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The gender wage gap and the early-career effect*

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Abstract

This paper identifies the sources of the gender wage gap across education groups and studies how the gap develops with work experience throughout the career. The analysis applies matched employer-employee register data for Norway covering hourly wages for all full-time workers 20-40 years old in 2008 and with information on actual work experience the previous 15 years. Overall, less than half the male wage premium is explained by differences in observable factors. The remaining gap follows from lower returns to worker characteristics for women, especially lower returns to experience. The gender wage gap between observable equal workers is non-existing upon entry to the labor market, while it increases rapidly throughout the early career, before stabilizing. The findings of early-career effects are robust to an analysis following cohorts during 1993-2008. The degree of gender discrimination in the labor market decreases with the level of education. Low educated women have lower returns to experience and lose more from entering family life compared to highly educated women.

JEL codes: J16, J31, J71

Key words: gender wage gap; return to experience; early-career effect; register data

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1. Introduction

On average, men earn higher wages than women. There is a huge literature on the sources of the aggregate gender wage gap, nicely surveyed by Altonji and Blank (1999) and Blau and Kahn (2000, 2016). A related (but smaller) literature considers how the gender wage gap evolves during the work career. In an analysis of West-German workers with apprenticeship training, Kunze (2005) finds a large gender wage gap upon entry to the labor market, which stays constant during the early career. I apply matched employer-employee register data for Norway to identify the sources of the male wage premium across education groups, and to study how the gap develops with work experience throughout the career. In contrast to Kunze (2005), I find a non-existing gender wage gap between observable equal workers when entering the labor market, which increases rapidly the first 10-15 years of the career, before stabilizing. The degree of gender discrimination in the labor market decreases with the level of education.

Gender segregation in the labor market and human capital differences are typically identified as the main explanatory factors of the male wage premium. Evidence based on US sample data is offered by Blau and Kahn (1997, 2007). They find that differences in worker characteristics account for about 60% of the observed gender wage gap, while 40% of the gap remains unexplained. Wood et al. (1993) focus on a more homogeneous group of workers; graduates from the University of Michigan Law School classes of 1972-75. They compare wages 15 years after graduation, and find a male wage premium of 13% when controlling for observable characteristics. Addabbo and Favaro (2011) and Mussida and Picchio (2014) analyze the gender wage gap across education groups in Italy. They use quantile regressions to investigate the evolution of the gap along the wage distribution, and find larger gap among low educated, especially in the lower end of the distribution.

A few analyses of the gender wage gap apply matched employer-employee data to compare wages among men and women with the same occupation working for the same employer. Based on Norwegian data for six private sectors in 1984 and 1990, Petersen et al. (1997) report male wage premiums of 2-6% for workers with the same occupation within the same establishment. The findings are based on simple calculations of average wages by gender

within occupation-establishment pairs, and do not control for worker heterogeneity. Meyersson Milgrom et al. (2001) do a similar analysis for Sweden. Regression-based evidence of the importance of segregation at the occupation-establishment level is offered by Bayard et al. (2003) for the US, Datta Gupta and Rothstein (2005) for Denmark, Korkeamäki and Kyyrä (2006) for Finland, and Amuedo-Dorantes and De la Rica (2006) for Spain. Although segregation in the labor market and worker heterogeneity explains a sizeable fraction of the gender wage gap, Bayard et al. (2003) find that almost half the male wage premium remains unexplained, indicating significant within-job wage discrimination.

The early-career effect in the aggregate gender wage gap is previously documented by Manning and Swaffield (2008) using a sample of workers included in the British Household Panel Study. However, their analysis is based on potential, rather than actual, work experience. In the early stages of the career, female workers often face interruptions in their work life with periods out of the labor force. Measures of potential work experience would in this case overestimate the experience of women. Bertrand et al. (2010) focus on highly educated workers in the US corporate and financial sectors and document rapid increases in the male wage premium during the early stages of the career for this group of workers. As mentioned above, contrarian evidence is offered by Kunze (2005).

The analysis in the present paper applies register data for Norway covering hourly wages for all full-time workers 20-40 years old in 2008 and with information on actual work experience the previous 15 years (measured in days based on work contracts). I study how the gender wage gap evolves with work experience throughout the early career, both aggregate and within four education groups; primary, secondary, short tertiary (1-3 years at college/university) and long tertiary (at least four years at college/university). Estimating the male wage premium within education groups implies less unobserved heterogeneity between workers. In addition, labor markets may differ across education groups, in particular low and high educated typically face different occupational choices. Family dynamics (like timing of child birth) might also differ between low and high educated and have consequences for the development of the gender wage gap along the career.

The dataset allows for a comparison of hourly wages of men and women working in the same firm with the same occupation, and with other characteristics equal (including work experience, level of education, and marital status). Women account for 40% of the observations, and have on average 12% lower hourly wages than men. To identify the sources of the observed male wage premium I use the Oaxaca-Blinder decomposition technique. Overall, less than half the male wage premium is explained by differences in observable factors, while the remaining gap follows from lower returns to worker characteristics for women, especially lower returns to experience. The gender wage gap between observable equal workers is non-existing upon entry to the labor market, while it increases rapidly throughout the early career, before stabilizing. The findings of early-career effects are robust to an analysis following cohorts during 1993-2008. The degree of gender discrimination in the labor market decreases with the level of education. Higher returns to work experience among male workers is especially prevalent in the lower education groups. In addition, entering family life seems to disadvantage low educated women relatively more than highly educated women.

The data and the econometric strategy are presented in section 2. Section 3 discusses the empirical results on the sources of the gender wage gap for all workers and for subgroups of workers defined by their level of education. The evolution of the gender wage gap during the work career is investigated in section 4. Section 5 offers concluding remarks.

2. Data and econometric strategy

This paper applies matched employer-employee register data on individual wages for all workers in Norway in 2008. The employment register links workers and firms and gives information on work contracts for all employees. It includes the number of days worked, the type of contract, and the number of hours worked per week. This is used to calculate the number of hours worked per year, which is combined with data on annual wage income from the tax register to give a measure of hourly wages. I concentrate on workers with full-time contracts (at least 30 hours per week).[1] The employment register has information on

[1] Workers with more than two contracts, as well as workers with one full time and one part time contract are excluded. Workers with two full time contracts are excluded if the number of days worked exceeds 455 days.

work contracts back to 1993, which is used to calculate full-time work experience and degree of labor mobility for each individual. As a measure of mobility, I use the number of job changes relative to the total number of years the individual has been in the labor force. Since data on work contracts is not available prior to 1993, the analysis focuses on workers with complete history of work experience (between 20 and 40 years old in 2008).

