The persistence of the gender earnings gap: Cohort trends and the role of education in twelve countries

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Abstract

Studying twelve countries over 30 years, we examine whether women's educational expansion has translated into a closing gender earnings gap. As educational attainment is cohort-dependent, an Age-Period-Cohort analysis is most appropriate in our view. Using the Luxembourg Income Study (LIS) data, we show that while in terms of attainment of tertiary education women have caught up and often even outperform men, substantial gender differences in earnings persist in all countries. These results are consistent with the composition of the top earnings decile. Using Blinder-Oaxaca decomposition methods, we demonstrate that the role of education in explaining the gender earnings gap has been limited and even decreased over cohorts. Contrary, employment status as well as occupation explain a more substantial part in all countries. We conclude that earnings differences at levels far from gender equality likely also persist in the future, even if the "rise of women" in terms of education continues.

Keywords: gender gap, education, earnings, age-period-cohort analysis, Blinder-Oaxaca decomposition

JEL classification: J31 Wage Level and Structure; Wage Differentials, J7 Labor Discrimination, I26 Returns to Education, N30 General, International, or Comparative

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1. Introduction

In many developed countries, female cohorts have successively outperformed male cohorts in terms of tertiary education. On average, and in contrast with earlier birth cohorts, women are today more likely to have a degree from tertiary education than men (Mare 1995; DiPrete and Buchman 2013; Becker, Hubbard and Murphy 2010; Breen et al. 2010; Buchmann and DiPrete 2006; Grant and Behrman 2010; Wilson, Zozula and Gove 2011). With respect to educational attainment, the glass ceiling has been broken. However, does this increase in tertiary degrees translate into commensurate female earnings? Education is the main determinant of one's occupational outcomes and progress (Treiman and Terrell 1975). Moreover, educated women have higher employment levels and shorter career interruptions compared with less educated women (Steiber and Haas 2012). Therefore, an expansion in women's education should close or at least narrow the gender earnings gap.

Does the "rise of women", i.e. their catching up with men in terms of educational attainment, indeed coincide with a narrowing gender earnings gap? Some studies indeed document a narrowing of the gender gap in terms of hourly earnings; but they also show a slowing down of this trend (Bernhardt, Morris and Handcock 1995; Blau, Brinton, and Grusky 2008; England, Gornick and Shafer 2012; Fitzenberger and Wunderlich 2002; Fransen, Plantenga and Vlasblom 2010; Bailey and Diprete 2016). Consequently, significant gaps remain. Apparently, educational parity is a necessary, but not sufficient, condition for closing the gender earnings gap.

How can these two opposing trends, educational parity and persisting gender gap in earnings, be reconciled? First, many scholars agree that steady gender segregation is a major reason that gender earnings and income gaps do not converge to zero (Bielby and Baron 1986, Preston 1999, Olsen et al. 2010). Recent studies show that education explains only a relatively small part of the gender earnings gap compared to occupation and industry (Blau and Kahn 2016). Second, and this is the focus of our study, educational attainment may still have played a role in explaining gender differences *before*, i.e. in times where educational differences between women and men were large. Hence, an explanation may be that only the part of the gender

earnings gap explained by education has shrunk over time. Yet, these two developments have not been investigated jointly.

The objective of our paper is therefore to assess the effects of variation in the gender education gap – across countries and cohorts – on variation in the overall gender earnings gap. To this end, we investigate unadjusted gender earnings gaps but moreover also assess gender earnings gaps net of some important covariates. However, we neither aspire to decompose the gender earnings gap (across countries and cohorts) into all of its micro-level components, nor do we aim to identify the (residual) "discrimination" component. This has been done elsewhere with more refined data. The strength of our data, the Luxembourg Income Study, is the opportunity to investigate large number of countries over many decades and thus cohorts. Rather than providing institutional explanations, we focus here on the variation in the trends of the gender earnings gap across countries.

In our view, a cohort-based analysis is most suitable to study trends in the gender earnings gap, because educational attainment is known to be cohort sensitive (Chauvel 2004). In addition, it is important to use an age period cohort (APC) analysis to control for period (e.g., policy reforms) or age effects (e.g., motherhood) that only accrue in a certain period or at a certain age. Cohort analysis allows us to identify cohort replacement mechanisms and predict future trends more accurately, net of compositional effects. If younger, more egalitarian cohorts are small in size relative to older ones, an overall slowing down of the declining gender earnings gap may be observed, although the cohort effects point towards a continuation of this process as younger cohorts replace older cohorts. Existing studies have shown that countries differ considerably in the gender gap in earnings (Harkness 2010; England. Gornick and Shafer 2012; Mandel 2012; Christofides, Polycarpou, and Vrachimis 2013). We argue that the timing of the catch-up of women in terms of educational attainment is relevant to understanding why women have caught up more in terms of earnings in some countries, but not in others.

APC studies analysing the gender earnings gap are rare because long and coherent time series data are required. The few existing studies confirm strong cohort effects in the gender earnings gap (Campbell and Pearlman 2013). No cross-national cohort study decomposing the gender earnings gap into different factors exists to date. This study contributes to the literature by adding a comparative cohort study of twelve countries spanning over 25 years, which decomposes the gender earnings gap in order to identify the role of the level of education completed. It uses the Luxembourg Income Study (LIS) Database – a recognized cross-national dataset where earnings, incomes and the highest attained degree of education are systematically harmonized, making it possible to analyse a large set of countries over several

decades. A methodological contribution of this study is moreover the novel approach applying Blinder-Oaxaca decomposition methods in the framework of a new APC analysis and providing this tool to the research community (Chauvel, Hartung and Bar Haim 2017).

A merit of our study is its inclusiveness with respect to the part of the society we study. We look at the annual labour income (earnings) of all persons and thus also include persons with zero earnings and those in part-time employment in addition to those in full-time employment. Our "gender earnings gap" is thus a composite measure, conflating gender earnings gaps in employment rates, in hours worked among the employed, and in earnings per hour worked. We understand that this is an unusual way to conceptualize gender gaps in earnings but this measure has a few clear advantages (Gornick 1999). The distinction between different components of gender disparities into (a) allocative inequalities (i.e. in hiring practices), (b) within-job pay gap and (c) in the form of valuative discrimination (e.g. Petersen and Saporta 2004) makes these advantages clearer. Most studies have investigated the second type of inequalities, comparing like with like. Looking only at (full-time) employed women, they exclude a very large part of the female population (Gornick 1999). The majority of the literature that analyses the gender gap in earnings: (i) exclude non-earners, and (ii) among the employed, control for hours (using continuous data or the binary distinction of part-time versus full-time) or they restrict their samples to the full-time employed. This approach may offer precision, however, at the cost of exclusion. Put differently, such selections or samples may be representative for full-time employed women but they are also very far from representing women's relative position in the society overall. In the Netherlands, Switzerland, Australia, the UK, Japan, Germany, Ireland, and Austria for instance, less than two thirds of all women employed were full-time employed in 2016; in the Netherlands only about 40% (OECD 2018a). However, if we consider the employment rate simultaneously, which again reduces the observed population by a substantial part, in 21 out of 38 OECD countries, full-time employed women represent fewer than half of working aged women (own calculations based on OECD 2018a and 2018b).

A second merit of our measure is its multi-dimensionality and comprehensiveness (Gornick 1999). We are to account for other economic inequalities between women and men, such as those resulting from task division, joint household decisions and labour market discrimination, etc. Our measure comprises differentials in initial positions and wages as well as over the career, promotions, the glass ceiling, and departures (cf. Petersen and Saporta 2004). It is thus able to capture women's overall penetration into the labour market (relative to men's), which arguably correlates with women's status and power in society (Gornick 1999).

Third and related, both of these aspects are leading to a third merit, namely to better reflect women's relative position in comparisons over time and across countries. In some countries or period, societal and labour market changes may only be visible in some of these dimensions and by the same token only a comprehensive measure is able to account for the diverging trends.

2. Explaining the gender earnings gap

The total gender earnings gap can be understood as an accumulation of three main types of gender differences and inequalities: (i) differences in employment chances, (ii) in numbers of hours worked and (iii) earnings per hour (compare also Petersen and Saporta 2004). (In each of these dimensions, different factors are at play, to which we turn below.) A first source of inequality in the labour market concerns employment chances. It is a well-known fact that women are in many countries still far behind men in terms of labour market participation as well as employment rates. Lower female employment means more women without earnings and thus a greater gender earnings gap. Inequalities conditional on employment that typically arise between women and men are the number of hours worked as well as the earnings per hour. Women are more often part-time employed than men and thus have lower total earnings. Finally, women earn still less per hour in the same positions as many studies show.

There is a vast literature on the micro- and macro factors driving each of these three components of the gender earnings gap. Some of them stem from differences[1] between women and men; some are the result of differential treatment.

2.1 The rise of women: The declining gender gap in educational attainment

The closing or even reversal of the gender gap in education, or "the rise of women" – the title of the seminal book by DiPrete and Buchmann (2013) – has occurred in most western countries over a similar time frame (Breen et al. 2010), mainly during the phase of educational expansion. The expansion of educational systems has been attributed to a variety of economic, sociological and cultural reasons. National governments expand educational systems as a response to market demand. They believe that it enhances the productivity of the work force and increases economic growth (e.g. Schultz 1961). Technological developments raise employer demand for educated workers, which in turn boosts the economic returns to education. Families and students respond to these changes by investing more time and resources in the pursuit of

[1] We do not assume that all gender differences are disadvantages – they may also reflect preferences.

(higher) education (Becker 1964). Over time, the economy shifts towards occupations that require complex skills (Acemoglu 2002). As the skill intensity of the economy grows, recruitment of labour is increasingly reliant on educational credentials (Bound and Johnson 1992). Educational systems also expand as part of the institutional diffusion process, by which peripheral countries in the world system tend to emulate institutional forms prevalent in esteemed core nations (Meyer, Ramirez and Soysal 1992; Schofer and Meyer 2005).

The gender gaps in the three above mentioned components are strongly linked to the level of education especially in employment and hourly pay: women with higher degrees are typically more often employed, work more hours and show a smaller gender gap in hourly pay. Educational expansion has equipped women with higher diplomas and degrees, which should eradicate one reason for the "legitimate part" of the gender earnings gap. In addition, women show increasing participation in higher education (the "rise of women") and the labour market. Due to the increase in educational attainment, women were moreover able to move up in the occupational hierarchy. While many women used to hold clerical jobs in the past, more and more women can be found in top positions, e.g. managerial jobs.

