around mid-1990s and even falling for a few years during the early 2000s, female workers' wage growth continued until the mid 2000s.

The stagnation of wage growth for all female workers arose around the mid 2000s. This was about the same time as male workers at the 90th percentile started stagnating, and around eight to ten years sooner than male workers at the median and the 10th percentile started stagnating.

While stagnation has appeared to male workers at the lower tail in the early 1990s, the wage rates of male workers at the 90th percentile, so as those of female workers at all percentiles, continued to grow for another 10 years. As a result, as figure 5 shows, the log wage ratios of men to women dropped most rapidly among the median, compared to the ratios of those at the 90th

percentile.

Combination of the delayed stagnation of female wages and the recent decline in male wages, the gender wage gap is falling at all parts of the wage distribution. As figure 5 shows, the gender wage difference, based on median hourly wage for full-time workers, drops rapidly to 20 percent in 2010 from about 45 percent in 1990. The decreasing rate of the median of the gender wage gap is much higher than that at the top and bottom percentiles during the same period. In particular, the gender gap, based on the 90th (10th) percentile, decreases to 20 percent from 30 (40) percent.

Fernandez and Wong (2011) recently uncover a narrowing and eventually disappearing of the gender wage gap in the United States by comparing the 1935 and 1955 cohorts . They suggest that this phenomenon is associated closely with the convergence, or even a reversal, of gender gaps in education. I plan to investigate similar issues for the case of Taiwan, which the converging gender differences in educational achievement started to appear since the mid 1990s .

## 3.2 Polarization

An extreme and persistent polarization has long been a norm among female workers prior to 1978. In contrast, wage polarization among male workers just began in the mid-1990s, with relatively small but fast growing gaps.

Figure 3 shows the evolution of the upper and lower-tail wage inequalities for both men and women, measured by 90-50 and 50-10 log hourly wage differentials. The trends in upper-half and lower-half inequality exhibits a divergence in wage inequality in 1997, with the upper-half wage gaps dipped

first and rose later, while the lower-half wage gaps exhibits a downward trend that last at least four decades. The upper-half inequality is now more than 20 percentage points greater than the lower-half inequality, although the gap was less than 5 percentage points between 1980 and 1997.

The recent rises in polarization of wages during the mid 1990s, though mild, seem mostly a male phenomenon. Women also see polarization but it has appeared prior to 1978. The trends in male wage inequality in upper-half and lower-half are very similar until the mid 1990s, some divergence occurs in both upper-half and lower-half of the distributions among males. In contrast, female wage inequality has shown wide and persistent divergence over the entire periods. Unlike men's 90-50 and 50-10 inequality measures closely overlapped during the late 1980s and most of the 1990s, women's inequality measures have exhibited a persistent and deep polarization as early as in 1978.

Contrary to the earlier study by Fei et al. (1979), who documented a steady decrease in family-income inequality in Taiwan's economic growth prior to 1980 (measured by Gini coefficients), here we find substantial volatilities during the recent decades and a divergence in the upper-half (90-50) and the lower-half (50-10) wage inequality during the mid 1990s. The phenomena of polarization in the labor market has also appeared in U.K. (see, e.g., Goos and Manning) and in U.S. (see, e.g., Autor, Katz and Kearney 2006). But few studies investigate such a substantial change in wage structures and evident distinctive patterns in polarization between genders. I plan to come back to this issue.

## 3.3 The Lost Generations

Figure 4 shows the evolution of the log hourly wage within each cohort, at the 90th, 50th and 10th percentile of the wage distribution. As we can see, the lines slope up at the beginning of the evolution, but some slow down or even slope down after certain ages. The evolution grow fastest for the 90th percentile, which doesn't slow down until the retirement age, except for the females who were born in the 1940s or 1950s. In contrast, the evolution for the median and the 10th percentile exhibit concave curves, with the peak at the age of 50s for the cohort born in 1940s and at the age of 40s for the cohort born in 1950s. Surprisingly, the peak age for the younger cohorts born during or after 1960s is around mid 30s. Unlike most of other countries showing upward shifts in within-cohort evolutions of hourly pay, the inter-cohort progression in Taiwan exhibits evident stagnation for cohorts born after 1940s. The wage profile of later cohorts peaks at younger age.