The final dataset includes about 500 000 workers, allocated to 94 330 different firms, 347 occupation groups and 56 sectors.[2] As seen from the descriptive statistics in Table 1, female workers account for 40% of the observations, and have on average 12% lower hourly wages than men (calculated as the log differential). I separate between four levels of education: primary (no more than compulsory schooling), secondary (at least one year of secondary education), tertiary short (1-3 years at college/university) and tertiary long (at least four years at college/university). Overall, 16% of workers have only primary education, 43% are secondary educated, while 29% and 12% have short and long higher education, respectively. Immigrants account for 16% of all full-time workers, and 47% of workers live in cities (defined as labor market regions with more than 150 000 inhabitants). The share of immigrants is similar among men and women, while a larger share of female workers are highly educated and located in cities. Work experience varies from 0 to 15 years and equals 6.4 years on average. Male workers have about one year longer experience than female workers, and also have higher degree of labor mobility. The sector composition is very different across genders, with almost half the women employed in the public sector (health care, education, public administration). Women are slightly older than male workers and are more likely to be married.[3]

Table 1 about here

This means that a maximum of 3 months overlap between the two contracts is allowed. To avoid extreme observations, I exclude individuals working less than 50 hours or more than 3500 hours per year. Similar, workers with hourly wage below 70 NOK or above 1250 NOK are also excluded.

[2] Workers in the primary sectors (agriculture, fishery and forestry) are excluded from the analysis.

[3] An individual is defined as married if he/she is currently married or has previously been married (divorced/widowed). Data on the number of children is not available, but the dummy for married can be seen as a proxy for the likelihood of having children.

The first part of the analysis (documented in section 3) estimates the gender wage gap between equally productive workers and identifies the sources of the gap. Individual hourly wages are regressed on a gender dummy while controlling for observable worker characteristics, as well as sector, occupation and firm fixed effects. The male wage premium is estimated for all workers, as well as for subgroups of workers defined by their level of education. The estimation is based on variations of the following regression:

$$\ln w_i = \alpha \cdot male_i + X_i\beta + \mu_s + \gamma_o + \eta_j + \varepsilon_i \quad (1)$$

where w_i is the hourly wage income for worker *i*, $male_i$ is a dummy that equals 1 if the worker is male, and α is the main parameter of interest. The vector of observable worker characteristics (X_i) includes dummies for age (5-year intervals), education level, immigrant status (native, western immigrant, non-western immigrant), resident location (city or not) and marital status (married or not), as well as measures of labor mobility and actual work experience since 1993. Sector, occupation and firm fixed effects are represented by μ_s, γ_o and η_j, respectively.[4] The error term is given by ε_i and β is a vector of parameters. The estimated male wage premium is thus based on a comparison of hourly wages of men and women who work in the same firm with the same occupation, who are equal with respect to years of work experience and degree of labor mobility, as well as other observable worker characteristics.

To identify the sources of the observed male wage premium I use the Oaxaca-Blinder decomposition technique, which runs separate regressions for males and females allowing observable characteristics to be rewarded differently across genders.[5] The decomposition separates between differences in worker characteristics and differences in returns to worker characteristics as sources of the gender wage gap:

[4] When firm fixed effects are included, sector fixed effects do not add any new information and are dropped from the regression.

[5] Based on the estimation in equation (1) the observed gender wage gap can be decomposed into an explained part due to differences in characteristics and an unexplained residual. However, this approach has its limitations compared to the Oaxaca-Blinder decomposition, because the relative importance of each characteristic in explaining the gap depends on the order in which they are introduced in the regression. In addition, the Oaxaca-Blinder approach is able to relate the unexplained part of the gap to differences in returns to characteristics.

$$\ln w^M - \ln w^F = \overline{X^M}\beta^M - \overline{X^F}\beta^F$$

$$= (\overline{X^M} - \overline{X^F})\beta^* + (\beta^M - \beta^*)\overline{X^M} + (\beta^* - \beta^F)\overline{X^F} \quad (2)$$

Superscripts *M* and *F* refer to male and female workers, respectively. Mean values of worker characteristics (including sector and occupation groups) are given by $\overline{X^M}$ for men and $\overline{X^F}$ for women. The average return to worker characteristics is estimated in a pooled model including both male and female workers and is given by β^*.[6] The predicted gender wage gap is given on the left hand side of equation (2), and can be decomposed into three terms. The first term identifies the part of the male wage premium that can be explained by differences in worker characteristics between male and female workers (evaluated at the average return to these characteristics). The second and third terms compare male and female returns to worker characteristics, respectively, to the average return (evaluated at the mean value of the characteristic for the respective gender). The sum of these two terms captures the contribution to the wage gap from differences in returns to worker characteristics, either as a male advantage or a female disadvantage, and is sometimes referred to as discrimination in the labor market. However, if relevant differences between the genders (for instance levels of ambition) are not controlled for, the extent of discrimination is overestimated. On the other hand, if gender differences in observable characteristics are themselves due to discrimination, the extent of discrimination is underestimated. This could for instance be the case if female workers face entry barriers into certain occupations or if lack of family friendly policies affects women's opportunities to participate in the labor market.

The second part of the analysis (documented in section 4) focuses on the evolution of the gender wage gap during the work career. As a first start, I extend the regression in equation (1) to include an interaction term between the gender dummy and work experience, and estimate the gender wage gap during the early stages of the career.[7] Since work history is not available prior to 1993, the analysis is limited to 20-40 years old workers and their first

[6] The pooled regression model includes the gender dummy, as suggested by Jann (2008).
[7] The main specification introduces experience as a quadratic function, but as a robustness check, experience is also represented by year-by-year dummies.

15 years of the career. To study how the male wage premium develops in the later stages of the career, I extend the dataset to include all workers between 20 and 64 years old (in total about 1 million observations), and estimate the gender wage gap for different age groups. In this estimation, work experience and degree of labor mobility are not included as control variables (since these variables have incomplete information for the older age groups). Finally, to check whether the findings from the 2008 data could be driven by differences between cohorts, I take advantage of the full dataset for the period 1993-2008. By following five-year cohorts over time (in 1993, 1998, 2003 and 2008), I can identify how the male wage premium develops at different stages of the career. The analysis is based on a total of 4.7 million observations, and uses daily wages as dependent variable (since hours worked per week is not available for the full period).

3. Sources of the gender wage gap

3.1 The aggregate gender wage gap

Among all full-time workers between 20 and 40 years old in Norway in 2008, men on average earn 12% higher hourly wages than women.[8] This is consistent with previous Norwegian studies (Petersen et al., 1997) and also comparable to international findings (see overview by Blau and Kahn, 2000). The gender wage gap can be due to differences in worker characteristics, including choice of workplace (sector, occupation, firm), or it can be due to differences in returns to these characteristics.