Contrary to the gender trends in education, recent studies suggest that, at least for the US, the narrowing of the gender earnings gap has slowed down and stalled at levels far from parity (Blau and Kahn 2007, Campbell and Pearlman 2013). Furthermore, Boockmann and Steiner (2006) have shown that the returns to education decline among women but not among men. This is surprising, because education differentials are commonly adduced as an important reason for earnings gaps; for example, over racial, ethnic and migration lines (Black et al. 2006; Mandel and Semyonov 2016).

Recent studies on the US, moreover, suggest that gender differences in education and human capital (and thus presumably productivity) do not explain but a minor part of the gender earnings gap today (Blau and Kahn 2016). In the past, however, their role was more important, when the gender differences in formal education, as well as in years of work experience, in job tenure, in fields of study, in engagement in on-the-job training, etc., were larger. Our hypothesis is therefore that the role of education in explaining the gender gap has decreased in all countries.

As our main aim in this paper is to estimate the role of the educational gender gap as one driver of the gender earnings gap, we test the following hypotheses:

H1: The gender gap in educational attainment has declined over birth cohorts and has been reversed among the most recent cohorts.

H2: The gender gap in earnings has declined over birth cohorts.

H3: As the gender gap in educational attainment has continued to close, its role as a factor explaining the gender earnings gap has declined across cohorts/with educational expansion.

Simultaneously, changes in the occupational structure might have affected the relative ability of women to translate their new educational advantage into returns. Therefore, we next turn to the nexus between education and occupational structure.

2.2 Education, occupational segregation and occupational transformation

Also preferences of women -either for employment, particular job types or flexibility- may explain the gender gap. But the mechanism is subtler than this simplified explanation suggests. Goldin (2014) for instance suggests that women disproportionately pursue jobs compatible with family responsibilities, which have lower earnings per hour. Gender roles, norms and the culture of a society may lead women to these choices; or they may even cause entry barriers for women, e.g. the labour division between women and men, or the male dominance of an occupation. In any case, the outcome is that women and men do different work: they hold different jobs, work in different occupations, and in different industries. Blau and Kahn (2016) find that difference in the type of work account for about half of the gender pay gap in the US in 2010, more than in 1980.

Occupational gender segregation in particular is believed to be one of the main reasons for the gender earnings gap (Bielby and Baron 1986, Preston 1999, Olsen et al. 2010). Women tend to concentrate in middle-status occupations, from non-manual to lower service class occupations, while men tend to concentrate in both low-level manual occupations and high-level managerial positions (Jacobs 1989). Due to educational expansion and skill biased technological change (SBTC), the occupational structure of the labour market has changed during the recent decades, which should have a differential impact on women and men (Häusermann, Kurer and Schwander 2014). A number of authors claim that these changes led to a decline in real wages of low-skilled workers as well as to an increase in employment of high-skilled workers and to a decrease in employment of middle occupations (Card and DiNardo 2002; Hijzen 2007; Acemoglu and Autor 2010). These changes are particularly important for changes in the gender earnings gap, since the labour market is partially segregated into female and male occupations. Due to structural boundaries (Preston 1999), self-selection (Carlsson 2011) and informal discrimination (Bielby and Baron 1986, Goldin 2002), a great number of occupations are held mainly by either men or women. Therefore, changes at both ends of the occupational structure should impact men much more than women.

These changes can either reinforce or impair the gender-equalizing trend in terms of earnings. The strongest gender-equalizing trend in the US has occurred among the lowest educated, which can in part be attributed to the disappearance of relatively well-paid, typically male-occupied jobs in manufacturing, while the gender earnings gap at the top of the occupational hierarchy remains the widest pointing towards a "glass ceiling". This is similar in Europe, although there is also some evidence for a "sticky floor", i.e. a widening wage gap at the bottom of the wage distribution (Arulampalam, Booth and Bryan 2007). Briefly, we expect:

H4: The gender earnings gap has declined faster among those who attained lower levels of education than among those who completed tertiary education.

2.3 Other explanations for the gender earnings gap

Our overview of sources of gender differences in earnings is not exhaustive. There are also other mechanisms at work (for an excellent review see Blau and Winkler 2017). There is, first, ample evidence for different forms of allocative and pay discrimination, e.g. old-fashioned or statistical gender discrimination, but also discrimination against parents, caregivers, and part-time workers - all of which disproportionately penalize women (e.g. Petersen and Saporta 2004, Bardasi and Gornick 2008, Fang and Moro 2011). Blau and Kahn (2016) suggest that discrimination may account for as much as 38 percent of the gender pay gap. Different authors (Levanon, England and Allison 2009, Petersen and Saporta 2004) argue that women's work is valuated less than men's. Using US Census data from 1950 to 2000, Levanon, England and Allison (2009) find that when women's share in an occupation increased substantially, its average pay decreased. Employers pay women less than men for the same job, the authors explain. This also decreases the average in that field, the more women enter. Discrimination, however, is likely to even play a larger role for the gender earnings gap, for instance by discouraging women from aiming for well-paid, male-dominated jobs in the first place. In addition, women are paid less than men for very similar work, as the substantial pay difference between maids and janitors illustrates. This form of gender discrimination has been labelled as valuative discrimination (Petersen and Saporta 2004).

Second, also psychological or noncognitive skills may account for parts of the gender earnings gap but they play only a small to moderate role, and especially in view of the role occupation and industry effects (Blau and Kahn 2016). Third, there may, arguably, be gender gaps in soft skills, i.e., the types of productivity-related attributes but these are very difficult to measure.

Third, it is widely acknowledged that institutions shape gender inequalities (Lewis and Ostner 1991, Langan and Ostner 1991, Lewis 1992, Gornick et al. 1997, Esping-Andersen 2002, Olivetti

and Petrongolo 2017). As classic welfare state typologies (Esping-Andersen 1990, Ferrera 1996) do not sufficiently incorporate the gender inequality dimension, a number of scholars developed -or adapted these to- gender policy regimes (Lewis and Ostner 1991, Langan and Ostner 1991, Sainsbury 1999, Gornick and Meyers 2006). Although several authors differentiate the realm of gender regimes further, there are two main, opposing regimes. The male breadwinner regime exhibits a gender ideology of male privilege and a gendered division of labour. Women's social rights are derived from men's entitlements, while they are responsible for care of children, the sick, and the elderly through unpaid work. Conversely, the dual-earner/dual-carer (or earner-carer) regime is characterised by equally shared roles and obligations, and thus by equal rights. The state provides or remunerates large parts of the care services leading to higher employment among both genders. These typologies are compelling tools for cross-national comparisons analysis in general, but -we believe- less suited for cohort analysis of long-term transformations due to their inability to capture the complex historical trajectories of economic and political conditions that have distinct impacts on different cohorts. In this matter, we observe that countries from the same welfare regime can experience very divergent paths: institutional proximities do not necessarily mean similarity in trends of social change.

3. Method

3.1 The Age Period Cohort Gap/Oaxaca model (APC-GO)

The purpose of the Age-Period-Cohort Gap/Oaxaca model (APC-GO[2], Chauvel, Hartung and Bar-Haim 2017) is – see in particular Smith (2008) – to measure the change across birth cohorts in the gap in a dependent variable *y* (e.g., earnings) between two groups (e.g., gender). Data fitted to APC-GO are structured as a Lexis table, i.e. an *age* by *period* table of (cross-sectional) data with a constant pace in age and in period (e.g., five-year age groups measured each fifth year). Each cell of the Lexis table is indexed by its age *a* and a period *p* and then pertain to cohorts $c = p - a$. Then, we apply a two-step method:

- First, we compute a matrix u_{apc} of (un)explained and total differences on a base of Oaxaca-Blinder models of *y* including relevant control variables run for each (age by period) cell of the initial Lexis table y_{apc} and obtain the Oaxaca Lexis table of the gender earnings gap.

[2] The APC-GO ado file for Stata can be downloaded via the command *ssc install apcgo*.

- To this Oaxaca Lexis table, we apply, second, a specific trended APC model in order to obtain the trend measure of the cohort-specific earnings gap, the APCT-lag coefficient.

The complete APC-GO method cannot provide direct estimations for confidence intervals due to its complexity; i.e. succession of Blinder-Oaxaca and APC methods. Therefore, we bootstrap the entire process considered, including first the Oaxaca-Blinder decomposition of each cell of the initial Lexis table of y_{apc} to obtain the non-explained o_{apc} Oaxaca Lexis table.

Step 1: Oaxaca Lexis table

In order to obtain the gender gaps in earnings (un-)explained by education and other characteristics, we apply the Blinder-Oaxaca decomposition method (Blinder 1973; Oaxaca 1973; Jann 2008) to each cell of the initial Lexis table. Since the mean of the residuals are equal to zero, we can express the average earnings of men and women as products of the coefficients obtained from the two regressions and their mean covariates, as presented in equations (1) and (2):

$$\overline{\log(dpi)}_c^{M} = \overline{X}_c^{M} b_c^{M} \quad (1)$$

$$\overline{\log(dpi)}_c^{W} = \overline{X}_c^{W} b_c^{W} \quad (2)$$

Where $\overline{X}_c^{M}$ represents the mean of the covariate X at cohort C for men and b_c^M represents the coefficient for the mentioned covariate, at the same cohort for men. Similarly, $\overline{X}_c^{W}$ and b_c^W represent the mean of the covariate X and the coefficient for women at cohort C.

