

Is employment polarization inevitable? Occupational change in Ireland and Switzerland, 1970-2010

Emily Murphy and Daniel Oesch, 27 April 2016

Abstract

The routinization thesis expects technological change to hollow out the middle of the employment structure, thus leading to uniform patterns of polarized occupational change in affluent countries. We argue that occupational change is also decisively shaped by labor supply – educational expansion and immigration – as well as labor market institutions. Thus, polarization represents just one scenario of occupational change. We analyze occupational change for Ireland and Switzerland and improve upon existing studies in two ways. First, by studying the long term (1970-2010), we test whether an onset of employment polarization fits with the predicted timing of mass diffusion of information technology. Second, we use large-scale census data and an encompassing definition of the labor force, not excluding migrants, women or part-timers. Our result shows no time trend of occupational upgrading morphing into polarization. The largest employment gains are in high-paid occupations and largest losses in low-paid ones. We find a close link between patterns of occupational change and the evolution of labor supply, particularly immigrants and women. Inflows of low-skilled migrants fueled job expansion in low-end occupations in the 1980s in Switzerland and during the 2000s in Ireland. The increased employment of women first supplied low-paid labor between 1970 and 1980. In the 1990s and 2000s, the inflow of tertiary-educated women was then key for occupational upgrading.

JEL classification: J15, J21, J31, J62

Emily Murphy
Jacobs Center for Productive Youth Development
& LIVES – Swiss National Centre of Competence in Research
University of Zurich
CH-8050 Zurich
murphy@jacobscenter.uzh.ch

Daniel Oesch
Life Course and Inequality Research Centre (LINES) & LIVES – Swiss National Centre of
Competence in Research
University of Lausanne
CH-1015 Lausanne
daniel.oesch@unil.ch

Paper presented at the “Challenges in post-industrial labor markets seminar” in
Lausanne, 3 May 2015

1 Introduction

In the early 2000s, a set of new studies created a stir in the social sciences by arguing that technological change does not lead to upgrading, but rather a polarization of the employment structure (Autor 2003, Wright and Dwyer 2003, Goos and Manning 2007). The issues at stake are no less than spectacular. Labor markets that grow at the margins have far-reaching implications for social cohesion and economic inequality.

However, the evidence on job polarization is far from conclusive. So far, clear-cut trends have only been shown for the United States (Wright and Dwyer 2003; Dwyer 2013) and Britain (Goos and Manning 2007). Contrary to the hypothesis of a uniform trend towards polarization, findings for Europe show substantial cross-country variation, with a predominance towards occupational upgrading (Fernández-Macías 2012; Oesch 2013). If technological change is the sole determinant of occupational change, we should observe employment polarization in other affluent countries.

We argue that employment polarization is an outcome specific to the nexus between institutions and labor supply found in the two Anglo-Saxon countries. American and British labor markets do not only share similar levels of technology. They also share similar market-liberal wage-setting institutions and similar migratory regimes, both countries attracting a disproportionate share of immigrants with low and very high levels of education (OECD 2008: 83). Polarization may thus result from the specific interaction between technology, lenient wage-setting institutions and large migratory flows that augments labor supply at the top and bottom end (Kalleberg 2012: 429-30).

Why should occupational trends differ across countries and time-periods? We argue that changes in the educational profiles of native and immigrant men and women (labor supply) and changes in the rules under which employers create or destroy jobs (labor market institutions) decisively shape the pattern of upgrading or polarization. In other words, educational expansion, female labor market participation and immigration determine the pool of worker profiles available to employers. Labor market institutions determine the price of these workers. The adoption of technology and the creation of jobs are then, to some extent, endogenous to institutions (Acemoglu 2003) and the evolution of labor supply (Lewis 2006).

This paper examines this argument by analysing occupational change for two countries, Ireland and Switzerland, between the 1970s and 2010s. For the polarization

thesis to hold, a common polarizing trend should be observed – a trend that echoes the American and British trajectory and first appears in the 1990s with the mass diffusion of information technologies (Goos and Manning 2007, Autor et al. 2008).

In contrast, if wage-setting institutions and changes in labor supply do matter, we would expect variation between the two countries and over time. Switzerland's coordinated market economy leads to a more compressed earnings structure than Ireland's more liberal wage-setting institutions. In addition, the evolution of labor supply differs between the two countries, and over time. Switzerland witnessed outmigration in the 1970s and large immigration in the 1980s and 2000s, whereas Ireland experienced positive in-migration in the 1970s, mass emigration in the 1980s, and a surge of foreign immigration and return migration between 1996 and 2007.

In our empirical analysis of occupational change, we try to improve upon existing studies on three accounts. (i) We use an encompassing definition of the working population, including the self-employed, immigrants, workers in agriculture and the public sector; (ii) we use the largest datasets available, namely census data, instead of survey data with often small samples; (iii) we use long time periods (1970-2010), as opposed to short time spans strongly influenced by business cycle variation.