To estimate the gender wage gap between equal workers, I run hedonic wage regressions including a gender dummy, as described by equation (1) in section 2. The findings are documented in the first column of Table 2. Controlling for observable worker characteristics, as well as sector, occupation and firm fixed effects, reduces the gender wage gap to 6.5%. Comparing men and women working in the same firm with the same occupation, and with other characteristics equal (including work experience, level of education, and marital status) still leaves a male wage premium of 6.5%. This implies that less than half the raw

[8] Among all full-time workers aged 20-64 years old, men on average earn 16% more than women.

wage gap is explained by observable factors. The rest is due to different returns to characteristics between men and women.

To identify the sources of the gender wage gap, I use the Oaxaca-Blinder decomposition technique, as explained in relation to equation (2) in section 2. The decomposition is based on regressions without firm fixed effects, given in the last three columns of Table 2. The pooled regression controlling for worker characteristics, as well as sector and occupation fixed effects, gives a male wage premium of 7.6%, indicating that about 1/3 of the raw gap is explained by differences in worker characteristics across genders. The contribution from each characteristic is documented in the first column of panel a of Table 3. The main observable factor explaining the male wage premium is gender segregation in the labor market with respect to sector affiliation, which account for more than half the premium. Women are more likely to work in low-wage sectors. Almost half the female workers are employed in the public sector (public administration, education and health care), while typical high-wage sectors like business services, oil related sectors and transport sectors are dominated by male workers. Top female occupations include teacher, nurse, shop employee, secretary and office worker. Differences in work experience explain about 10% of the wage gap. On average, men have about one more year of experience than women. Gender differences in the level of education, on the other hand, favor women and work in the opposite direction. The male wage premium exists despite the fact that female full-time workers are better educated than men. More than half the female workers have higher education (short or long tertiary education), while only one third of men are tertiary educated. The other worker characteristics do not differ much across genders.

Table 2 and 3 about here

The remaining 2/3 of the male wage premium reflects differences in returns to worker characteristics, and can be seen as discrimination in the labor market (documented in the first column of panel b of Table 3). The dominating factor is work experience. As seen above, women have shorter experience than men, which explains some of the gap. But more importantly, the return to experience is much lower for female workers. One extra year of experience increases hourly wages by 2.1% and 0.8% for men and women, respectively

(calculated from the mean level of experience). While women are better educated than men, female workers face somewhat lower returns to education. A male worker with short tertiary education earns 18% more than a male worker with primary education. The same wage premium for female workers with short tertiary education is down at 16%. In addition, being married adds 4% to male wages, compared to 1% to female wages.

To check whether the large share of female workers employed in the public sector drives the findings above, I do the same analysis separately for private and public employees. The hedonic wage regressions are documented in Appendix Table 1, while the corresponding decompositions of the gender wage gaps are given in the two last columns of Table 3. Excluding public sector workers leaves about 370 000 observations with female workers accounting for 30%. The size of the raw gender wage gap is still 12%, but a smaller share of the gap is explained by differences in characteristics between men and women (down from 1/3 to 13%). Not surprisingly, gender segregation in the labor market is dominated by the public sector, where wages on average are lower than in the private sector. Without public employees, sector affiliation explains less than 20% of the male wage premium. The other findings remain, and are not affected by the exclusion of public employees. In particular, lower return to work experience among women is still the dominating factor, and is not a public sector phenomenon. Female private sector workers are better educated than men, while receiving lower returns to education. The return to being married is still much lower for women.

When considering the public sector separately, the male wage premium is lower (around 8%) and as much as 85% of the gap is explained by differences in observable characteristics between the genders. The dominating factor contributing to the gap is occupation group. Female workers in the public sector are more likely to have low-wage occupations. When firm fixed effects are included, the male wage premium is entirely explained by differences in characteristics. In the public sector, men and women working in the same firm with the same occupation and with other characteristics equal, basically earn the same wage. More comprehensive analysis of the differences between the private and the public sector is offered by Rattsø and Stokke (2016).

3.2 The gender wage gap within education groups

The analysis is extended by considering possible heterogeneity across the four education groups. Separate wage regressions for men and women by level of education are documented in Appendix Table 2, while the corresponding Oaxaca-Blinder decompositions are given in Table 4. The raw unadjusted gender wage gap varies from 12% in the lowest and highest education groups to 20% among workers with secondary education. The share of the wage gap explained by differences in observable factors increases with the level of education. Among workers with short or long tertiary education, differences in worker characteristics explain almost 2/3 of the male wage premium. Women are more likely to work in low-wage sectors and low-wage occupations (typically in the public sector), and have shorter work experience. Gender segregation in the labor market is also the dominating factor among low educated, but only 40% of the wage gap between primary educated workers is accounted for by observable factors.

Table 4 about here

This implies that the degree of gender discrimination in the labor market decreases with the level of education. The gender wage gap between observable equal workers is twice as high among secondary educated as among workers with long tertiary education (10% vs. 5%). Lower return to work experience for women is dominating at all levels of education, but especially among low educated. One extra year of experience increases hourly wages of low educated women (primary and secondary) by 0.5% – 0.8%, compared to 2.2% for highly educated women (calculated from the mean level of experience). Being married adds about 4% to male wages independent of the level of education. For women, the wage effect from marriage depends on the level of education and varies from zero among low educated to 2.5% for women with long tertiary education. Entering family life seems to disadvantage low educated women relatively more than highly educated women. Excluding public sector workers do not alter these findings.

4. The gender wage gap during the career

Motivated by the large differences in returns to work experience between men and women, I analyze the evolution of the male wage premium during the work career. As a first start, the dataset of all workers aged 20-40 years old in 2008 with complete history of work experience is applied to study the gender wage gap in the early stages of the career. Table 5 documents regressions with interaction terms between the male dummy and work experience, while controlling for worker characteristics (including degree of labor mobility and marital status) as well as sector, occupation and firm fixed effects. Based on the estimated coefficients in the first column, Figure 1 illustrates the development of the aggregate male wage premium during the first 15 years of the career. Consider a male and female worker with the same level of education, working in the same firm, with the same occupation, and with other characteristics equal. Upon entry to the labor market, the two workers have about equal hourly wages (actually a small female advantage), while after 5 years of work experience the male worker has a wage premium of 7%, which increases further to 11% after 10 years, and then stabilizing. As a robustness check, I apply a more flexible functional form with year-by-year experience dummies, rather than the quadratic experience function. The estimation is given in the first column of Appendix Table 3, and the findings are consistent (as seen from the dotted line in Figure 1).