By subtracting (1) and (2), we can express the differences in returns to education for each cohort:

$$\overline{\log(dpi)}_c^{M} - \overline{\log(dpi)}_c^{W} = b_c^M(\overline{X}_c^{M} - \overline{X}_c^{W}) + \overline{X}_c^{W}(b_c^M - b_c^W) \quad (3)$$

where the term $\overline{\log(dpi)}_c^{M} - \overline{\log(dpi)}_c^{W}$ is the overall earnings gap in cohort C, $b_c^M(\overline{X}_c^{M} - \overline{X}_c^{W})$ is the gap explained by covariate X in cohort C and the term $\overline{X}_c^{W}(b_c^M - b_c^W)$ is the unexplained part. The unexplained part comprises the effect of variables not observed in our model, which we call *uapc.*

Step 2: APCT-lag of the Oaxaca Lexis table

In the second step, we develop a cohort-indexed measure of the gaps in the Oaxaca Lexis table. This step relies on an adaptation called the APCTL ("Lag") of the APCT ("Trended") (Chauvel and Schröder 2015) model, that had been designed to detect cohort change in level of living in the context of different welfare regimes. The APCT is itself a cohort-trended variation of the more standard APCD ("Detrended") model (Chauvel 2013; Chauvel et al. 2016), which we fully describe below in Appendix A. Based on this model, the new APCT-lag approach that is distinctive from previous approaches in its constraints, designed to have a realistic linear trend of the age component[3] implying a robust identification of the cohort dynamics. It is widely acknowledged that appropriate constraints are necessary to solve the identification problem of the linear combination of age, period and cohort effects, which is an inherent issue of APC models (see appendix A). In the APCD model, constraints are designed to robustly estimate the cohort deviation to the zero-slope (i.e. "fluctuations"), to identify how specific cohorts can significantly deviate from the linear trend:

$$y^{apc} = \alpha_a + \pi_p + \gamma_c + \alpha_0 rescale(a) + \gamma_0 rescale(c) + \beta_0 + \varepsilon \qquad (4)$$

where the sums and trends of each set of coefficients $\alpha_a, \pi_p, \gamma_c$ are constrained to zero; α_0 and γ_0 absorb the age and the cohort trend respectively the establishment of specific baselines for comparisons of models. Some constraints provide easy-to-understand baselines such as the APCD, which have a baseline of zero linear trend in cohort (see Appendix A). We propose here a new APC model, the APCT-lag, proposing an empirically relevant baseline to understand cohort trends. We constrain the estimated linear component of the age effect α to equate the observed average age shift of cohorts in the observed Lexis table o_{apc}. Consider this average shift α:

$$\alpha = \sum \frac{(o_{(a+1,p+1,c)} - o_{apc})}{(A-1)(P-1)} \qquad (5)$$

where α represents the average shift for a cohort c when it becomes one age group older in the next period across the window of observation of a age groups and p periods. Once this constraint is implemented (α is known) and the linear trend of period is constrained to zero, the cohort effect will absorb the long-term time transformations and the APCT-lag is identifiable:

$$o^{apc} = \alpha_a + \pi_p + \gamma_c + \varepsilon \qquad (APCT\text{-}lag) \qquad (6)$$

[3] "Realistic" because it equates the age trend lag we observe on the window of observation.

with $\sum(\alpha_a) = 0 \ and \ \sum(\pi_p) = 0 ; Trend(\pi_p) = 0; Trend(\alpha_a) = \alpha$. We calculate the formula of the operator *Trend* for age coefficients, where *A* is the number of age coefficients, as follows:

$$Trend(\alpha_a) = 12 \frac{\sum(\alpha_a(2a\text{-}A\text{-}1))}{(A\text{-}1)A(A+1)} \quad (7)$$

In the APCT-lag, γ_c absorbs the constant (larger when the gap is high); its average linear trend shows the variation in the intensity of the controlled gap and the fluctuations show possible non-linear accelerations or deceleration in the cohort trend.

3.2 Data and variables

Using data from the Luxembourg Income Study (LIS) Database, we include the following twelve countries for which we have sufficient information on education and cohorts: Germany (DE), Denmark (DK), Spain (ES), Finland (FI), France (FR), Israel (IL), Italy (IT), Luxembourg (LU), the Netherlands (NL), Norway (NO), the United Kingdom (UK) and the United States (US). We divide our cross-sectional data into approximately five-year periods between 1985 and 2010, and construct five-year birth cohorts between 1935 and 1980, restricting age to 25–59 years to focus on the primary years of earning (i.e., after the completion of schooling and before retirement and/or increased disability). Descriptive statistics of our sample are provided in the supplementary material S2.

Our dependent variable is *earnings* (or personal labour income, LIS variable *PIL*), which includes paid employment income (basic wages, wage supplements, directors' wages, casually paid employment income), and self-employment income. These are, in other words, monetary payments and value of non-monetary goods and services received from dependent employment as well as profits or losses and value of goods for own consumption from self-employment.[4]

Then we apply the logit-rank transformation as proposed by Chauvel (2016), which offers a standardization strategy consistent with the Pareto characteristics of income distributions (ibidem). More importantly, it allows us to include zero earnings. This is a substantial contribution relative to previous studies as the focus on hourly wages omits those parts of the population with no labour market participation or zero earnings and thus underestimates the real gender gap (Blau and Kahn 2013).

[4] Due to the gender gap in self-employment and for robustness, we repeat the variable *pile*, which excludes income sources from self-employment. The output is presented in the supplementary material.

We proceed as follows. Let p∈[0;1] be the percentile rank of individual *i* in the income distribution, so that the logged odds of the percentile $\ln(p_i/(1-p_i)$ measure the relative social power of individual *i* (Copas 1999, compare also the Positional Status Index in Rotman et al. 2016). Using the so-created rank positions enables us to look at changes in the earnings structure net of the Gini (Chauvel 2016). We use the logit-rank of earnings as the dependent variable in our APC-GO model.

When analysing the gender earnings gap we proceed in three steps: first we display the overall, uncontrolled gap in earnings. In a second step, we introduce education to investigate to what degree the gender gap in educational attainment is able to explain the gender gap in earnings. Third, we include also household characteristics (living with a partner, number of children[5]), employment status[6], and occupation (with the exception of Italy and Norway, where consistent occupational information is not available). This strategy allows us to explain the gap in the means of our outcome variables between women and men, net of other differences.

In a final step, we investigate the gender composition of the top decile of the joint (women and men) earnings distribution. It is important to note that parity in chances to be part of the top decile does not necessarily correspond to gender equality to the degree that there is vertical gender segregation within the top group. In other words, women may still earn less than men while being equally represented in terms of numbers. Nonetheless, if interpreted as a minimum condition, it can be a straightforward indicator that is useful to observe the opposite, namely whether or to what degree women are present in or absent from the top.

The variable *education* refers to the highest completed level of education grouped in three categories:

- less than secondary education completed (never attended, no completed education or education completed at the ISCED levels 0, 1 or 2)
- secondary education completed (completed ISCED levels 3 or 4)
- tertiary education completed (completed ISCED levels 5 or 6)

Employment status (LIS variable *emp*) is a dummy variable indicating any current employment activity (employed/not employed) according to the ILO definition of employment.

[5] Other studies have used "age of youngest child" instead. However, to exploit the maximum number of waves and countries, we have opted for number of children.

[6] Another contribution of our study is to include family or household characteristics into the wage equations, which is still not a standard procedure in the economic literature.

Household characteristics summarise whether the respondent is living with a partner (yes/no) as well as the number of children present in the household (none/one/two or more).

Our *occupational variable* refers to the main job (*occb1*) and is based on the 1-digit ISCO classification.[7] We exclude armed forces occupations. To avoid empty cells in the Lexis table, we collapsed occupation into the following three categories: (1) managers and professionals, (2) technicians and associate professionals, clerical support workers, service and sales workers, skilled agricultural, forestry and fishery workers, craft and related trades workers, as well as plant and machine operators, and assemblers, and (3) elementary occupations.

4. Results

Our results confirm the gender-equalising effect of educational expansion in most countries, where the gender gap in educational attainment today is closed or even reversed. Figure 1 shows the difference in the levels of attainment of tertiary education between men and women across birth cohorts and confirms our first hypothesis. More specifically, the results indicate that the earliest timing of the rise of women occurred in Denmark, followed by Norway and the US, where the gender gap in attainment of tertiary education had already diminished and reversed in the cohorts born after 1950 and 1960, respectively. Women have caught up but not (significantly) surpassed men in three of the twelve observed countries (Germany, Luxembourg, and the UK). In the UK, however, women and men have historically had equal levels of completed tertiary education.

FIGURE 1 ABOUT HERE

This general inversion in the educational gap may lead to a socioeconomic convergence of women and men – to the extent that educational equalities are the underlying reason for the gender earnings gap. Figure 2, which shows the uncontrolled gender difference in logit-ranked total earnings, confirms such a clear general cohort trend as hypothesised in H2. In all countries, the gender earnings gap decreased considerably. However, against expectations, empirical results give a paradoxical picture: the gender gap in the hierarchy of total earnings is more evident than the gap in educational attainment and the convergence between women and men in terms of earnings ranks is thus much weaker. In some countries, particularly in Spain, Finland, France, and the US, the decreasing trend appears to be slowing down or even

[7] Please note that LIS Waves I-VII recode occupation according to the ISCO-88 standard but from Wave VIII onwards according to the ISCO-08 standard.

stagnating in the latest cohorts. Luxembourg is another clear and interesting case. It made a rapid transition from coal and steel industry towards a service economy, abolishing an immense number of well-paid jobs in male-dominated occupations. Due to late educational expansion and low female labour force participation rates the gender earnings gap among the higher educated did not converge in Luxembourg, in contrast with the stark decrease in the earnings gap among the lower educated. In a nutshell, this uncontrolled gender earnings gap reflects different mechanisms that have changed over the cohorts, e.g. differences between women and men in educational attainment, employment status, and occupations but also family characteristics, preferences and (statistical) discrimination. We therefore decompose these differences to acquire more detailed insights.

FIGURE 2 ABOUT HERE

Moving to H3, our aim was to identify to the role of education in explaining the gender earnings gap. To this end, we decomposed the gender earnings gap in two steps: first, including only *education* (Figure 3), second, including education as well as *employment status*, *occupation*, household characteristics (presence of *partner* and *number of children*; Figure 4 and 5). Figure 3 reveals how much of the mean differences across gender are accounted for by group differences in education. We can see that, with the exception of the UK, the role of education is universally declining across cohorts confirming our hypothesis. Moreover, it has reversed in most countries as the negative Oaxaca coefficient indicates. This implies that while women had lower earnings and inferior levels of completed education than men in earlier cohorts, women in more recent cohorts are better educated but still have lower earnings levels. Given their higher education than men, they should also have higher earnings today.

FIGURE 3 ABOUT HERE

Decomposing the gender earnings gap further, Figure 4 shows that the relative importance of education has been relatively limited over the cohorts. We moreover observe that there is no single common pattern. Countries differ with respect to the contribution of each factor. Similarities, however, are that education and family characteristics (living with partner, presence of children in the household) explain little of the total gender earnings gap, relative to other factors. Employment status on the other hand used to be an important gender difference that contributed much to explaining the gender earnings gap in Germany, Spain, Israel, Italy, Luxembourg, the Netherlands and to some lesser extent in France and Norway. Except for Italy, in all these countries the role of employment in explaining the gender earnings gap has decreased to a large extent: The cohort trends confirm the trend that women have increasingly

joined the work force and increased thus their earnings over the last decades. This downward trend is also true for the role of occupation in Germany, Denmark, Spain, France, Luxembourg and the US. Opposite to this trend, we find that occupational differences increasingly explain the gender earnings gap in a few countries such as Finland, Israel, the Netherlands and the UK. Put differently, occupational segregation by gender is more important than education in explaining the gender earnings gap.