The initial wage rates of the cohort born during the 1960s grew faster than not only the older cohort (born during the 1950s), but also the younger cohorts (born after 1960s). The growth rate of log hourly wage for the cohort born in 1960s is about 5 percent from age 25 to 30. That for the cohort born in 1980s is about 3 percent or less.

After age 50, log hourly wage starts declining most rapidly for men at the bottom quintile. For women at the bottom quintile, the downturn is not as steep, but the downturn is evident for the entire wage distribution.

Contrary to the earlier trends of economic development in Taiwan – with falling inequality and rising wage growth prior to 1979, the trends post 1979 has shown an entirely different pattern. Both inter-cohort and within-cohort

evolutions have stopped or slowed down. The wage profile for younger generations is flat, with no upward shifts compared to the previous generations. Although many factors can drive those changes, I explore the role of educational expansion in the following section as a starting point.

# 4 The Great Expansion in Education

Secondary schools in Taiwan expanded in large measure between 1946 and 1970 and during the 1990s. Figure 5 shows a rapid growth in high school openings before 1968 when the 9-year compulsory schooling law was implemented. The number of high schools increased by about five folds within 25 years – from 30 in the late 1940s to more than 150 in 1969. Between 1969 and 1989, almost no high school opened and the number of high school remained nearly constant.

The second expansion in high school started in 1989. Within 10 years the number of high schools nearly doubled - increasing from 160 to 300. And the expansion continues until 2010 the end of our data.

# 5 The Return to Education and the Great Expansion

After accumulating more and more high-school graduates who were trained during the 1940s - 1960s and 1990s, we should have observed their relative wage to decline when they entered the workforce. However, our statistics show otherwise.

Figure 6 presents the estimates of the educational wage differential for ten years age groups. I also refer the educational wage differential to the "return to education" though with not causal interpretation. The estimated return to high school education, summarized in the second row of the figure, are based on differences in mean log average hourly wages between middle school graduates and high-school graduates or beyond, conditional on their potential work experience. The potential work experience is calculated by their age minus six minus the number of years of schooling, and the number of years of schooling is approximated by the self-reported categorical education level. We construct the return to middle school and the return to college in the similar manner. All schooling coefficients in the figure are statistically significant at conventional levels.

An important feature of the wage differentials in figure 6 is that the trends in the return to education are very similar, irrespective of education levels. As high school expanded greatly during the 1990s, we do see some decline in the return to high school after 2003, but the same downward trend also appears in the return to mid school and the return to college.

# 6 Concluding Remarks

The new evident trends in Taiwan wage structure during the past 33 years are stagnation within cohorts and across cohorts. The full-time male workers at the lower tail of the wage distribution experienced the stagnation the earliest. The greater wage growth and the delayed arrival of the stagnation help reduce the gender wage gaps in log hourly wage. The key fact about female wage

inequality is the considerably larger gap between the median and the top percentile, coupled with an enduring contraction in the bottom part of the wage distribution.

Educational wage differentials at all education levels appear to share the same trend in spite of the large expansion in high schools during 1990s. Although the number of colleges and middle schools didn't increase as rapidly as the number of high schools during the same period (not reported in the figures) , it's likely the enrolment rates in high school that have increased at the same rate as those in middle schools and colleges. More investigation is needed to explore this.

# References

Acemoglu, Daron (2002): "Technical Change, Inequality, and Labor Market," Journal of Economic Literature, March 2002, pp. 772.