Table 5 and Figure 1 about here

The last four columns of Table 5 offer an analysis of the early-career effect within each education group. For low educated workers (primary or secondary educated), the pattern of the male wage premium is similar to the aggregate findings. The gender wage gap between observable equal workers is low when entering the labor market, increases rapidly the first 10 years, and then stabilizes at around 12%. For workers with tertiary education, female wages are higher than male wages the first couple of years of the career. The return to experience is higher for men, and the gender wage gap increases gradually over time, without any clear sign of stabilizing. Estimation with year-by-year experience dummies (documented in Appendix Table 3) confirms these patterns.

The broad picture is that wage differences between observable equal men and women are non-existing when entering the labor market, while the male wage premium increases rapidly during the first 10-15 years of the career. This pattern is prevalent both aggregate and within education groups. The increase during the early career can be due to gender discrimination in the labor market, or follow from for instance changes in family situation (beyond marital status) that affect men and women differently, gender differences in levels of ambition or due to differences in unobserved abilities that are revealed over time. The early-career effect in the gender wage gap documented above is consistent with Manning and Swaffield (2008) and Bertrand et al. (2010), but contrasts the results by Kunze (2005). She applies West-German data and finds a large gender wage gap upon entry to the labor market which stays constant throughout the early career.

The complete dataset of all full-time workers aged 20-64 years old in 2008 is applied to analyze the evolution of the male wage premium in later stages of the career. This includes about 1 million observations with 40% female workers. Since work experience prior to 1993 is not available I do not have the complete work history of older workers. To identify the gender wage gap at different stages of the career, I use age as a proxy, and divide the dataset into 5-year age groups. For each of the four levels of education, the raw unadjusted gender wage gap increases rapidly throughout the early career, while it stabilizes for workers above 40 years old (also among tertiary educated). To investigate if this life-cycle effect can be accounted for by different developments in observable characteristics, I estimate the gender wage gap within each 5-year age group while controlling for worker characteristics as well as sector, occupation and firm fixed effects.[9] On average across age groups, differences in observable characteristics explain about 50% of the gap among primary and secondary educated and 2/3 of the gap among tertiary educated. Consistent with the findings in Table 4, the degree of gender discrimination in the labor market decreases with the level of education and the gender wage gap between observable equal workers is lowest for highly educated.

Figure 2 about here

[9] Work experience and degree of labor mobility are not included as controls in these regressions since data is incomplete for older workers.

The development in the adjusted male wage premium along the course of the career is illustrated in Figure 2. The gender wage gap between observable equal workers is low when entering the labor market, while it increases rapidly during the early career, before stabilizing or slightly decreasing among workers above 40 years old. Among primary educated, the male wage premium increases from 1.8% in the youngest age group (20-24 years old), via 5.3% and 8.6% in the next two age groups (25-29 and 30-34 years old), to 10.3% among workers 35-39 years old. For older age groups, the gap remains stable at around 10%. The pattern is similar for workers with secondary education. Among tertiary educated, the male wage premium remains low for the two youngest age groups (25-29 and 30-34 years old), before increasing rapidly the next 10 years, and then stabilizing. The 'delay' in the wage gap increase among highly educated could possibly reflect different family dynamics compared to low educated (highly educated women typically have children later in life).

As indicated above, smaller gender wage gap among young workers can reflect a career effect, where wage differences between men and women vary during the course of their career. The alternative understanding is that wage differences between genders increase with age because of differences between cohorts. Each new cohort entering the labor market faces better conditions than the previous one (with respect to degree of discrimination, family policies etc.), and thus the gender wage gap is smallest for the youngest workers. To separate between career and cohort effects I take advantage of register data for all full-time workers in Norway during 1993-2008 to follow the same cohorts over several years. I focus on 5-year cohorts and estimate gender wage gaps for the years 1993, 1998, 2003 and 2008. The analysis is based on a total of 4.7 million observations, and uses daily wages as dependent variable.[10] Data on occupation group and firm affiliation is not available for the full period, which implies that the estimated wage gaps are biased upwards, but the changes over time can shed some light on important mechanisms. The main finding is that the career effect is significant and consistent with the pattern in Figure 2.

[10] The number of workers in each cohort can vary over time, as workers enter and leave the labor market and change education category.

The estimated male wage premium for different cohorts during 1993-2008 is documented in Appendix Table 4, separating between four education categories. Each number in the table corresponds to the estimated coefficient on the male dummy in a wage regression controlling for immigrant status, resident location and sector fixed effects. The development in the male wage premium for a given 5-year cohort is seen along the respective diagonal in the table. For instance, in 1993, the estimated male wage premium for the youngest workers with short higher education (25-29 years old) equals 4.8%. Five years later, the same cohort (now 30-34 years old) has a male wage premium of 11.6%. In 2003, the premium has increased to 16% and then it seems to stabilize and remains at 16% also in 2008 when this cohort is 40-44 years old. For older cohorts, the gender wage gap is typically stable or decreasing over time. The broad picture is a rapidly increasing gender wage gap in the early stages of the career, which stabilizes or decreases later in the career (typically among workers above 40 years old). This pattern is common to all education groups. There is also some evidence of between cohort effects in the sense that the gender wage gap is typically lower in 2008 than in 1993 for all age groups.

The development in the estimated gender wage gap during 1993-2008 for six different cohorts with primary education is illustrated in Figure 3. The youngest cohort is born in 1969-73 and is observed as 20-24 years old in 1993, 25-29 years old in 1998, 30-34 years old in 2003 and 35-39 years old in 2008. The cohort consists of about 33 000 workers the two first years, which decreases to 28 000 in 2003 and 2008. The adjusted gender wage gap increases from 6% in 1993, via 14% in 1998 to about 16% in 2003 and 2008. The oldest cohort is born in 1944-48, and consists of 34 000 workers aged 45-49 in 1993, gradually decreasing to 15 000 workers aged 60-64 in 2008. The decrease in the number of workers is likely due to early retirement. The estimated gender wage gap equals 21% in 1993, decreases to 16% in 1998 and remains stable at 16% the next ten years. The other education groups show similar patterns within cohorts over time (illustrations available from the author).

Figure 3 about here

5. Concluding remarks

This paper offers an analysis of the gender wage gap across education groups, with particular focus on how the gap develops with work experience throughout the career. The analysis applies matched employer-employee register data for Norway covering hourly wages for all full-time workers 20-40 years old in 2008 and with information on actual work experience the previous 15 years. The dataset allows for a comparison of hourly wages of men and women working in the same firm with the same occupation, and with other characteristics equal. Women account for 40% of the observations, and have on average 12% lower hourly wages than men. To identify the sources of the observed male wage premium I use the Oaxaca-Blinder decomposition technique. Overall, less than half the male wage premium is explained by differences in observable factors, while the remaining gap follows from lower returns to worker characteristics for women, especially lower returns to experience. The gender wage gap between observable equal workers is non-existing upon entry to the labor market, while it increases rapidly throughout the early career, before stabilizing. This pattern is prevalent both aggregate and within education groups. The findings of early-career effects are robust to an analysis following cohorts during 1993-2008.