FIGURE 4 ABOUT HERE

Figure 5 shows the total gender difference in earnings and how much of it remains unexplained by the comprehensive set of individual characteristics. First, important differences between the countries can be observed. In some countries, most notably Finland, much of the gender earnings gap is explained by the covariates: the differences between women and men are due to differences in education, family patterns, and employment status. Finland is distinctive from other Nordic countries for its very high rate of full-time employment among employed women (Gornick 1999). In a few countries, such as Germany and the UK, the differences in the above-mentioned characteristics including education still explain a relevant part of the gender earnings gap. The total differences indicate, second, that the overall gender earnings gap is shrinking but that it is far from being closed, while there seems to be a persistent unexplained part, except in the UK, even with control variables included.

FIGURE 5 ABOUT HERE

How can these diverging levels and trends across countries be summarised? Apparently and surprisingly, these patterns do not follow the logic of welfare states or gender policy regimes. To facilitate the deduction of a more general trend, we compare the early and late cohorts (Figure 6). The most striking result is that in terms of the explained part of the gender gap countries converge towards a lower gender gap. While the differences in education, employment, occupation and household characteristics were responsible for a large part of the gender earnings gap among older cohorts, they helped to considerably shrink the total gender gap in younger cohorts. The countries with the biggest changes are Luxembourg, Germany, Spain and the US (right panel in Figure 6). Conversely, the development of the unexplained part of the gender gap has been very heterogeneous. It shrank in the countries below the diagonal in the middle panel in Figure 6, e.g. in Germany, the UK and the US, but rose in countries above the diagonal including Italy, France and the Netherlands. In the latter group, the closing gender earnings gap induced by the "assimilation" of women and men in terms of education, employment, occupation and family characteristics was partially offset by other factors. In the

Netherlands, where part-time employment plays an important role, differences in work intensity between women and men could, for instance, be considered responsible for an additional part of the unexplained gender earnings gap. Also more detailed data on occupation could better reflect the role of gender segregation. Country studies could investigate these explanations in further detail; these could not be consistently integrated in our comparative study.

Eventually, our results do not reproduce patterns consistent with those of welfare or gender policy regimes. For instance, Italy and Spain, which are the two Southern European welfare states and typical male breadwinner cases, in our analysis, show diverging trends. While the gender gap in Italy has been lower among older cohorts, which remained fairly stable over time, Spain has experienced a remarkable "modernisation" from a traditional gender-unequal country with respect to the gender earnings gap catching up to the ranks of the more gender equal countries today. Also with respect to the Conservative welfare states, we find large disparities in the trends. Germany, for example, is rather similar today in terms of the gender earnings gap, but has been been (one of) the most gender unequal countries in our analysis in the past. The dual-earner/dual-carer model, representing the ideal type of a gender egalitarian society to which the Nordic countries come closest (Gornick and Meyers 2009). Yet, also consistent with other studies, we find deviating trends in these countries (Sainsbury 1999). In contrast to the rather low but stable gender gap in Finland, we find an originally higher but decreasing gender gap in Denmark and Norway. Norway, however, is the only Nordic country that shows an increasing unexplained gender gap, similar to the Netherlands, a formerly male breadwinner country that has moved towards a more gender-egalitarian direction. In a nutshell, while we do not attempt here to provide a proper test of regime typologies, our analysis seems to point to the conclusion that historical configurations and their legacies and their diverging impact on the outcomes of different cohorts can be more complex than these typologies suggest.

FIGURE 6 ABOUT HERE

Looking next at two groups with different levels of educational attainment, we hypothesised in H4 a smaller gender earnings gap among lower educated people due to the restructuring of the labour market. To this end, we separate our analysis by level of educational attainment (Figure 7). Indeed, we find significant differences in the gender earnings gap between non-tertiary and

tertiary educated in many countries, at least in some cohorts.[8] Systematically larger gender earnings gaps among the lower educated compared to higher educated are prevalent in Denmark and the US, but also in Finland, Norway and Israel among older cohorts. Only in Spain in the 1965-1970 cohort is the gender earnings gap among the lower educated significantly higher than among the higher educated.

As to the trends, the shrinking gender earnings gap is a result of a similar development in both educational groups in Germany, Denmark, the UK and the US. In Finland, Norway and to a lesser extent in Israel, it is mainly the gender gap among the higher educated that caused the narrowing gender gap (while the gender gap among the lower educated is stable or slightly increasing). In the other countries, the trends are much less clear. Yet, we do not find evidence for a generally faster shrinking gender gap among the low skilled, only in the US. Here, the steady disappearance of relatively well-paid, typically male occupied unskilled jobs seems to haves contributed to narrow the gender earnings gap.

FIGURE 7 ABOUT HERE

As a final step, we investigated the gender composition of the top earnings decile. These analyses enable us to observe cohort changes in women's representation at the top of the labour market. Figure 8 presents these results.[9] All of the countries, with the exception of Luxembourg and Finland, experienced a significant increase in the chances of women in the top earnings decile. In Finland, the share was relatively lower in earlier cohorts than in other countries, and remained stable even after most of the other countries achieved similar levels. In Luxembourg, the decline was not significant, likely due to the small sample size.

Younger cohorts experienced a slower increase, and in some countries, most notably the US, Spain, Denmark and Israel, cohorts born after the 1960's did not experience a rise at all. From the entire sample, only Italy demonstrated a linear decline in men's share of the top earnings decile, which seems to continue even for the last cohorts. Neither of the countries presented a reversed gender gap, i.e. overrepresentations of women in the top earnings decile. Most importantly, comparing Figures 2 and 8, we find very similar patterns suggesting that women's chances to hold top positions and a closing gender earnings gap are closely connected. Yet, most importantly, while the chances of women to be in the top earnings group increased in almost every country, the gender earnings gap among the higher educated has not decreased in parallel – or only at a much slower pace.

[8] Note that in earlier cohorts with only few women with tertiary education the power to find significant results is restricted. For the same reason, we restrain ourselves from interpreting the result on Italy and Luxembourg.

[9] The results of the corresponding analysis for the top vingtile are very similar to the ones presented here.

FIGURE 8 ABOUT HERE

5. Conclusion

There is much evidence that gender inequalities have eroded in the past in many respects. Regarding the future, scholars have outlined two diverging scenarios, an optimistic one, in which this trend continues and a pessimistic one, where gender inequalities persist (Blau et al. 2008, Blau and Kahn 2016). The present study on the gender gap in education and earnings in twelve countries provides evidence for both. First, we noticed significant general educational shifts in most of the twelve developed countries towards a relative improvement for women, leading, in most countries, to an inversion from male to female domination in education in recent cohorts. This raises hopes for a concomitant declining explained gender earnings gap. However, this trend has not translated into a closing of the gender earnings gap. On the contrary, it has reached and stagnated at levels far from economic equalisation, even among the most recent cohorts. With respect to earnings, there is thus only weak evidence for a declining significance of gender.

Our aim also was to identify the degree to which education and -to a lesser extent- other factors contribute to explaining the gender earnings gap. We found that the converging profile of both genders leads to a declining gender earnings gap. Furthermore, we have shown that the role of education in determining the gender earnings gap has been relatively small relative to other factors and that it has decreased further across cohorts. More specifically, the differences and changes in the employment status and to a lesser extend in occupation seem to be able to explain the largest part of (the trends in) the gender earnings gap. Therefore, the decline in the gender earnings gap slowed down among younger cohorts and for some countries, even stopped completely. The picture is similar for women's chances of holding positions in the top earnings tier. In sum, there are important results as they contradict the wide belief that the rise of women in terms of education could lead to a closing of the gender earnings gap.

On the contrary, in almost all countries, a large residual of unexplained differences persists. This also implies that a substantial part of the gender earnings gap is due to circumstances we were not able take into consideration here. One of the possible explanations may be that new forms of work organisation such as overwork sustain long-standing gender inequalities despite educational parity. Cha and Weeden (2014) show for the US that the effect of disproportionately long working hours among men outweighs the earnings-equalising effects

of the narrowing gender gap in educational attainment. Moreover, women seem to seek jobs with greater flexibility, allowing them to reconcile family responsibilities, which are, however, often less well paid (Goldin 2014). Future research could investigate such questions for a smaller set of countries, with more detailed harmonized data.

Nevertheless, we were able to identify patterns in the diversity of country-specific cohort trajectories and thus historical transformations. We demonstrate that welfare regimes can influence the average situation of a country, but its cohort dynamics do not follow the logics of welfare states or gender policy regimes. No welfare state regime experienced a homogeneous trend. Specifically, we find a clearly converging trend towards more egalitarian outcomes, which is mostly due to the decreasing explained gender earnings gap in formerly highly gender-inegalitarian countries. In other words, the generally narrowing gender earnings gap is due to the decreasing gender gap that is due to education, employment status, occupation and family characteristics.

On the contrary, with regards to the trend in the unexplained part of the gender gap, there is much more diversity across countries, with a large number of societies stagnating around the initial levels. These trends, most importantly, do not coincide with the typologies of welfare states or gender regimes leading us to the conclusion that complex historical economic and political configurations of countries and their legacies impact distinctly on different cohorts, which is difficult to capture by comparative typologies. Evidently, the persistent unexplained gender earnings gap points towards societal or cultural differences, social norms and barriers that past gender-equalising policy reforms as well as the more general transformation of societies have not been able to stir, not even in the Nordic countries, which are approaching the dual-earner/dual-carer model.

Furthermore, we show that the pace of the narrowing gender earnings gap differs across countries for the lower and higher educated, with lower and/or decreasing levels of gender inequality among low educated people. Policies matter for women's outcomes (Mandel and Shalev 2009) but their effect has only rarely been investigated differentiating levels of educational attainment, which opens another interesting direction for further research. Korpi, Ferrarini and Englund (2013) have for instance shown that the effects of work-family reconciliation and women's employment policies on women's outcomes differ across their levels of completed education.