Our paper is structured as follows. Section 2 and 3 present a conceptual frame for understanding how changes in institutions and labor supply shape occupational change. Section 4 outlines the specificities of the Irish and Swiss labor markets and spells out our hypotheses. Section 5 presents our data and analytical strategy. The following three sections present our empirical evidence. To conclude we discuss the implications of our findings for the polarization debate.

2 Prerequisites for polarization

2.1 Technology and tasks

There is a large consensus that long-term occupational change is driven by technology (Manning 2004). Workers are displaced from occupations strongly affected by technological progress, such as agricultural and manufacturing jobs, and migrate to occupations for which technology has less direct influence, such as health care and educational jobs. David Autor and his colleagues (2003) proposed a novel distinction in the influence that technology has on employment, depending on whether jobs

primarily included routine or non-routine tasks. While computers replace *routine* production and clerical tasks, partly carried out in mid-wage jobs, they have little impact on either the *non-routine* cognitive tasks carried out in high-end jobs, or the *non-routine* personal service tasks carried out in low-end jobs (Autor et al. 2003; Goos and Manning 2007). Computers and machines act as a complement to both high-skilled analytical and low-skilled interpersonal service jobs, but may hollow out the middle of the employment structure, traditionally occupied by production workers and clerks.

The routinization thesis argues that the skill-biased technical change of the 1980s has given way to polarized change since the 1990s. This thesis is easily tested. Western countries are exposed to the same technological change and should thus have experienced a shift from occupational upgrading in the 1970s and 1980 to employment polarization in the 1990s and 2000s (Autor et al. 2008: 301). The empirical case has been made for two countries thus far, namely the US and Britain. Wright and Dwyer (2003) used the Current Population Survey to document a shift in the American job structure from clear-cut upgrading in the 1960s and 1970s to even job growth in the 1980s and polarization in the 1990s. A careful replication study arrived at the same conclusion for Britain (Goos and Manning 2007). In contrast, the employment changes in other countries of Western Europe show much variation – where an overall trend can be established it is towards occupational upgrading rather than polarization (Fernández-Macías 2012; Oesch 2013).

Clearly, the evidence showing that polarization is a common cross-country phenomenon is far from conclusive. The typical routinization paper quickly presents, as stylized fact, the phenomenon (usually a smoothed curve of employment change), before moving on to the nobler task not of establishing, but of *explaining*, this curve. The reader thus gets a highly sophisticated explanation of a highly uncertain phenomenon.

We illustrate this point for three influential economic studies documenting employment polarization in Europe. Based on the European labor force survey 1993-2010, Goos and his colleagues (2014) distinguish 21 occupations, divide them into employment terciles of highly unequal size, and conclude that European labor markets have polarized. However, their sample excludes workers from several key sectors and occupations, thereby omitting some occupations that have declined in the labor

market's bottom-end (mining and agriculture), and other occupations that have expanded at the top-end (education and public administration).

The analysis of occupational change in Germany by Dustmann and colleagues (2009: 871) is based on a sample of full-time male employees in the private sector in West Germany. Similarly, the study by Spitz-Oener (2006: 266) uses a sample of German national employees in West Germany. Both studies omit the self-employed and employers. Additionally, Dustmann et al. (2009) exclude women, civil servants and part-time workers, whereas Spitz-Oener (2006) excludes immigrants and agricultural workers. However, it seems doubtful that the changing pattern of German male workers in fulltime, (non-agricultural) dependent employment in the private sector accurately reflects the changing job pattern of immigrants, female part-timers, the self-employed, welfare-state employees and farm laborers.

2.2 Labor supply and institutional arrangements

These examples suggest that the *empirical* case for employment polarization is not watertight. But are there reasons to doubt its *theoretical* foundation? Technology certainly affects firms' demand for labor. Yet firms do not adopt new technologies independently from the kind of workers they find in the labor market. Rather, the profitability of substituting or complementing labor with technology is assessed with occupational incumbents in mind. Depending on whether more or less educated workers are in plentiful supply in a particular region, employers resort to different production techniques and create jobs in different occupations (DiPrete and McManus 1996: 42). In other words, focusing solely on labor demand is not enough; labor supply is also paramount for occupational change.

In particular, the presence of a large pool of unqualified labor seems a precondition for employment polarization. Without an abundant supply of workers willing to take on low-paid jobs – less educated workers – growth in low-end jobs will be hampered. Where constant educational expansion and a restrictive immigration policy limit the supply of less educated workers, employers face strong incentives to make their production techniques complementary to the (intermediate and high) educational levels of available workers. If instead a country attracts many immigrants with low levels of education, and a sizeable share of nationals leave the education system at the

end of obligatory schooling, employers can draw from a larger pool of job candidates for low-end occupations.