The degree of gender discrimination in the labor market decreases with the level of education. Men receive larger returns to work experience, especially in the lower education groups. In addition, entering family life seems to disadvantage low educated women relatively more than highly educated women. Future analysis should pursue these issues in more detail by studying how the timing of child birth and number of children affect the evolution of the gender wage gap throughout the early career, and in particular consider differences between low and high educated women.

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Fig. 1: Adjusted male wage premium during the early career, 2008 data, 20-40 years old

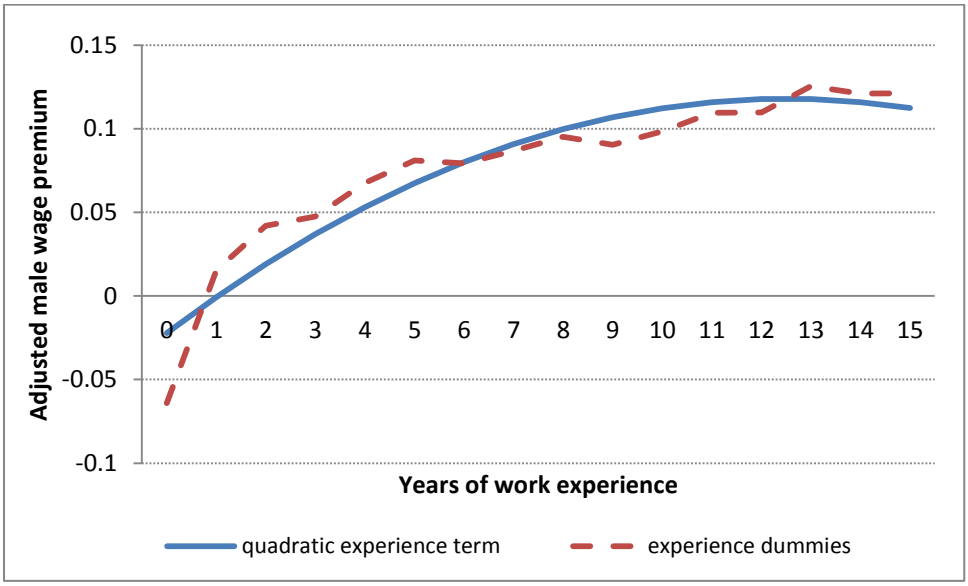

Fig. 2: Adjusted male wage premium different age groups, 2008 data, 20-64 years old

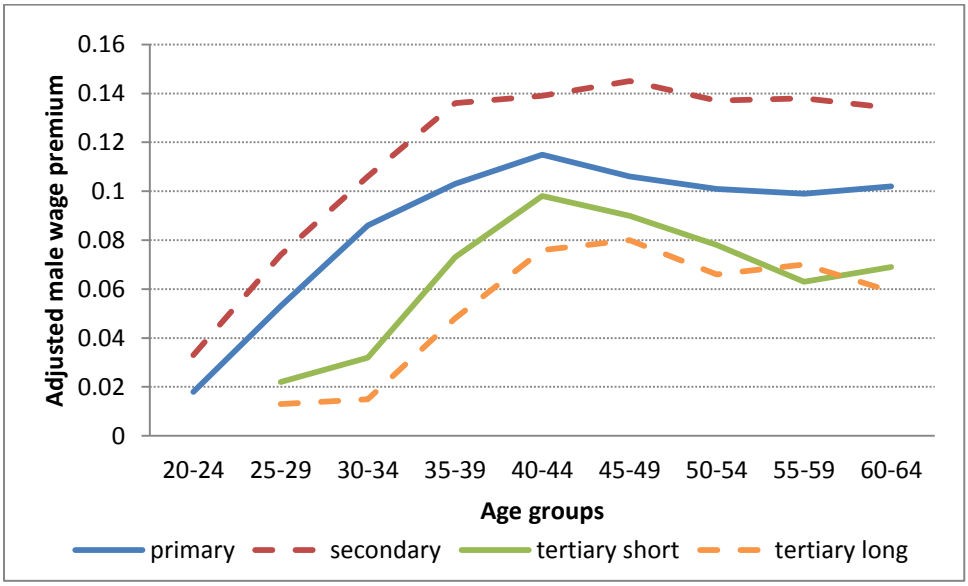

Fig. 3: Adjusted male wage premiums, 1993-2008, six cohorts of primary educated workers

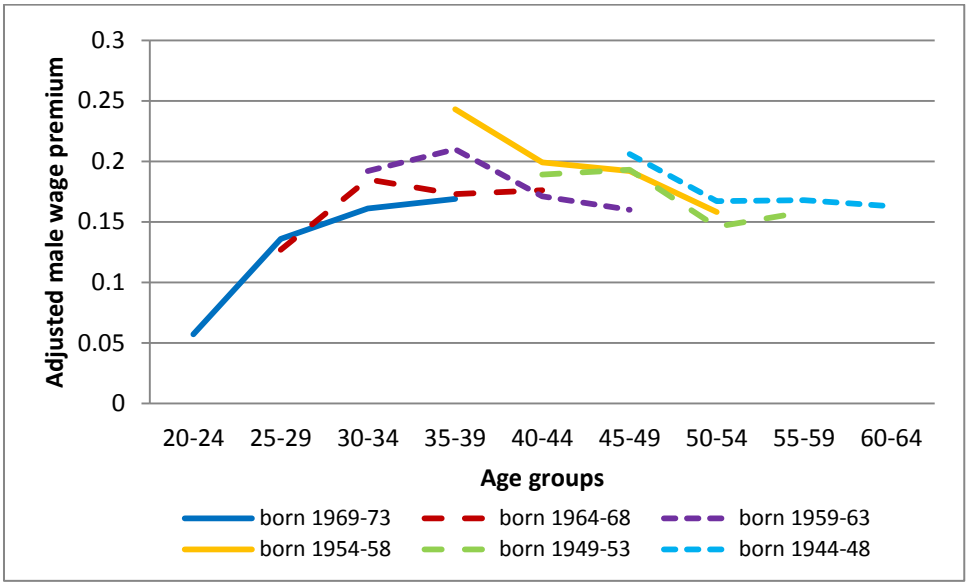

Table 1: Descriptive statistics

Panel a

	MEN		WOMEN	
	Mean	St dev	Mean	St dev
Log hourly wage (in NOK)	5.44	0.38	5.32	0.40
Work experience since 1993 (in years)	6.8	4.6	5.7	4.1
Labor mobility	0.12	0.16	0.09	0.16