A contribution of our study is its inclusion of women not in full-time employment; i.e., those who work part-time or have no employment. Instead of focusing on hourly earnings or other

measures that exclude the non-employed, we have assessed annual earnings and also included women with zero earnings. Our measure is moreover more comprehensive than traditional ones as it comprises not only with-in job pay differentials but also differences in the initial position and wage as well as over the career, promotions, the glass ceiling, and departures or labour market exits (cf. Petersen and Saporta 2004). This represents, in our view, a wider, more realistic gender earnings gap better reflecting women's relative position and power in today's societies.

Finally, our study contributes to understanding the timing of the reduction of the gender gap in earnings: it has been strong and fast in Germany, Luxembourg, and the US; it has been slower in France and the UK. In countries where the gaps were smaller for the 1940 birth cohort, the convergence is much slower with some stagnation. The importance of comparative birth cohort analysis can therefore not be overstated. The gendered trends in educational attainment that are central factors in the dynamics of stratification are diverse as are their real impact. Thus, comparative research in this respect is vital for the stabilization of results on social stratification.

Our central conclusion is that educational and earnings inequality in labour market outcomes are two relatively independent dimensions of gender inequality, and the reduction of educational gaps may be a necessary condition of economic equality, but it is not sufficient. In many countries, educational equality has been reached or even exceeded (with women having a better education), but the economic gap as well as the gap in chances to hold top positions remain large, visible, and durable, even for the very latest cohorts of young adults and, thus, for the future. We observe in several countries including the Netherlands as well as the South and the North of Europe a persistence of the "unexplained" part of the gender earnings gap, often presented as "pure discrimination" (Oaxaca and Ransom, 1988). This large, stagnant unexplained residue after taking into account observable differences implies that "other factors" (values, norms, etc.) generate pertinacious gender gaps. In those countries, over the last decades, time alone brought no reduction of this "pure" inequality.

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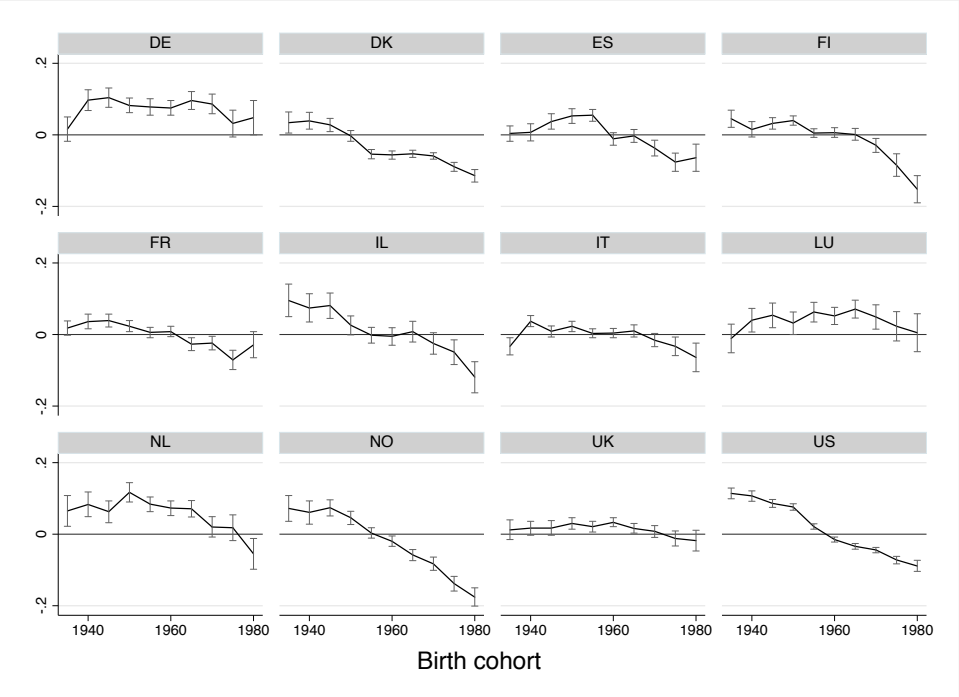
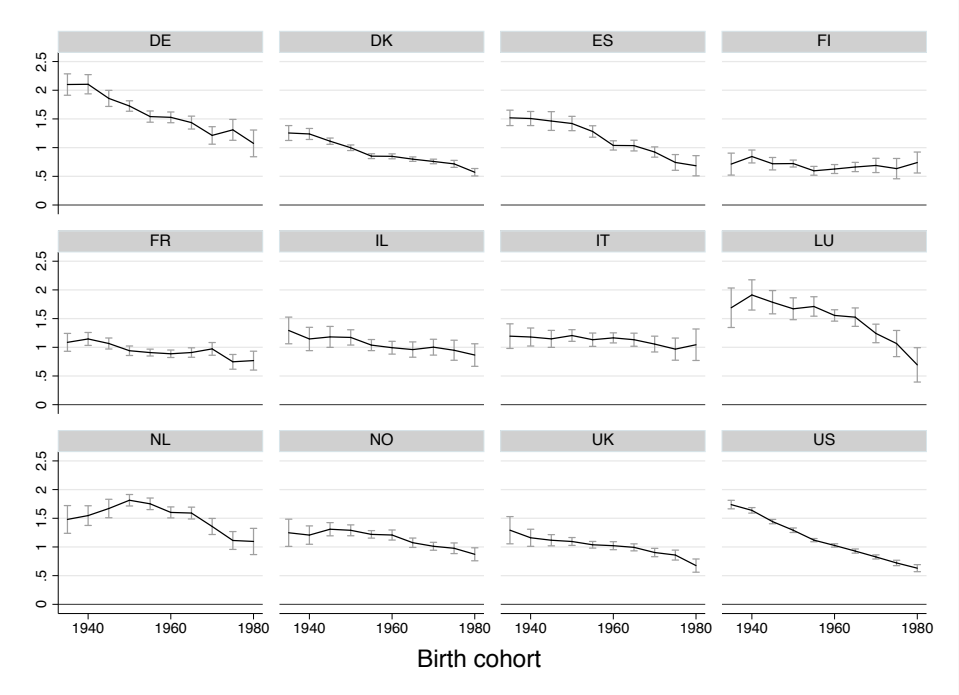
Figures

Figure 1. Cohort trends in the gender gap in attainment of tertiary education



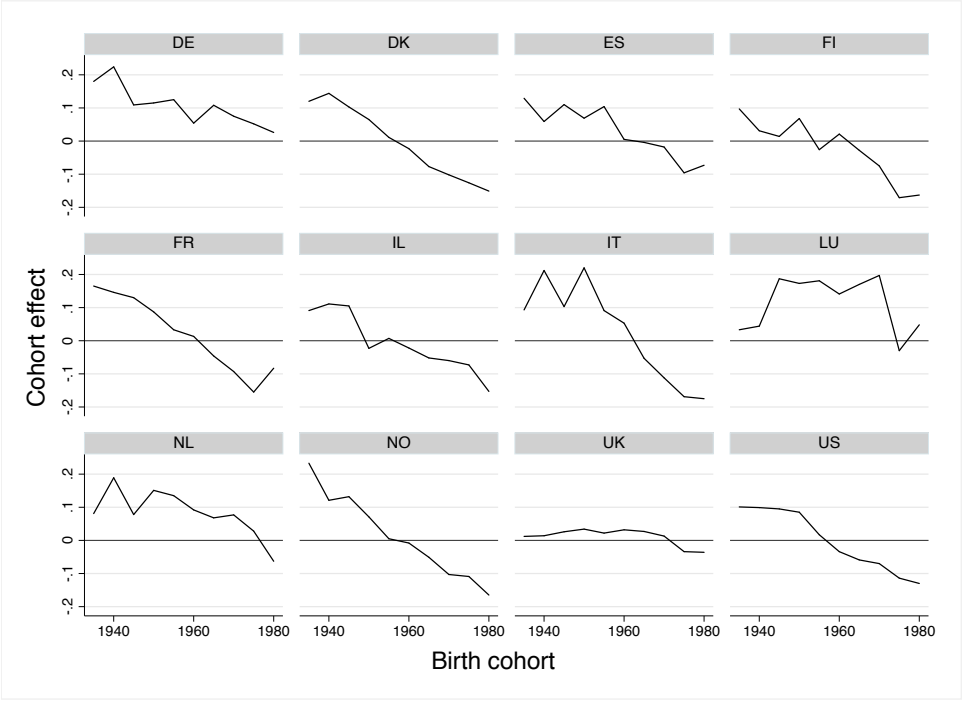
Note: The Y-axis represents gap in proportion of tertiary education attainment. Zero denotes gender equality; negative values refer to female advantage. Source: LIS.

Figure 2: Cohort trends in the uncontrolled gender earnings gap



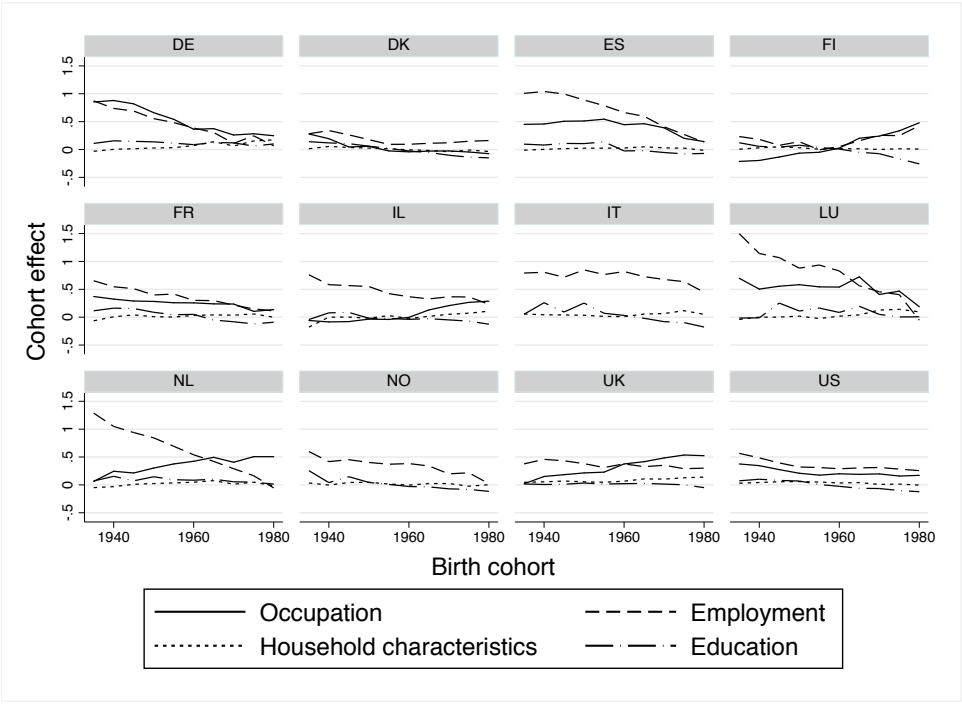
Note: The Y-axis represents the gap in logitranks of earnings. Zero denotes gender equality; positive values indicate male advantage. Source: LIS.