Countries not only vary in the skill composition of their labor force, but also in their labor market institutions – and institutions likely channel firms' demand for labor into different occupational outcomes. Firms will create less low-end jobs in countries where they are given less latitude to set low wages – and the pay in jobs they do create will be closer to the median wage. The idea is that governments have some leeway in how they accommodate technical change and translate it into the organization of labor (Fernández Macías 2010: 226, Kalleberg 2012: 430). State policies and worker unionization can lead to pay norms that push employers to organize the labor process in particular ways (Rosenfeld 2006). Where unions and the welfare state lead to wage compression and constrain firms to pay higher wages to less educated workers, firms will be under pressure to introduce new technologies that increase the productivity of less educated workers (Acemoglu 2003: 127).

Is there evidence that shifts in skill supplies have affected patterns of occupational change? In the US, government-coordinated labor migration in the second half of the 20th Century was responsible for unprecedented levels of low-skilled immigration from Mexico, initially to supply farm jobs. Employers actively encouraged this, not for want of workers in the local labor market, but in order to ensure that wage floors did not rise (Rodriguez 2004: 456). Immigration was also paramount to the expansion of low-end service jobs in the United States – and thus for employment polarization. During the 1990s, two thirds of jobs created in the bottom tier of the US labor market were filled by immigrants (Wright and Dwyer 2003: 309). Without a growing pool of workers ready to fill these low-wage jobs, the number of low-end jobs in the US would not have increased to the same extent. Similarly, plant-level evidence collected by Lewis (2006: 35) suggests that jumps in immigration, or higher shares of high-school dropouts, in a given metropolitan area of the US induced more manufacturing plants to resort to less modern production techniques – notably to less automation (Lewis 2006: 35).

Educational policies are central drivers of occupational upgrading. This has been the case for changes in obligatory school laws in the US (Rauscher 2013) or for strong increases in women's tertiary education in Ireland in the 1990s, leading to an increasing over-representation of women in top-end public sector occupations (Turner and McMahon 2011). Likewise, over the 2000s in Britain and Spain employment

among nationals in low-end occupations decreased. Were it not for a large immigration boom in the early 2000s we would likely have observed a stronger shift towards occupational upgrading and not net employment expansion in the labor market's bottom quintile, an expansion exclusively due to growth among foreign workers (Bernardi et al. 2009: 160; Oesch and Rodriguez Menes 2011: 531).

Labor supply interacts with institutions. Institutional constraints, such as extensive collective bargaining, high minimum wages and generous unemployment benefits, may lead employers to opt for a 'high road' job strategy (Streeck 1997). There is ample cross-national evidence on the effect institutions have on production techniques and the occupations associated with them in sectors such as hospital care, call centres, or food processing (Gautié and Schmitt 2010). Cross-country differences in job design seem particularly stark in the hospital sector: the employment of low-skilled and poorly paid cleaners and nursing assistants in the United States contrasts with the more highly skilled and better-paid jobs of hospital attendants in Denmark. Although technological pressures in the hospital sector are similar across developed countries, human resources strategies differ strongly, dependent as they are on institutional context (Méhaut et al. 2010: 360).

In sum, the impact technology has on the job structure depends on the evolution of labor supply and institutions, which means employment polarization is just one scenario of post-industrial change – one specific to liberal market economies with large net immigration, such as the United States or Britain.

3 The onset of polarization

3.1 Timing and institutions in Ireland and Switzerland

A focal point for doubting the pervasive nature of polarization due to routinization is that the most robust evidence stems from Britain and the US. With respect to variation in institutional arrangements and labor supply dynamics, these countries share many key similarities. In addition, the timing element of an onset of polarization has not been explicitly tested backwards in time. If technological change is the sole and decisive determinant of occupational change we should observe employment polarization in other countries, and it should depart from earlier decades' patterns at the time computers flooded the markets as of the 1990s.

We analyse the pattern of occupational change for two countries whose wage-setting institutions and skill supply evolution differ. Ireland is commonly qualified as a liberal market economy (like Britain), whereas Switzerland belongs to the coordinated market economies (like Germany) (Hall and Soskice 2001). With respect to wage setting, the Swiss labor market shares many features with Germany, the main difference being weaker trade unions and more lenient dismissal policies. Collective bargaining in Switzerland is mainly coordinated across industries by powerful employers' association (Oesch 2011). In contrast, Ireland's industrial relations system has traditionally been decentralized, sharing many features of the British system. However, while Britain further deregulated its wage-setting system in the 1980s and early 1990s, from 1987 onwards Ireland moved to more centralized bargaining and state coordination in the labor market (Baccaro and Simoni 2007) and tried to align the evolution of wages in the public and private sector (Roche 2007). Overall, labor market institutions and the welfare state create higher hurdles for low-wage job creation in Switzerland than in Ireland.