Panel b

	Share of observations		
	All	Men	Women
All workers	1	0.60	0.40
Primary education	0.16	0.19	0.12
Secondary education	0.43	0.49	0.34
Tertiary education short	0.29	0.21	0.41
Tertiary education long	0.12	0.11	0.14
Immigrant	0.16	0.15	0.16
Immigrant, western	0.11	0.10	0.11
Immigrant, non-western	0.05	0.05	0.05
City resident	0.47	0.45	0.51
Married	0.38	0.34	0.44
Age 20-24	0.12	0.14	0.08
Age 25-29	0.22	0.22	0.22
Age 30-34	0.28	0.27	0.30
Age 35-40	0.38	0.37	0.40
Public employee	0.26	0.13	0.46

Notes: Work experience is calculated in days from 1993 onwards, and expressed in years. Secondary education corresponds to workers that have completed at least one year of secondary education, short tertiary education includes workers with 1-3 years at university/college, and long tertiary education corresponds to at least 4 years at university/college. Western immigrants are defined as immigrants from Europe, Japan, North America, Australia or New Zealand. The city group is defined as labor market regions with more than 150 000 inhabitants in 2008, which includes 7 out of 89 regions. Public employees belong to the three sectors public administration, health care and education.

Table 2: Hedonic wage regressions, pooled and separately for men and women

Dependent variable	Log hourly wage	Log hourly wage	Log hourly wage	Log hourly wage
Gender	All	All	Men	Women
Male	0.065***	0.076***		
	(0.0012)	(0.0012)		
Secondary education	0.06***	0.07***	0.075***	0.048***
	(0.0015)	(0.0014)	(0.0016)	(0.0027)
Tertiary education short	0.141***	0.176***	0.18***	0.161***
	(0.002)	(0.0019)	(0.0022)	(0.0033)
Tertiary education long	0.2***	0.257***	0.257***	0.244***
	(0.0025)	(0.0024)	(0.0029)	(0.0042)
Experience	0.028***	0.026***	0.041***	0.011***
	(0.0004)	(0.0004)	(0.0005)	(0.0007)
$(\text{Experience})^2$	-0.001***	-0.0008***	-0.0016***	-0.0002***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Immigrant, western	-0.005***	-0.002	-0.000	-0.003
	(0.0015)	(0.0015)	(0.0018)	(0.0025)
Immigrant, non-western	-0.02***	-0.02***	-0.013***	-0.023***
	(0.0023)	(0.0023)	(0.0028)	(0.0038)
City resident	0.007***	0.035***	0.035***	0.037***
	(0.0016)	(0.001)	(0.0012)	(0.0016)
Mobility	0.006**	0.046***	0.039***	0.044***
	(0.0029)	(0.0029)	(0.0034)	(0.0051)
Married	0.027***	0.029***	0.039***	0.011***
	(0.0011)	(0.001)	(0.0013)	(0.0017)
Age controls	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes
Occupation fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	No	No	No
Obs.	504 140	504 140	302 999	201 141
Adjusted R^2	0.45	0.33	0.38	0.25

Notes: The regressions are based on 2008 data of all full-time workers aged 20-40 in Norway. Age controls are given as 5-year intervals. Labor mobility is measured as the number of job changes relative to the total number of years the individual has been in the labor force. The dummy for married equals 1 if the individual is married, divorced or widowed. Sector fixed effects are at the 2-digit level and include 56 sectors. Occupation fixed effects are at the 4-digit level and include 347 occupations. Firm fixed effects correspond to 94 330 distinct firms. Further definitions of the included variables are given in the notes to Table 1. Standard errors are given in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percent level, respectively. All regressions include a constant term.

Table 3: Oaxaca-Blinder decomposition of the gender wage gap

	ALL EMPLOYEES	PRIVATE EMPLOYEES	PUBLIC EMPLOYEES
Predicted male-female wage gap	0.116	0.118	0.078
Panel a: Explained by differences in characteristics			
Education	-0.032	-0.023	0.005
Experience	0.014	0.014	0.005
Immigrant status	0.000	0.000	0.000
City resident	-0.002	-0.004	0.000
Mobility	0.001	0.001	0.000
Married	-0.003	-0.003	-0.001
Age	-0.004	-0.001	0.000
Sector	0.061	0.021	0.004
Occupation	0.004	0.01	0.053
Total	0.04	0.015	0.066
	(34%)	(13%)	(85%)
Panel b: Explained by differences in returns			
Education	0.018	0.022	-0.023
Experience	0.104	0.084	0.041
Immigrant status	0.001	0.000	0.001
City resident	-0.001	-0.01	-0.005
Mobility	-0.001	-0.002	0.000
Married	0.011	0.014	0.003
Age	-0.018	-0.018	0.012
Sector	-0.021	-0.004	-0.01
Occupation	-0.002	0.002	0.032
Constant	-0.016	0.014	-0.039
Total	0.076	0.103	0.012

Notes: The decomposition of the gender wage gap is based on separate wage regressions for male and female workers given in Table 2 (for all employees) and Appendix Table 1 (for private and public employees separately).

Table 4: Oaxaca-Blinder decomposition of the gender wage gap by education group

	Primary	Secondary	Tertiary short	Tertiary long
Predicted male-female wage gap	0.128	0.202	0.164	0.124
Panel a: Explained by differences in characteristics				
Experience	0.006	0.012	0.012	0.02
Immigrant status	0.000	0.000	-0.000	-0.000
City resident	-0.001	-0.003	0.002	-0.000
Mobility	0.003	0.001	0.001	0.000
Married	-0.005	-0.002	-0.001	-0.001
Age	-0.004	-0.001	0.001	0.002
Sector	0.051	0.055	0.067	0.05
Occupation	0.000	0.041	0.024	0.007
Total	0.05	0.103	0.106	0.078
	(39%)	(51%)	(65%)	(63%)
Panel b: Explained by differences in returns				
Experience	0.082	0.113	0.08	0.043
Immigrant status	0.002	-0.001	0.001	0.002
City resident	-0.002	-0.001	0.007	0.007
Mobility	0.002	-0.003	-0.003	-0.003
Married	0.014	0.015	0.01	0.007
Age	-0.011	-0.012	0.003	0.017
Sector	-0.017	-0.013	-0.043	-0.047
Occupation	0.008	-0.001	-0.019	0.008
Constant	-0.002	0.001	0.022	0.012
Total	0.077	0.099	0.058	0.046

Notes: The decomposition of the gender wage gap is based on separate wage regressions for male and female workers given in Appendix Table 2.