Figure 3. Part of the gender earnings gap explained by education across cohorts



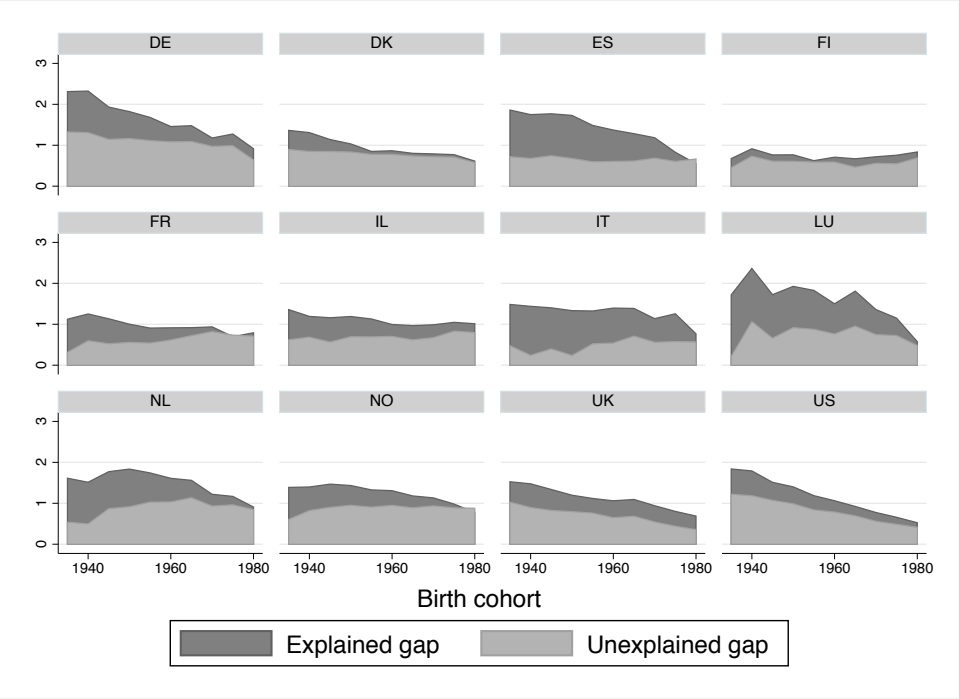
Notes: The graph plots the APC modelled difference explained by education through country-year-cohort based on Blinder-Oaxaca decomposition. The Y-axis represent the gap in logitranks of earnings. Source: LIS.

Figure 4: Contribution of different components to explaining the gender earnings gap across cohorts



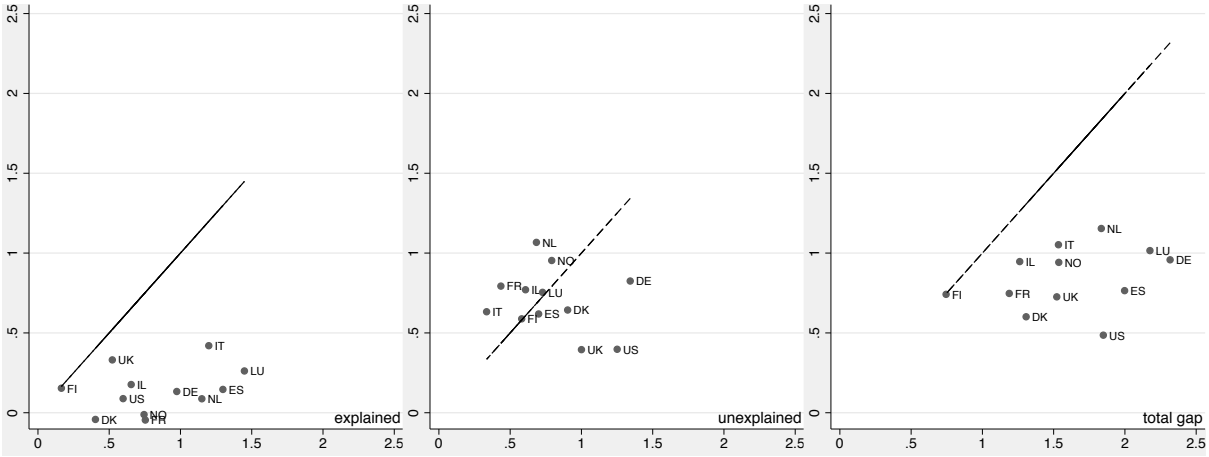
Note: Blinder-Oaxaca decomposition of the gender earnings gap into a part explained by education, household characteristics (living with partner, number of children in the household), employment status and occupation. Note that for Italy and Norway consistent information on occupation was not available and is therefore omitted from the model in these two countries. Source: LIS.

Figure 5. Cohort trends in the total (cumulative line), unexplained and explained gender earnings gap



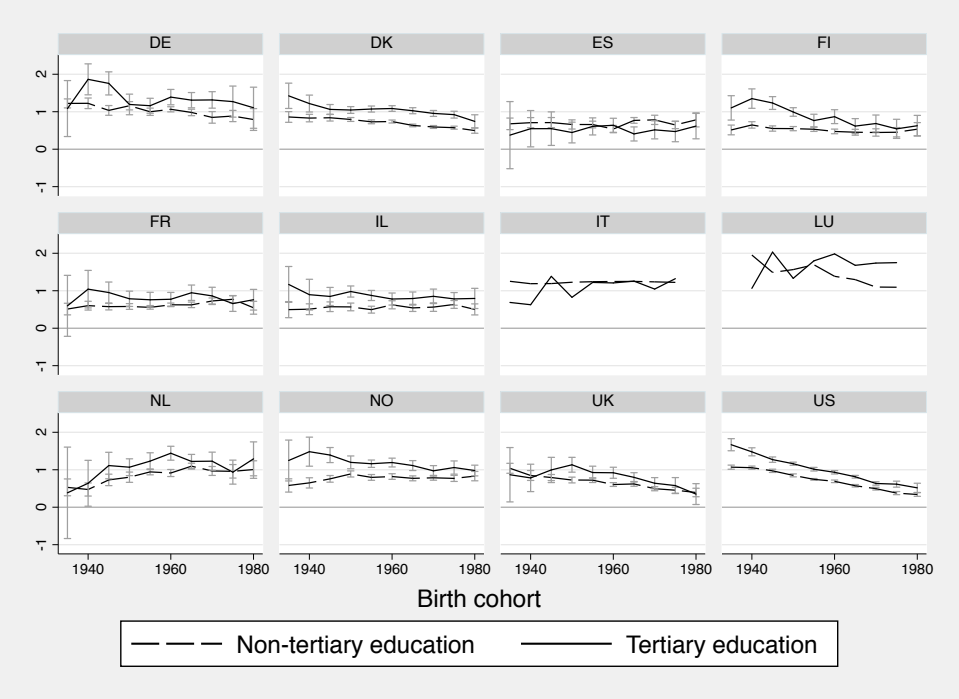
Note: Blinder-Oaxaca decomposition of the gender earnings gap into a part explained by education, household characteristics (living with partner, number of children in the household), employment status and occupation as well as an unexplained part. Note that for Italy and Norway consistent information on occupation was not available and is therefore omitted from the model in these two countries. Source: LIS.

Figure 6: Explained, unexplained and total gender earnings gaps for birth cohorts 1935 (x-axis) vs. cohort 1980 (y-axis) – linear predictions



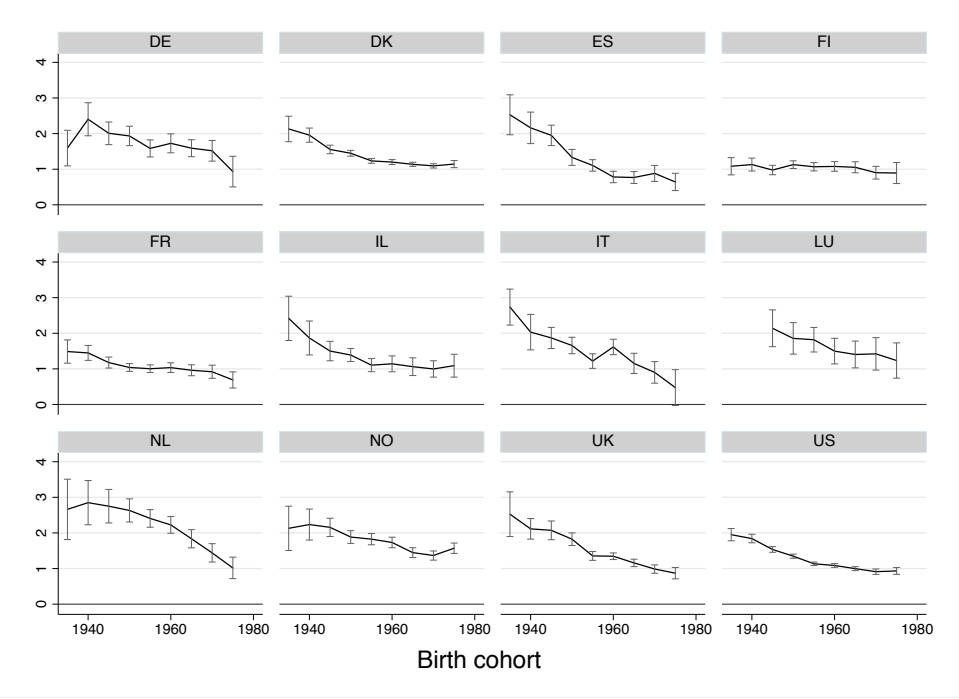
Source: LIS.

Figure 7. Cohort trends in the gender earnings gap, by educational attainment



Note: Gap unexplained by (controlled for) employment status and household characteristics (living with partner, number of children in the household), except for Italy and Luxembourg where we show only the uncontrolled gap (APC-lag) due to small number of cases among the highly educated women. Source: LIS.