With respect to skill supplies, both Ireland and Switzerland experienced a massive surge in educational attainment over the last few decades. While this process was gradual in Switzerland (Buchmann et al. 2007; Becker and Zangger 2013), Ireland has witnessed a dramatic expansion in educational participation since the 1980s (Whelan and Hannan 1999; Barrett 2002). The proportion of the adult population aged 25-64 with no more than compulsory schooling was 51 per cent in Ireland in 1971, and 40 per cent in Switzerland in 1970. At the end of the period under study, this proportion had declined to 27 percent in Ireland (2006) and to 13 per cent in Switzerland (2010). Growth in educational attainment did not falter in either Ireland or Switzerland – unlike the slow-down observed in the US (Goldin and Katz 2007: 152). In both countries, the catch-up effect in educational attainment was particularly marked for women. By 2010 and 2006, respectively, 32 percent of the female workforce aged 25-64 held tertiary education in both countries – compared to 43 percent of the male workforce in Switzerland and 24 percent in Ireland.

Perfect skill-to-job matching would mean an increase in highly educated workers taking on high-skilled jobs. Were the evolution of educational attainment and the employment structure to go hand in hand in Ireland and Switzerland, we would expect clear-cut occupational upgrading. However, the contribution of immigration to labor supply is inadequately captured by data on educational attainment, and is subject to

fluctuations in particular decades via migration policy changes. During Ireland's immigration boom in the early 2000s, newly arrived immigrants had higher levels of educational attainment than the domestic population. A large share of them accepted unskilled and low-paying jobs in services, tourism and manufacturing, jobs for which they were over-qualified (OECD 2007: 137).

Unlike Ireland, Switzerland had one of the lowest over-qualification rates among immigrants within the OECD in the early 2000s (OECD 2007: 137). This was a direct result of a radical policy turn following the recession of the 1990s. Up until the end of the 1980s, the Swiss economy mostly attracted low qualified immigrants in order to staff jobs in manufacturing, construction, tourism and agriculture. However, Switzerland's recession of the early 1990s brought a shift in migration policy (Flückiger 1998: 384-8). As a result, highly qualified immigrants began to outnumber low qualified ones in the 2000s.

Figure 1 shows the influence of immigration on labor supply. Ireland's small net immigration in the 1970s turned strongly negative in the 1980s when unemployment peaked at 16 per cent and many Irish citizens emigrated to Britain and the US (Honohan and Walsh 2002). When the Irish economy began its spectacular take-off in 1996, it attracted large numbers of immigrants. In Switzerland, the consumption boom in the 1980s invited large numbers of (mostly low-skilled) immigrants. Economic immigration dwindled during the long recession of the 1990s, but soared again in the 2000s as many professionals from neighbouring EU-countries came to Switzerland.

Figure 1. Net migration in Ireland and Switzerland, 1974-2010 (in 1000 individuals)



Data Source: Central Statistics Office Ireland, Swiss Federal Office of Statistics

3.2 Hypotheses of occupational change by decades

From our discussion of labor market institutions and labor supply in Ireland and Switzerland what are the hypotheses for occupational change? Subdividing decades by country, we arrive at the expectations shown in Table 1. The extent of employment polarization in Switzerland should be limited, where minimum wages set by collective bargaining and the reservation wage set by the welfare state hamper the creation of low-wage jobs. The period when polarization seems likely is the consumption and housing boom of the 1980s, during which the Swiss labor market drew in large numbers of less educated migrant workers. For the 1970s, 1990s and 2000s, the interaction of coordinated bargaining and educational expansion (including qualified immigration in the 2000s) make occupational upgrading a more likely outcome.

In Ireland, institutions leave firms more leeway to create low-end jobs. Whenever there was a positive labor supply shock – a surge in migration – it is likely that the Irish labor market created jobs at both ends of the occupational hierarchy. Accordingly, we expect polarization in the boom period between the mid-1990s and mid-2000s, whereas upgrading seems more likely in the recessionary decades of the 1970s and 1980s as well as during the sluggish growth period of the early 1990s.

Our country and period-specific expectations contrast with the hypotheses derived from routinization, which leads us to expect occupational upgrading in the 1970s and 1980s and job polarization in the 1990s and 2000s (Autor et al. 2008: 301).