Autor, David H., Katz, Lawrence F. and Kearney, Melissa S. "The Polarization of the U.S. Labor Market." American Economic Papers and Proceedings, 96(2), 2006, pp. 189-194

Autor, David H.; Katz, Lawrence F. and Kearney, Melissa S. "Trends in the U.S. Wage Inequality: Revising the Revisionists." The Review of Economics and Statistics, 90(2), 2008, pp. 300-323

Chen, B. L. and Hsu, M. Time-Series Wage Differential in Taiwan: The Role of International Trade. Review of Development Economics, 5(2), 2001, pp. 336-354

Chu, Cyrus C. Y. and Jiang, L. Demographic Transition, Family Struc-

ture, and Income Inequality. Review of Economics and Statistics, 79(4), 1997, pp. 665-669

Deaton, Angus S. and Paxson, Christina H. Intertemporal Choice and Inequality Journal of Political Economy, 102(3), 1994, pp. 437-467

Fei, John C. H.; Ranis, G. and Kuo, Shirley W. Y. Growth with Equity: The Taiwan Case. New York: Oxford University Press, 1979

Fernndez, Raquel and Joyce Cheng Wong. "The Disappearing Gender Gap: The Impact of Divorce, Wages, and Preferences on Education Choices and Women's Work" NBER Working Paper No. 17508.

Goldin, Claudia, Lawrence F. Katz, and Ilyana Kuziemko, 2006. "The Homecoming of American College Women: The Reversal of the College Gender Gap," Journal of Economic Perspectives, vol. 20(4), pages 133-156, Fall.

Goos, Maarten and Alan Manning, . "Lousy and Lovely Jobs: The Rising Polarization of Work in Britain," The Review of Economics and Statistics, 89(1), 2007, pp. 118-133.

Guvenen, Fatih and Burhanettin Kuruscu "Understanding the Evolution of the U.S. Wage Distribution: A Theoretical Analysis" Journal of European Economic Association, 2010, forthcoming.

Guvenen, Fatih and Burhanettin Kuruscu "A Quantitative Analysis of the Evolution of the U.S. Wage Distribution: 1970-2000" NBER Macroeconomics Annual, 2009, Volume 24, pp. 231-276.

Guvenen, Fatih and Burhanettin Kuruscu "A Quantitative Analysis of the Evolution of the U.S. Wage Distribution: 1970-2000," in NBER Macroeconomics Annual 2009, Volume 24 (2010), University of Chicago Press.

Heckman, James J. and Bo E. Honore "Th Empirical Content of the Roy

Model" Econometric 58(5) 1990, pp. 1121-1149.

Huang, F. M. (2011) "Human Capital and Wage Dynamics: Evidence from Taiwan." Taiwanese Economic Forecasting and Policies, 42(1): 1-37.

Juhn, Chinhui, Kevin M. Murphy, and Brooks Pierce (1993) "Wage inequality and the rise in returns to skill." *Journal of Political Economy* 101 (3): 41042.

Katz, Lawrence F., and David H. Autor (1999): Changes in the Wage Structure and Earnings Inequality, in Orley Ashenfelter and David Card, eds., Handbook of Labor Economics, Vol. 3A, Amsterdam: Elsevier-North Holland, pp. 1463-1555.

Kuznets, Simon S. Economic Development, the Family, and Income Distribution: Selected Essays. New York: Cambridge University Press, 1989.

Lemieux, Thomas Increasing Residual Wage Inequality: Composition Effects, Noisy Data, or Rising Demand for Skill? American Economic Review, 96(3), 2006, pp. 461-498

Lin, C.Y. and Chu Y. P. "Intertemporal changes in wage Income inequality in Taiwan: an application of factor analysis," Academia Economic Papers, 30(3), 2002, pp. 341-361

Luoh, M. C. "Gender Differences in Educational Attainment and International Marriages" Taiwan Economic Review, 34(1), 2006, pp. 79-115

Murphy, Kevin M., and Welch Finis R. *The Role of International Trade in Wage Differentials. In Workers and Their Wages: Changing Patterns in the United States,* Washington, D.C.: The AEI Press, 1991, pp. 39-69.

Pierce, Brooks "Recent Trends in Compensation Inequality," in *Labor in the New Economy* edited by Katharine G. Abraham, James R. Spletzer, and

Michael Harper; Chicago: University of Chicago Press, 2010, pp. 63 - 98.