Table 5: The gender wage gap during the early career

Dependent variable	Log hourly wage	Log hourly wage	Log hourly wage	Log hourly wage	Log hourly wage
Education group	All	Primary	Secondary	Tertiary short	Tertiary long
Male	-0.022***	0.001	0.012***	-0.032***	-0.018***
	(0.0024)	(0.0071)	(0.0045)	(0.0047)	(0.006)
Experience	0.017***	0.014***	0.007***	0.007***	0.027***
	(0.0006)	(0.0024)	(0.0012)	(0.0012)	(0.0019)
$(\text{Experience})^2$	-0.0007***	-0.0006***	-0.0001*	0.0000	-0.0008***
	(0.0000)	(0.0002)	(0.0001)	(0.0001)	(0.0001)
Experience x Male	0.022***	0.02***	0.02***	0.015***	0.01***
	(0.0008)	(0.0026)	(0.0013)	(0.0016)	(0.0023)
$(\text{Experience})^2$ x Male	-0.0009***	-0.0008***	-0.0008***	-0.0002*	-0.0001
	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0002)
Education controls	Yes	No	No	No	No
Immigrant status	Yes	Yes	Yes	Yes	Yes
Resident location	Yes	Yes	Yes	Yes	Yes
Mobility	Yes	Yes	Yes	Yes	Yes
Marital status	Yes	Yes	Yes	Yes	Yes
Age controls	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes
Occupation FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Obs.	504 140	82 399	217 197	144 476	60 068
Adjusted R^2	0.45	0.37	0.44	0.37	0.49

Notes: Explanatory variables are defined in the notes to Table 2. Standard errors are given in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percent level, respectively. All regressions include a constant term.

Appendix Table 1: Hedonic wage regressions, separately for private and public employees

	PRIVATE EMPLOYEES			PUBLIC EMPLOYEES		
Dependent variable	Log hourly wage	Log hourly wage	Log hourly wage	Log hourly wage	Log hourly wage	Log hourly wage
Gender	All	Men	Women	All	Men	Women
Male	0.103***			0.011***		
	(0.0014)			(0.0021)		
Secondary education	0.067***	0.072***	0.043***	0.061***	0.075***	0.053***
	(0.0015)	(0.0016)	(0.0033)	(0.0039)	(0.006)	(0.005)
Tertiary education	0.181***	0.185***	0.157***	0.155***	0.132***	0.168***
short	(0.0021)	(0.0024)	(0.004)	(0.0045)	(0.0067)	(0.0059)
Tertiary education	0.269***	0.267***	0.254***	0.22***	0.191***	0.238***
long	(0.0027)	(0.0031)	(0.0054)	(0.0053)	(0.0076)	(0.007)
Experience	0.037***	0.046***	0.021***	0.005***	0.013***	0.003***
	(0.0005)	(0.0006)	(0.001)	(0.0008)	(0.0013)	(0.001)
$(\text{Experience})^2$	-0.0014***	-0.0019***	-0.0007***	0.0000	-0.0003***	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0000)
Immigrant, western	-0.001	-0.001	-0.001	-0.002	0.002	-0.004
	(0.0017)	(0.002)	(0.0034)	(0.0028)	(0.0042)	(0.0035)
Immigrant, non-	-0.018***	-0.013***	-0.02***	-0.02***	-0.011*	-0.025***
western	(0.0026)	(0.0031)	(0.0052)	(0.0043)	(0.0064)	(0.0054)
City resident	0.044***	0.039***	0.058***	0.011***	0.004	0.014***
	(0.0011)	(0.0013)	(0.0023)	(0.0018)	(0.0027)	(0.0022)
Mobility	0.047***	0.039***	0.056***	0.023***	0.018**	0.021***
	(0.0033)	(0.0037)	(0.0068)	(0.0058)	(0.0086)	(0.0075)
Married	0.033***	0.043***	0.008***	0.017***	0.019***	0.014***
	(0.0012)	(0.0014)	(0.0024)	(0.0018)	(0.0029)	(0.0023)
Age controls	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Occupation FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	No	No	No	No
Obs.	371 582	263 306	108 276	132 558	39 693	92 865
Adjusted R^2	0.36	0.38	0.28	0.27	0.40	0.23

Notes: Explanatory variables are defined in the notes to Table 2. Standard errors are given in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percent level, respectively. All regressions include a constant term.

Appendix Table 2: Separate wage regressions for men and women by education group

Dependent variable	Log hourly wage	Log hourly wage	Log hourly wage	Log hourly wage
Education group	Primary	Secondary	Tertiary short	Tertiary long
Panel a: Men				
Experience	0.039***	0.029***	0.023***	0.036***
	(0.0013)	(0.0009)	(0.0013)	(0.0017)
$(Experience)^2$	-0.0016***	-0.001***	-0.0003***	-0.0007***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Immigrant, western	-0.003	-0.005**	0.002	0.013***
	(0.0043)	(0.0027)	(0.004)	(0.0046)
Immigrant, non-western	0.000	-0.019***	-0.033***	-0.032***
	(0.0052)	(0.0045)	(0.0067)	(0.0075)
City resident	0.011***	0.032***	0.058***	0.044***
	(0.0029)	(0.0016)	(0.0025)	(0.0035)
Mobility	0.082***	0.025***	0.02***	-0.008
	(0.0074)	(0.0051)	(0.0075)	(0.009)
Married	0.046***	0.036***	0.039***	0.039***
	(0.0037)	(0.0018)	(0.0026)	(0.0034)
Age controls	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes
Occupation fixed effects	Yes	Yes	Yes	Yes
Obs.	58 714	149 115	62 740	32 430
Adjusted R^2	0.25	0.29	0.34	0.44
Panel b: Women				
Experience	0.011***	-0.001	0.004***	0.025***
	(0.0022)	(0.0013)	(0.0012)	(0.0022)
$(Experience)^2$	-0.0003**	0.0004***	0.0003***	-0.0003*
	(0.0002)	(0.0001)	(0.0001)	(0.0002)
Immigrant, western	-0.000	0.003	-0.009**	-0.004
	(0.0075)	(0.0045)	(0.0038)	(0.0055)
Immigrant, non-western	-0.025***	-0.014**	-0.034***	-0.017***
	(0.0086)	(0.0067)	(0.0068)	(0.0096)
City resident	0.015***	0.035***	0.045***	0.033***
	(0.0051)	(0.0028)	(0.0024)	(0.0044)
Mobility	0.054***	0.05***	0.042***	0.016
	(0.0161)	(0.0098)	(0.0076)	(0.011)
Married	0.006	-0.005	0.017***	0.025***
	(0.0058)	(0.003)	(0.0025)	(0.0042)
Age controls	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes
Occupation fixed effects	Yes	Yes	Yes	Yes
Obs.	23 685	68 082	81 736	27 638
Adjusted R^2	0.12	0.15	0.13	0.27

Notes: Explanatory variables are defined in the notes to Table 2. Standard errors are given in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percent level, respectively. All regressions include a constant term.