Table 1. Hypotheses of occupational change – based on routine-based technological change only or the addition of labor supply and institutions

		1970s	1980s	1990s	2000s
H1: Evolution in labor supply & Institutions	IRE	<u>Upgrading</u>	<u>Upgrading</u>	<u>Upgrading</u>	<i>Polarization</i>
	SWI	<u>Upgrading</u>	<i>Polarization</i>	<u>Upgrading</u>	<u>Upgrading</u>
H2: Task-based technological change (routinization)	IRE		<u>Upgrading</u>		<i>Polarization</i>
	SWI		<u>Upgrading</u>		<i>Polarization</i>

4 Data and methods

Studies on occupational change tend to be plagued by two problems. First, they are based on survey data and hence run into problems of sample size. Occupations are the building blocks of the analysis on employment change, and require a large number of observations to reliably measure changes in their size; census data are thus preferable to survey data. Second, although shifts in the employment structure are long-term phenomena that require long-term data, these studies often cover short time periods of 12 to 18 years. Accordingly, they risk showing (transitory) business cycle effects.

We improve on this by the use of census data with more cases per occupation category, and data spanning back four decades. For Ireland, we take the cross-sections from 1971, 1981, 1991, 1996 and 2006. For Switzerland we select the years 1970, 1980, 1990, 2000, and 2010. The Irish data were extracted from the Integrated Public Use Microdata Series (IPUMS) and contain a 10 percent representative national sample; the Swiss data from 1970 up to 2000 are a full population census, whereas 2010 is a 5 percent nationally representative sample

We restrict our sample to 22 to 64¹ year old individuals, and include all jobholders who report being employed² with valid information on occupation and industrial sector. Our data do not allow us to distinguish between full- and part-time workers. There are no indicators on this item for Ireland. In Switzerland, we are only able to impose a restriction of 6 hours of work per week for comparison across each of the five data points. This is an imperfect solution, but has the side-benefit of covering part-time jobs – jobs that gained importance in tandem with increasing female labor participation.

Our analyses are based on large numbers of observations. For Ireland our initial sample in 1971 is 80,124 and reaches 170,389 in 2006. In Switzerland the number of observations ranges from 2,305,578 in 1970 to 125,450 in 2010. Items with missing values reduce the number of observations in the analyses related to nationality and educational attainment, notably in earlier decades. However, our census data still provide us with a more accurate description of trends than labor force surveys.

To trace the evolution of job-quality quintiles over time we adopt the analytical strategy developed by Wright and Dywer (2003). We first distinguish occupations as precisely as possible. During the period of study, the Irish census coded occupations according to several nation-specific schemas³. These schemas are roughly translated

into ISCO-88 at the one digit level in IPUMS, providing us with 9 occupational groups. In addition to occupations, we use the available information on 14 economic sectors. For our Irish sample, we thus define an occupation based on a matrix of 9 occupational groups by 14 economic sectors.⁴

For Switzerland, occupational information stems from the ISCO-88 variable at the detailed 4-digit level, available for 1970-2000. For 2010 we use a crosswalk to translate the ISCO-08 variable to ISCO-88 (Lambert and Griffiths 2011). Since this coding scheme already incorporates relevant industry distinctions, we only use a 6-sector variable to further disaggregate certain large and indiscriminate occupations such as general managers, protective service workers, secretaries and clerks. In both countries, occupations with less than 30 observations are collapsed into neighbouring occupations. This leaves us with 89 occupations for Ireland and 177 for Switzerland.

We define jobs as 'good' or 'bad' jobs based on median wages: the higher an occupation's median wage, the better the occupation. The earliest data available to determine our country-specific job rankings start in the early 1990s, a period which roughly corresponds to the mid-point of our analysis. Our census data do not include information on earnings, and instead we use survey data. In the Irish case we draw on the Living in Ireland (LII) survey, which is the Irish component of the European Community Household Panel, merging the years 1994-1999. For the Swiss earnings data we use the annual Swiss Labor Force Survey, merging the years 1993-1998.

Five years are pooled, between 1994 and 1999 for Ireland, and between 1993 and 1998 for Switzerland. We calculate the median wage of each occupation over this period by averaging the hourly median earnings (expressed in constant 2010 prices), weighted by the number of individuals employed in the occupation over the six years in total. We use the same sample restrictions as for the census data to compute these occupational median wages – with the two additional conditions that individuals work at least 8 hours per week and that occupations hold a minimum of 20 valid wage observations.

Our study equates occupational upgrading with an expansion of higher paid occupations at the expense of low-paid occupations. The computed median wages of an occupation serve to order occupations from the highest paid to the lowest paid ones in a given country. These rank-ordered occupations are then classified into one of five quintiles, each comprising as close to 20 percent of total employment in each base

year. Earnings are thus solely used to determine the quality of an occupation – and not to analyse the evolution of wage inequality.

In order to check the reliability of our results, we conducted a second set of analyses where the quality of an occupation was instead measured with the average educational level of occupational incumbents.⁵ Quintiles derived from occupations ranked by their average education level in each country, calculated separately for each base year in the census data, i.e. 1970/1; 1980/1; 1990/1 and 1996/2000. The idea is that job-holders' education serves as proxy for the skill requirements of an occupation (Fernández-Macías 2010: 90). As will be shown below, the two measures of job quality lead to similar conclusions in terms of occupational change.