Figure 1: Log hourly wage of full-time male and female workers, age 15-64

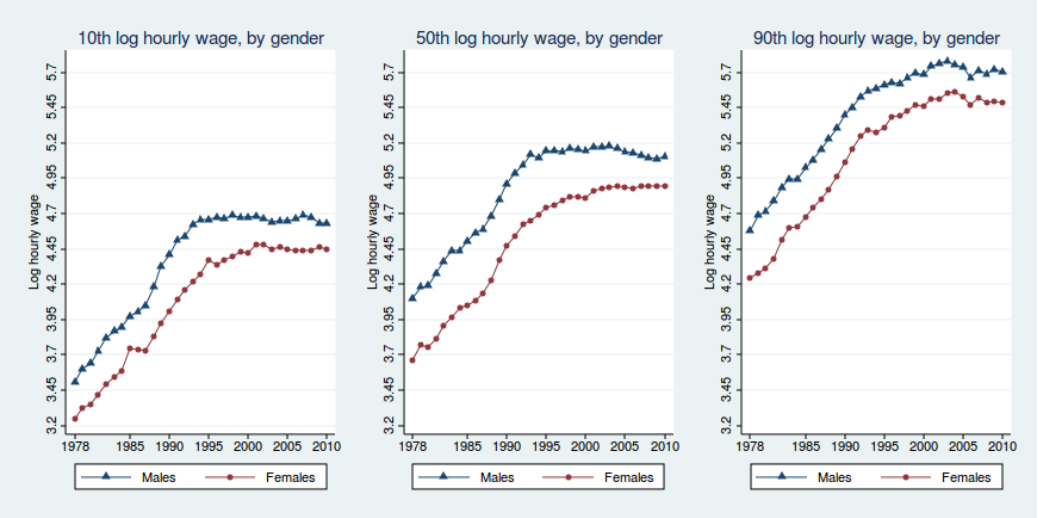

Figure 2: Log hourly wage ratios of male to female workers, by percentile