Figure 8: Chances of men vs. women to be in the top earnings decile across cohorts



Note: The Y-axis represents the (log)odds ratio to be in the top decile vs. not being at the top decile. A value of 0 denotes gender equality; positive values refer to male advantage. Source: LIS.

Supplementary material S1:

The APCD model as basis of the APC-GO

The second step relies on an adaptation called the APCL (lag) of our former APCD (detrended) model (Chauvel 2013; Chauvel et al. 2016). The APCD delivers a trend zero vector of cohort fluctuations. The APCD is modified here to deliver a γ_c vector of intensity and trend in gap. Based the pioneering works (Ryder 1965, Mason et al. 1973, Glenn 1976), important improvements of APC models were made in the last decade (Nielson 2015). Albeit some aspects are still debated (Luo et al. 2016), two aspects of the APC debate have clearly stabilized today. The first one is the identification of fluctuation: it is now clear that cohort fluctuations (i.e., the degree to which some cohorts did/do better than others after controlling for linear effects of age period and cohort) are (easily) identifiable with simple tools. This is the purpose of the APCD model[10] (Chauvel 2013; Chauvel and Schröder 2014; Chauvel et al. 2016), otherwise called ZLT (zero linear trend), a recent reformulation of the Holford model (1980). From a Lexis table where yapc is a dependent variable that pertains to an individual *i* of age *a* in period *p*, and thus of cohort membership *c*, where c=p-a, APCD, one can extract:

- a single constant β_0
- a single two-dimensional linear (=hyperplane) trend that can be arbitrarily associated with age and period, age and cohort or period and cohort, but no decomposition can be directly interpreted as causally relevant [this is the term $\alpha_0 rescale(a) + \gamma_0 rescale(c)$]
- three vectors (age, period and cohort $\alpha_a, \pi_p, \gamma_c$) of fluctuations defined by zero sum and zero trend

$$y^{apc} = \alpha_a + \pi_p + \gamma_c + \alpha_0 rescale(a) + \gamma_0 rescale(c) + \beta_0 + \varepsilon \qquad \text{(APCD)}$$

where the sums and trends of each set of coeffcients $\alpha_a, \pi_p, \gamma_c$ *are constrained to zero*;
α_0 *and* γ_0 *absorb the age and the cohort trend respectively*

As such, the APCD is not able to produce the solution needed, since the cohort vector expresses accelerations and decelerations of gender gaps once the general trend is suppressed. Therefore, we consider an extension by constraining the model.

This involves the second aspect of the APC debate, which pertains to the identification of trends and is thus more complex. Due to the collinear relation a=p-c, the decomposition of age, period and cohort linear effects (the above-mentioned hyperplane) has no general solution without the implementation of a constraint (Glenn 1976). Once it is done, this arbitrary choice leads to a unique APC trend decomposition. Some conventional 1980s APC models proposed to equate the first and the last coefficients of a cohort, or to keep the period trend as zero, for instance. Once a constraint is implemented, the model is identified; however, it is impossible (or difficult) to propose a general non *ad hoc* justification of this choice. Strategies which are supposed to make no arbitrary choice in the constraints – for example the APC-IE intrinsic estimator (Yang

[10] The APCD can be downloaded as a Stata ado-file by typing "ssc install apcd" in Stata.

et al. 2008) or the Hierarchic HAPC (Zheng et al. 2011) – actually hide such implicit arbitrary constraints. For instance, APC-IE is based on a principal component analysis to reduce the three dimensional indices *a p c* on a geometrically optimal two dimensional hyperplane; for multilevel strategies such as HAPC, random effects on period and cohort effects hide an implicit detrending of period and cohort (e.g., Bell and Jones 2017). These methods are even more problematic when dealing with the effect of education over age period and cohort. Due to their general inaptitude to relevantly decompose trends, they inadequately decompose the age effect of education as a strong, steady decline in education across life span – as seniors are always older than juniors. This is obviously misleading, if not absurd.[11]

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[11] See annexes and replication files of 'Problems with APC-IE and HAPC' in the online version of the study by Chauvel and Schröder (2015).

Supplementary material S2:

Descriptive statistics

Table S.1: Descriptive Statistics: Means and Standard Errors of (log)Income and Number of Children by Country and Cohort

Country	Variable/ Cohort	1935	1940	1945	1950	1955	1960	1965	1970	1975	1980
DE	(log)Income	10.75	10.86	10.84	10.78	10.75	10.77	10.7	10.58	10.32	10.32
	S.D.	(0.51)	(0.54)	(0.58)	(0.62)	(0.6)	(0.56)	(0.56)	(0.57)	(0.61)	(0.68)
	Number of Children	1.15	1.1	1.12	1.15	1.27	1.28	1.14	0.98	0.62	0.34
	S.D.	(01.02)	(01.06)	(01.04)	(01.05)	(01.03)	(01.05)	(01.03)	(01.)	(0.88)	(0.71)
DK	(log)Income	12.32	12.46	12.58	12.66	12.67	12.67	12.63	12.64	12.61	12.55
	S.D.	(0.51)	(0.52)	(0.52)	(0.54)	(0.57)	(0.56)	(0.58)	(0.58)	(0.63)	(0.67)
	Number of Children	0.34	0.45	0.59	0.81	1.13	1.33	1.22	1.06	0.8	0.44
	S.D.	(0.65)	(0.74)	(0.85)	(0.96)	(01.03)	(01.05)	(01.06)	(01.05)	(0.97)	(0.74)
ES	(log)Income	14.31	14.45	13.35	12.8	12.66	12.4	11.6	11.02	10.09	10.16
	S.D.	(0.78)	(0.78)	(02.08)	(02.28)	(02.29)	(02.41)	(02.44)	(02.13)	(0.72)	(0.76)
	Number of Children	1.79	1.98	1.81	1.57	1.47	1.42	1.27	1.02	0.63	0.21
	S.D.	(01.03)	(0.97)	(01.)	(0.98)	(0.92)	(0.91)	(0.96)	(0.93)	(0.84)	(0.54)
FI	(log)Income	11.87	11.98	11.7	11.54	11.52	11.48	11.31	11.03	10.45	10.43
	S.D.	(0.51)	(0.52)	(0.81)	(0.84)	(0.81)	(0.8)	(0.81)	(0.81)	(0.57)	(0.59)
	Number of Children	0.93	1.11	1.18	1.25	1.37	1.45	1.42	1.21	0.89	0.56
	S.D.	(0.97)	(01.03)	(01.05)	(01.07)	(01.09)	(01.11)	(01.11)	(01.11)	(01.02)	(0.87)
FR	(log)Income	11.76	11.92	11.69	11.41	11.37	11.23	10.99	10.72	10.19	10.09
	S.D.	(0.67)	(0.64)	(0.88)	(01.01)	(0.97)	(01.03)	(01.03)	(01.03)	(0.82)	(0.96)
	Number of Children	0.99	1.14	1.26	1.3	1.41	1.48	1.46	1.34	1.1	0.75
	S.D.	(01.04)	(01.07)	(01.07)	(01.07)	(01.06)	(01.05)	(01.07)	(01.09)	(01.08)	(01.01)
IL	(log)Income	10.65	10.95	11.13	11.2	11.16	11.44	11.57	11.66	11.66	11.73
	S.D.	(0.85)	(0.91)	(0.94)	(0.99)	(01.03)	(0.77)	(0.69)	(0.65)	(0.67)	(0.74)
	Number of Children	1.89	2.04	2.02	2.05	2.1	2.16	2.07	1.97	1.86	1.85
	S.D.	(01.12)	(01.07)	(01.08)	(01.05)	(01.)	(0.98)	(01.03)	(01.05)	(01.11)	(01.15)
IT	(log)Income	17.2	17.31	16.04	15.04	15.02	14.7	14.02	13.07	10.14	10.2
	S.D.	(0.68)	(0.68)	(02.84)	(03.37)	(03.33)	(03.58)	(03.76)	(03.79)	(0.73)	(0.81)
	Number of Children	1.5	1.55	1.53	1.47	1.42	1.39	1.24	1.11	0.78	0.65
	S.D.	(0.98)	(0.96)	(0.94)	(0.95)	(0.93)	(0.94)	(0.98)	(0.98)	(0.89)	(0.81)
LU	(log)Income	14.05	14.2	13.21	12.53	12.53	12.55	12.27	11.78	10.91	11.01
	S.D.	(0.52)	(0.54)	(01.62)	(01.66)	(01.66)	(01.71)	(01.73)	(01.57)	(0.54)	(0.55)
	Number of Children	1.21	1.22	1.16	1.14	1.27	1.4	1.37	1.23	1.01	0.54
	S.D.	(01.03)	(01.04)	(01.01)	(01.01)	(01.01)	(01.06)	(01.06)	(01.06)	(01.02)	(0.84)
NL	(log)Income	10.65	10.81	10.68	10.68	10.69	10.72	10.66	10.6	10.45	10.46
	S.D.	(0.6)	(0.56)	(0.59)	(0.56)	(0.53)	(0.52)	(0.51)	(0.49)	(0.44)	(0.48)
	Number of Children	1.04	1.13	1.08	1.09	1.32	1.48	1.45	1.31	1.01	0.85
	S.D.	(01.08)	(01.08)	(01.06)	(01.06)	(01.07)	(01.07)	(01.08)	(01.05)	(01.03)	(01.)
NO	(log)Income	12.57	12.69	12.79	13.09	13.14	13.18	13.19	13.18	13.09	12.88
	S.D.	(0.5)	(0.55)	(0.54)	(0.66)	(0.7)	(0.69)	(0.67)	(0.65)	(0.71)	(0.84)
	Number of Children	1.1	1.1	1.17	0.65	1.	1.36	1.57	1.5	1.07	0.53
	S.D.	(01.02)	(01.05)	(01.07)	(0.92)	(01.01)	(01.05)	(01.06)	(01.08)	(01.03)	(0.81)
UK	(log)Income	9.47	9.65	9.82	9.91	9.93	9.99	9.99	10.11	10.19	10.23
	S.D.	(0.73)	(0.74)	(0.76)	(0.76)	(0.77)	(0.71)	(0.7)	(0.67)	(0.6)	(0.6)
	Number of Children	0.59	0.73	0.85	1.03	1.27	1.38	1.3	1.17	0.98	0.65
	S.D.	(0.86)	(0.93)	(0.99)	(01.05)	(01.07)	(01.07)	(01.08)	(01.07)	(01.04)	(0.92)
US	(log)Income	10.3	10.41	10.49	10.54	10.55	10.63	10.69	10.72	10.72	10.74
	S.D.	(0.81)	(0.79)	(0.82)	(0.84)	(0.83)	(0.8)	(0.78)	(0.74)	(0.75)	(0.75)
	Number of Children	0.85	0.98	1.08	1.15	1.26	1.32	1.35	1.29	1.12	0.81
	S.D.	(01.)	(01.05)	(01.07)	(01.08)	(01.09)	(01.11)	(01.11)	(01.12)	(01.1)	(01.01)

Source: LIS.