5 Occupational change in Ireland and Switzerland

Before examining the onset of polarization and change by decades, we begin by looking at the five occupations that expanded or declined most over the last forty years in each country (see Table 2). For each occupation we note the quintile in which the occupation was set in 1970 in parentheses; quintile 1 comprises the lowest-paid occupations and quintile 5 the highest-paid ones.

In both countries, job growth has taken place in occupations associated with education, social welfare and business services. Where the two countries differ is in the hierarchical level at which employment has expanded. Job expansion in Switzerland has been heavily concentrated in financial, IT, engineering and educational occupations set in quintiles 4 and 5. In contrast, Ireland also saw the number of lower paid jobs rise – in hotels and restaurants as well as in health and social services. Occupations with the strongest decline comprise many 'male' manual occupations in manufacturing and agriculture: farmhands, manufacturing laborers, builders, and crafts workers. In Switzerland, secretaries in manufacturing also witnessed a strong job decline over the last four decades.

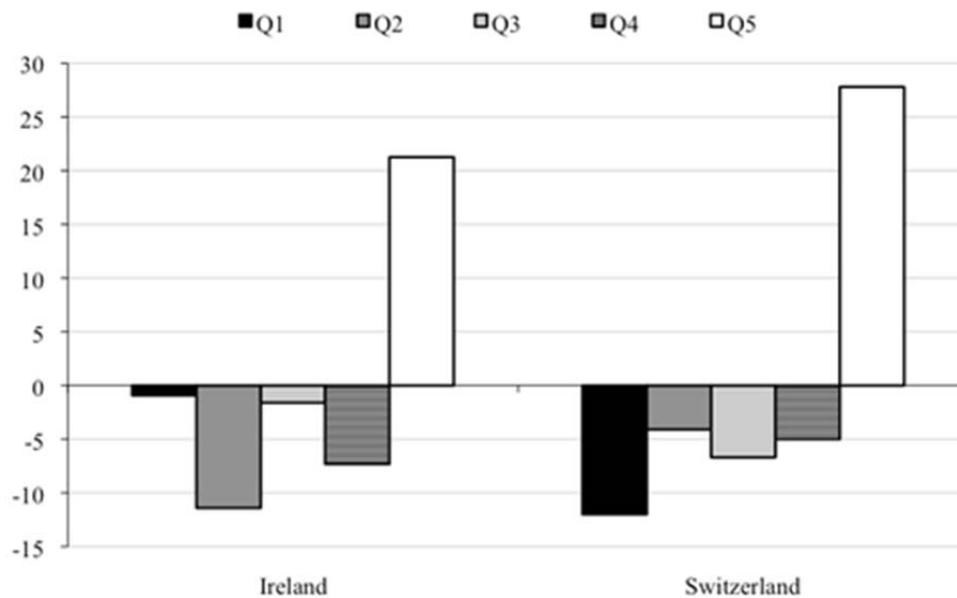
Table 2. The five occupations that experienced the largest absolute employment growth and decline between the 1970s and 2000s

Ireland, 1970-2006		Switzerland, 1970-2010	
Strongest growth	Strongest Decline	Strongest growth	Strongest Decline
Crafts workers in construction (3)	Skilled agricultural workers (2)	Clerks in business services (4)	Manufacturing laborers (1)
Associate professionals in retail, hotels (5)	Elementary occupations in construction (3)	Engineering technicians (5)	Farmers (1)
Service workers in hotels and restaurants (1)	Elementary occupations in agriculture (1)	Special education professionals (5)	Secretaries in manufacturing (2)
Service workers in health and social services (2)	Crafts workers in manufacturing (4)	Computer systems analysts (5)	Machinery mechanics (4)
Professionals in education (5)	Elementary occupations in manufacturing (2)	Managers in business services (5)	Building frame workers (4)

Source: Irish Census (IPUMS) 1971-2006; Swiss Census 1970-2010

Figure 1 displays the pattern of employment change across the five quintiles for Ireland and Switzerland over the past four decades. Over the long term, the two countries share a common picture of occupational upgrading. A look at the evolution of occupations within quintiles illustrates the shift over time from (agrarian-) industrial to service-based economies. The employment share of the four lower quintiles 1 to 4 decreased, whereas employment strongly expanded in the high-end quintile 5; jobs such as secondary school teacher, financial manager and senior officials in health and social services. While the two countries differ in the extent to which the lower and middle quintiles declined, the greatest employment losses did not take place in the middle of the occupational hierarchy, but towards the bottom end. Over the span of forty years, quintiles 1 and 2, comprising elementary and skilled agricultural occupations and manufacturing jobs, combined fell by 12 percentage points (p.p) in Ireland and by 16 p.p. in Switzerland.