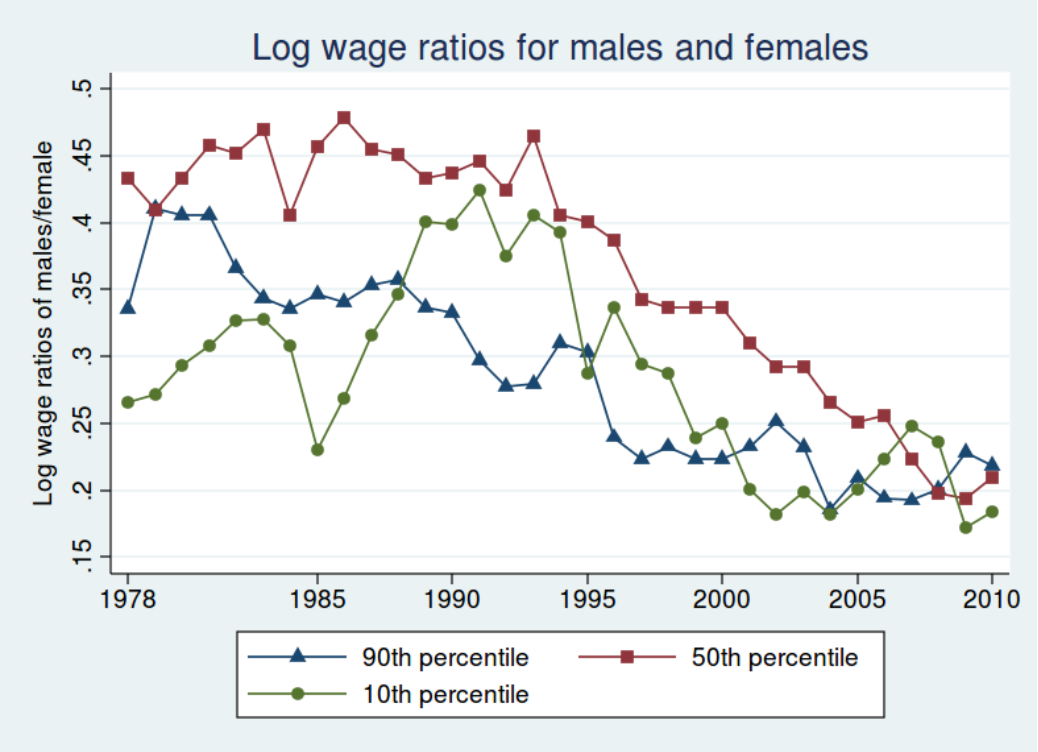

Figure 3: Log hourly 90/50 and 50/10 wage ratio

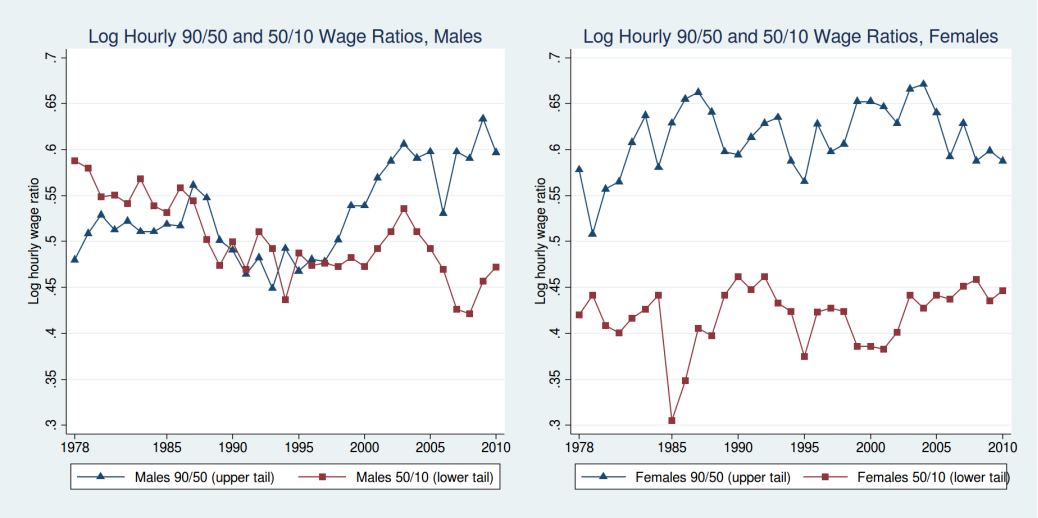

Figure 4: Within-cohort progression of log hourly wage