Appendix Table 3: The gender wage gap during the early career, year-by-year experience terms

Dependent variable	Log hourly wage	Log hourly wage	Log hourly wage	Log hourly wage	Log hourly wage
Education group	All	Primary	Secondary	Tertiary short	Tertiary long
Male	-0.064***	-0.028***	-0.051***	-0.04***	-0.008
	(0.0033)	(0.009)	(0.0067)	(0.0067)	(0.0083)
1 year of experience x Male	0.079***	0.071***	0.103***	0.028***	0.002
	(0.0044)	(0.0123)	(0.0087)	(0.009)	(0.0114)
2 years of experience x Male	0.106***	0.085***	0.123***	0.041***	0.006
	(0.0045)	(0.0134)	(0.0088)	(0.0091)	(0.0114)
3 years of experience x Male	0.112***	0.093***	0.126***	0.054***	0.004
	(0.0046)	(0.0145)	(0.0089)	(0.0093)	(0.0117)
4 years of experience x Male	0.132***	0.104***	0.142***	0.069***	0.025**
	(0.0047)	(0.0152)	(0.009)	(0.0095)	(0.0119)
5 years of experience x Male	0.145***	0.114***	0.151***	0.091***	0.036***
	(0.0048)	(0.016)	(0.009)	(0.0095)	(0.0121)
6 years of experience x Male	0.143***	0.133***	0.163***	0.072***	0.054***
	(0.0048)	(0.016)	(0.009)	(0.0093)	(0.0123)
7 years of experience x Male	0.151***	0.129***	0.157***	0.094***	0.064***
	(0.0049)	(0.0167)	(0.009)	(0.0095)	(0.0125)
8 years of experience x Male	0.159***	0.107***	0.161***	0.114***	0.096***
	(0.005)	(0.0177)	(0.0091)	(0.0096)	(0.0131)
9 years of experience x Male	0.154***	0.136***	0.154***	0.115***	0.068***
	(0.0051)	(0.0185)	(0.0092)	(0.0099)	(0.0133)
10 years of experience x Male	0.163***	0.128***	0.162***	0.136***	0.063***
	(0.0052)	(0.0198)	(0.0092)	(0.0101)	(0.0138)
11 years of experience x Male	0.174***	0.149***	0.169***	0.149***	0.108***
	(0.0054)	(0.0208)	(0.0094)	(0.0106)	(0.0148)
12 years of experience x Male	0.174***	0.131***	0.173***	0.152***	0.089***
	(0.006)	(0.0222)	(0.0095)	(0.0114)	(0.017)
13 years of experience x Male	0.19***	0.145***	0.177***	0.184***	0.1***
	(0.006)	(0.0216)	(0.0096)	(0.0127)	(0.0212)
14 years of experience x Male	0.185***	0.168***	0.179***	0.16***	0.09***
	(0.0064)	(0.0222)	(0.0098)	(0.0148)	(0.0275)
15 years of experience x Male	0.185***	0.168***	0.169***	0.172***	0.113***
	(0.0066)	(0.0214)	(0.0097)	(0.0192)	(0.0435)
Education controls	Yes	No	No	No	No
Experience dummies	Yes	Yes	Yes	Yes	Yes
Immigrant status	Yes	Yes	Yes	Yes	Yes
Resident location	Yes	Yes	Yes	Yes	Yes
Mobility	Yes	Yes	Yes	Yes	Yes
Marital status	Yes	Yes	Yes	Yes	Yes
Age controls	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes
Occupation FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Obs.	504 140	82 399	217 197	144 476	60 068
Adjusted R^2	0.45	0.37	0.44	0.37	0.49

Notes: Explanatory variables are defined in the notes to Table 2. Standard errors are given in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percent level, respectively. All regressions include a constant term.

Appendix Table 4: Cohort analysis 1993-2008 by education group

Primary	Adjusted gender wage gap			
	1993	1998	2003	2008
Age group				
20-24	0.057	0.029	0.038	0.026
25-29	0.127	0.136	0.093	0.059
30-34	0.192	0.185	0.161	0.148
35-39	0.243	0.21	0.173	0.169
40-44	0.189	0.199	0.171	0.176
45-49	0.206	0.193	0.192	0.16
50-54	0.193	0.167	0.146	0.158
55-59	0.187	0.199	0.168	0.158
60-64	0.17	0.165	0.183	0.163
Secondary	Adjusted gender wage gap			
	1993	1998	2003	2008
Age group				
20-24	0.017	0.056	0.01[1]	0.042
25-29	0.118	0.128	0.098	0.099
30-34	0.22	0.205	0.173	0.15
35-39	0.282	0.257	0.221	0.197
40-44	0.289	0.262	0.238	0.21
45-49	0.297	0.25	0.231	0.226
50-54	0.284	0.266	0.228	0.222
55-59	0.274	0.26	0.254	0.218
60-64	0.243	0.24	0.252	0.226
Tertiary short	Adjusted gender wage gap			
	1993	1998	2003	2008
Age group				
25-29	0.048	0.066	0.024	0.01[1]
30-34	0.137	0.116	0.085	0.041
35-39	0.184	0.198	0.158	0.122
40-44	0.173	0.185	0.187	0.157
45-49	0.186	0.141	0.162	0.143
50-54	0.173	0.152	0.12	0.128
55-59	0.171	0.139	0.132	0.11
60-64	0.191	0.173	0.131	0.115
Tertiary long	Adjusted gender wage gap			
	1993	1998	2003	2008
Age group				
25-29	0.025	0.028	0.02	0.011[1]
30-34	0.088	0.071	0.027	0.007[1]
35-39	0.104	0.108	0.08	0.059
40-44	0.149	0.142	0.13	0.109
45-49	0.15	0.134	0.119	0.13
50-54	0.131	0.121	0.121	0.109
55-59	0.14	0.102	0.099	0.108
60-64	0.092	0.124	0.068	0.094

Notes: Each number in the table corresponds to the estimated coefficient on the male dummy in a wage regression controlling for immigrant status, resident location and sector fixed effects. Superscript '1' indicates that the estimated coefficient is not statistically significantly different from zero at the 5% level.