Figure 2. Occupational change across quintiles in Ireland, 1971-2006, and Switzerland, 1970-2010 (relative change in percentage points)



Crucial for the routinization thesis is that polarization trends appear in the time when computer technologies made a large break-through in workplaces. For this, we turn to an analysis of employment changes by decade (see Figure 2). In order to account for differences in the business cycle and job growth over the last forty years, we compute these results of occupational change in absolute numbers (in 1000 jobs).

In the 1970s, we observe a pattern consistent with skill-biased technological change in both Ireland and Switzerland. The majority of job creation during this decade was in high-paid occupations, with net growth in quintile 5 of 90,000 jobs in Ireland and of over 100,000 jobs in Switzerland. This job expansion in quintile 5 constituted 80% of net growth in Switzerland, 62% in Ireland. Clerical workers in public administration, communication, and finance made up a part of Ireland's growth of 45 000 jobs in quintile 3. While the number of secretaries and clerks in public administration also grew in Switzerland, other higher paid occupations in quintile 5 such as architects and engineers saw their numbers rise more substantially.

In the 1980s, we observe an unequivocal polarisation of the employment structure in both countries, with the strongest job growth in quintiles 1 and 5. Slower off the mark in its transition to a post-industrial society (Whelan and Layte 2002), Ireland experienced a recession during much of the 1980s. With unemployment high, mass emigration followed. The outflow of potential labor supply was skewed towards the

highly educated. In the peak year 1989, 55 per cent of tertiary-level graduates emigrated from Ireland (O'Grada and Walsh 1994 in Barrett 2002: 152). Nevertheless, quintile 5 increased considerably, albeit by half the amount of the previous decade, spurred by growth among professionals in education and business services, particularly in finance. In the 1980s, Switzerland's economy was in a better shape as construction boomed in the decade's second half and employment expanded in quintile 4 and 5. Interestingly, this growth at the labor market's top end was flanked by a massive increase in employment in quintile 1. More than a quarter of a million jobs were created in Switzerland's low-end quintile 1, where growth was strongest among manufacturing laborers and, just as in Ireland, sales assistants.

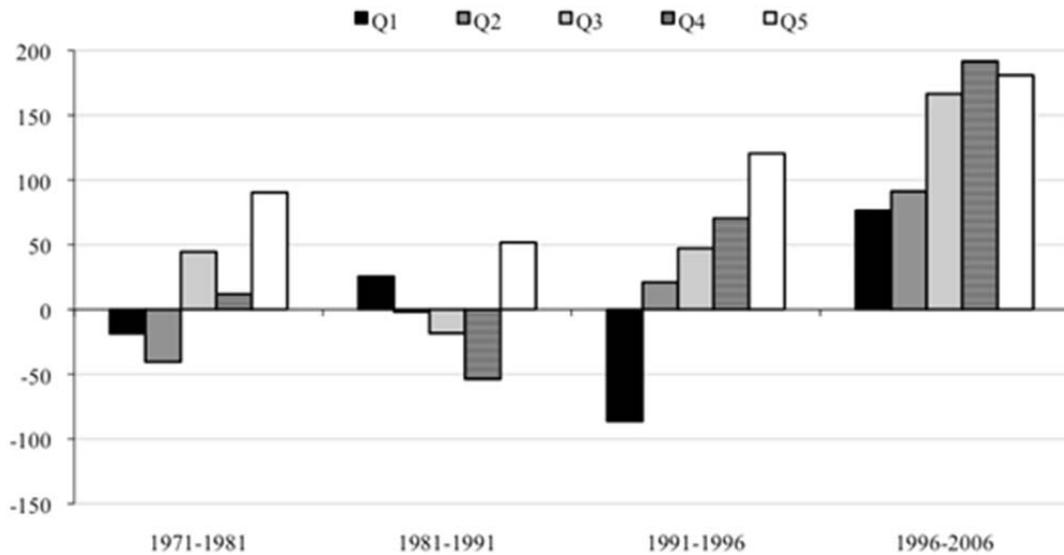
In the 1990s, there was straightforward upgrading in Ireland and Switzerland, and a steep fall of employment in quintile 1. The finding of clear-cut upgrading in the 1990s runs contrary to the evolution predicted by routinization: the broad diffusion of computer technology did not fashion a polarized pattern of occupational change. Instead it coincided with occupational upgrading.

Further doubt arises from the fact that we observe no polarisation for either one of the two countries over the 2000s. The Irish occupational structure underwent a remarkable expansion of employment. Between 1996 and 2006, over half a million jobs were created. Both immigration and return migration were high, and technological innovation played a decisive role in economic prosperity. And yet, not only high-level, but also mid-level occupations continued to grow, notably among clerks in finance and business services as well as educational (associate-) professionals. Overall, the rise in mid- and high-paid occupations by far outweighed growth in lower paid ones. In Switzerland, job growth over the 2000s was more concentrated in quintile 5, notably among computer analysts and business professionals.