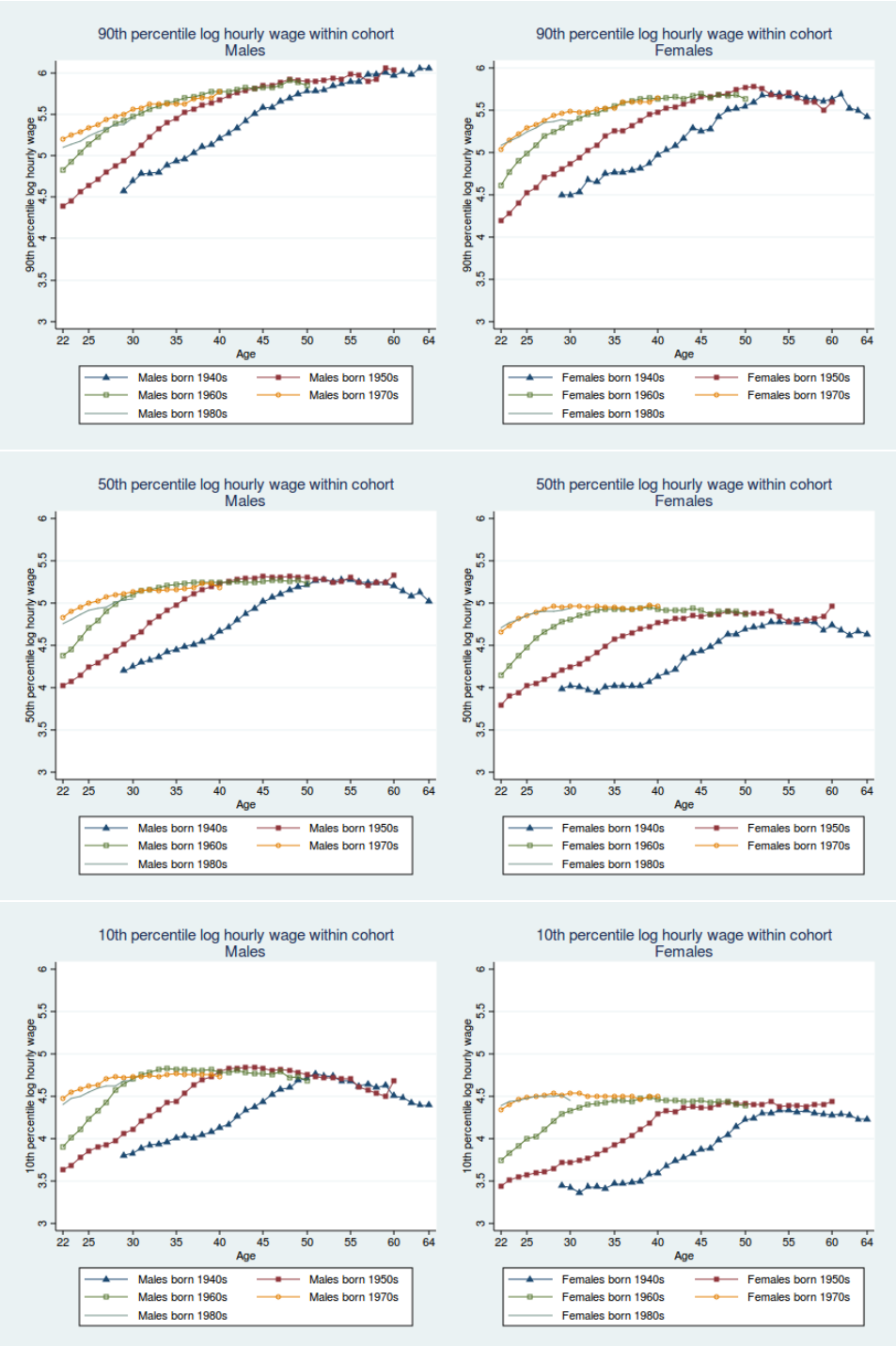

Figure 5: The number of academic high-school openings since WWII

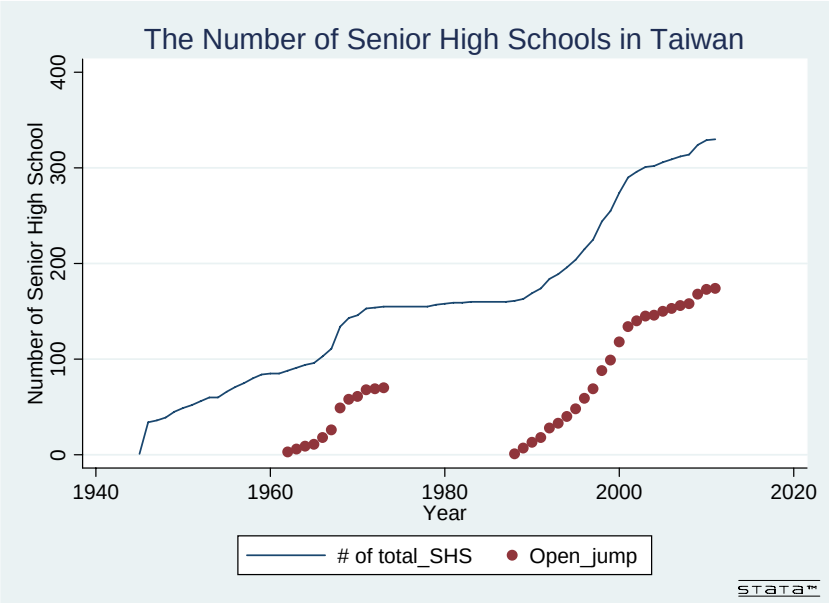

Figure 6: Educational wage differentials, by gender and education