Table A2: Descriptive statistics: Proportion of the Dichotomous Variables in the Sample by Cohort and Country

Country	Variable/Cohort	1935	1940	1945	1950	1955	1960	1965	1970	1975	1980	1985
DE	Female	0.49	0.45	0.50	0.49	0.53	0.52	0.50	0.52	0.54	0.55	0.57
	Employed	0.68	0.73	0.73	0.77	0.81	0.83	0.84	0.83	0.81	0.84	0.86
	Partner	0.85	0.87	0.87	0.87	0.84	0.81	0.78	0.75	0.71	0.61	0.52
	Tertiary education	0.11	0.15	0.19	0.22	0.28	0.28	0.27	0.26	0.27	0.27	0.34
DK	Female	0.50	0.50	0.49	0.50	0.49	0.50	0.49	0.49	0.50	0.50	0.50
	Employed	0.76	0.69	0.76	0.80	0.83	0.84	0.84	0.83	0.83	0.79	0.71
	Partner	0.78	0.76	0.76	0.75	0.73	0.72	0.71	0.68	0.66	0.61	0.52
	Tertiary education	0.16	0.17	0.20	0.25	0.28	0.28	0.27	0.29	0.32	0.35	0.35
ES	Female	0.46	0.44	0.47	0.49	0.49	0.50	0.51	0.52	0.51	0.51	0.50
	Employed	0.49	0.55	0.58	0.59	0.63	0.66	0.67	0.70	0.74	0.75	0.59
	Partner	0.85	0.87	0.87	0.85	0.82	0.75	0.66	0.69	0.63	0.45	0.25
	Tertiary education	0.06	0.07	0.11	0.14	0.19	0.24	0.29	0.32	0.38	0.40	0.39
FI	Female	0.49	0.50	0.49	0.49	0.50	0.50	0.50	0.50	0.50	0.49	0.50
	Employed	0.74	0.80	0.84	0.84	0.85	0.86	0.83	0.78	0.75	0.70	0.68
	Partner	0.82	0.84	0.85	0.85	0.84	0.81	0.81	0.81	0.78	0.75	0.72
	Tertiary education	0.11	0.15	0.17	0.15	0.16	0.17	0.17	0.19	0.27	0.33	0.37
FR	Female	0.51	0.51	0.50	0.50	0.51	0.52	0.52	0.53	0.53	0.55	0.57
	Employed	0.65	0.68	0.73	0.78	0.78	0.80	0.79	0.79	0.78	0.74	0.62
	Partner	0.84	0.85	0.85	0.85	0.82	0.79	0.77	0.78	0.73	0.69	0.56
	Tertiary education	0.04	0.08	0.13	0.17	0.18	0.18	0.22	0.28	0.37	0.40	0.35
IL	Female	0.51	0.51	0.51	0.52	0.53	0.53	0.52	0.54	0.52	0.51	0.51
	Employed	0.63	0.66	0.70	0.73	0.72	0.72	0.73	0.74	0.74	0.72	0.70
	Partner	0.88	0.86	0.87	0.86	0.85	0.80	0.77	0.73	0.69	0.61	0.47
	Tertiary education	0.20	0.24	0.29	0.35	0.35	0.35	0.37	0.40	0.48	0.47	0.39
IT	Female	0.52	0.51	0.51	0.51	0.53	0.51	0.53	0.50	0.50	0.46	0.49
	Employed	0.50	0.54	0.58	0.63	0.68	0.70	0.69	0.68	0.65	0.66	0.54
	Partner	0.86	0.87	0.87	0.85	0.82	0.73	0.65	0.55	0.40	0.28	0.19
	Tertiary education	0.08	0.05	0.08	0.09	0.12	0.09	0.11	0.14	0.16	0.20	0.26
LU	Female	0.49	0.54	0.53	0.48	0.52	0.49	0.51	0.48	0.52	0.53	0.52
	Employed	0.43	0.50	0.59	0.61	0.62	0.74	0.80	0.83	0.83	0.83	0.79
	Partner	0.85	0.83	0.85	0.84	0.80	0.76	0.77	0.76	0.76	0.71	0.50
	Tertiary education	0.03	0.05	0.10	0.12	0.14	0.15	0.17	0.23	0.31	0.31	0.30
NL	Female	0.53	0.50	0.50	0.50	0.50	0.52	0.52	0.54	0.53	0.52	0.52
	Employed	0.42	0.50	0.62	0.66	0.74	0.78	0.84	0.87	0.90	0.91	0.85
	Partner	0.86	0.88	0.88	0.87	0.86	0.85	0.84	0.84	0.83	0.77	0.61
	Tertiary education	0.11	0.14	0.19	0.22	0.27	0.30	0.30	0.33	0.41	0.43	0.45
NO	Female	0.48	0.49	0.48	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
	Employed	0.74	0.80	0.83	0.83	0.77	0.82	0.83	0.84	0.84	0.82	0.73
	Partner	0.85	0.87	0.86	0.86	0.75	0.73	0.71	0.72	0.72	0.66	0.48
	Tertiary education	0.14	0.18	0.22	0.24	0.29	0.30	0.32	0.37	0.42	0.45	0.42
UK	Female	0.50	0.51	0.51	0.51	0.52	0.52	0.52	0.53	0.53	0.54	0.55
	Employed	0.70	0.64	0.70	0.74	0.77	0.79	0.79	0.77	0.78	0.78	0.76
	Partner	0.81	0.79	0.81	0.80	0.78	0.76	0.75	0.71	0.68	0.66	0.58
	Tertiary education	0.07	0.09	0.12	0.16	0.20	0.19	0.21	0.23	0.33	0.43	0.44
US	Female	0.51	0.52	0.52	0.51	0.51	0.52	0.52	0.53	0.53	0.53	0.53
	Employed	0.69	0.73	0.76	0.78	0.78	0.79	0.80	0.79	0.78	0.76	0.72
	Partner	0.76	0.74	0.74	0.73	0.72	0.69	0.70	0.71	0.69	0.65	0.55
	Tertiary education	0.23	0.27	0.32	0.38	0.38	0.36	0.38	0.40	0.40	0.40	0.40

Source: LIS.

Table A3: Descriptive statistics: Proportion of the Occupational Categories in the Sample by Cohort and Country

Country	Occupation/Cohort	1935	1940	1945	1950	1955	1960	1965	1970	1975	1980	1985
DE	Managers	0.10	0.10	0.14	0.17	0.19	0.17	0.16	0.17	0.16	0.18	0.24
	Professionals	0.43	0.50	0.46	0.50	0.52	0.55	0.57	0.56	0.53	0.52	0.49
	Others	0.47	0.40	0.39	0.33	0.29	0.28	0.26	0.28	0.31	0.29	0.28
DK	Managers	0.19	0.05	0.03	0.07	0.11	0.11	0.10	0.11	0.14	0.19	0.20
	Professionals	0.45	0.12	0.07	0.17	0.23	0.25	0.25	0.24	0.31	0.44	0.39
	Others	0.36	0.83	0.90	0.77	0.65	0.64	0.65	0.65	0.55	0.37	0.41
ES	Managers	0.07	0.08	0.09	0.10	0.12	0.13	0.12	0.14	0.14	0.13	0.12
	Professionals	0.35	0.34	0.36	0.36	0.38	0.40	0.41	0.41	0.49	0.51	0.40
	Others	0.58	0.59	0.55	0.55	0.50	0.47	0.47	0.45	0.36	0.36	0.48
FI	Managers	0.17	0.21	0.24	0.22	0.23	0.23	0.23	0.24	0.26	0.22	0.20
	Professionals	0.49	0.48	0.51	0.53	0.54	0.55	0.53	0.49	0.46	0.46	0.44
	Others	0.35	0.30	0.25	0.25	0.23	0.22	0.24	0.27	0.28	0.32	0.36
FR	Managers	0.09	0.13	0.17	0.19	0.17	0.14	0.15	0.16	0.18	0.17	0.13
	Professionals	0.48	0.48	0.50	0.53	0.54	0.57	0.56	0.57	0.53	0.52	0.45
	Others	0.43	0.39	0.33	0.28	0.29	0.28	0.29	0.27	0.29	0.31	0.42
IL	Managers	0.12	0.13	0.15	0.15	0.13	0.13	0.14	0.15	0.15	0.14	0.11
	Professionals	0.48	0.49	0.51	0.52	0.53	0.53	0.53	0.52	0.52	0.52	0.53
	Others	0.40	0.38	0.34	0.33	0.35	0.33	0.33	0.33	0.33	0.35	0.36
LU	Managers	0.03	0.03	0.07	0.11	0.12	0.13	0.14	0.17	0.21	0.21	0.17
	Professionals	0.23	0.17	0.19	0.23	0.28	0.37	0.34	0.44	0.52	0.51	0.53
	Others	0.75	0.80	0.75	0.66	0.61	0.49	0.52	0.39	0.27	0.27	0.30
NL	Managers	0.06	0.11	0.13	0.16	0.20	0.22	0.24	0.25	0.27	0.31	0.29
	Professionals	0.08	0.16	0.16	0.23	0.31	0.33	0.43	0.43	0.42	0.54	0.52
	Others	0.86	0.73	0.71	0.61	0.49	0.45	0.33	0.32	0.31	0.15	0.19
UK	Managers	0.19	0.17	0.21	0.23	0.24	0.23	0.22	0.21	0.23	0.23	0.18
	Professionals	0.46	0.40	0.43	0.45	0.46	0.49	0.50	0.50	0.49	0.48	0.48
	Others	0.35	0.43	0.35	0.32	0.30	0.28	0.28	0.29	0.28	0.30	0.34
US	Managers	0.20	0.24	0.27	0.28	0.27	0.26	0.26	0.26	0.26	0.24	0.20
	Professionals	0.42	0.43	0.44	0.44	0.45	0.48	0.48	0.47	0.47	0.47	0.46
	Others	0.37	0.33	0.29	0.27	0.27	0.27	0.27	0.26	0.27	0.29	0.33

Source: LIS.