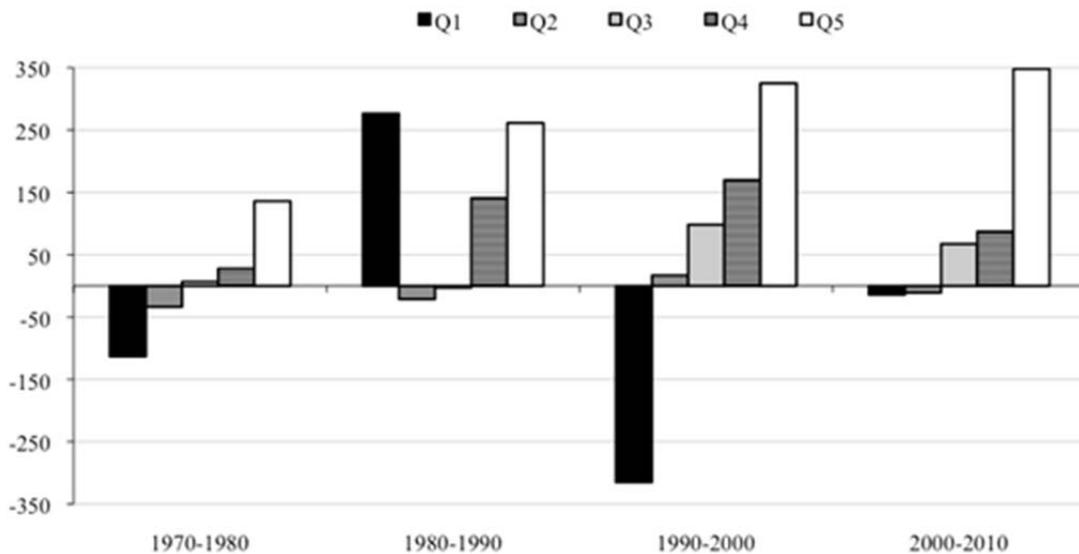
In both countries, job expansion in the highest quintile was complemented by growth in lower paid occupations in the area of health, as the number of service workers in health in Ireland and home-based personal care workers in Switzerland expanded. However, this evolution was quantitatively too small to shift the job structure towards polarization.

Figure 2. Occupational change across quintiles in Ireland and Switzerland by decade (absolute change in 1000 jobs)

Ireland



Switzerland



How do these results fit with routinization as primary driver of national employment structures? Over the 2000s, there was neither a hollowing out of the employment structure's middle nor growth in its bottom end. Rather, quintiles 1 and 2 declined. In contrast, the highest-paid occupations in quintile 5 were responsible for 70% of job growth.⁶ The signs of polarization we find are in a decade that precedes ICT diffusion.

6 Robustness checks for occupational upgrading

Our finding of occupational upgrading may raise several concerns. First, occupational upgrading may not warrant excessive optimism if it comes at the cost of unemployment – if the low educated are simply pushed out of the labor market. In Switzerland, occupational upgrading took place during the recession of 1991-96 which led to a disproportionate amount of job loss in low-paid occupations. A hypothesis may thus be that upgrading was responsible for increased unemployment rates, given that the lowest paid (and thus possibly most accessible) jobs declined over time. Figure A.1 in the appendix charts the unemployment rates in the two countries between 1970 and 2010, alongside that of the US for comparison. Economic recessions largely determine the increases in the two countries' unemployment rate, most strongly so in the 1980s in Ireland (when the occupational structure polarized) and the early 1990s in Switzerland (when it upgraded). However, between the mid-1990s until the onset of the Great Recession in 2008, the unemployment rate dropped spectacularly in Ireland and remained at very low levels in Switzerland (3.5 to 4.5 per cent) – despite the fact that the occupational structure upgraded in both countries. Note that over the same period, the male employment rate remained stable and the female employment rate increased steadily in both countries. There is, therefore, little empirical evidence of a trade-off between occupational upgrading and full employment (see Card et al. 1999: 870; Glyn 2001: 701, Oesch 2013: 106-126).

A second concern with our analysis is that five job quality quintiles is too crude a measure of change, and camouflages polarization tendencies. We examine this possibility by using single occupations as our unit of analysis and estimating a regression for each country and decade. The dependent variable is the logarithm of the employment level (in 1000 jobs) and the independent variable is an occupation's median wage entered both as a linear and a quadratic term.⁷ The rationale is simple: polarization leads to a U-shaped pattern of occupational change where the strongest job growth takes place in occupations with the lowest and highest wage: This pattern should show, in a regression, as a negative linear and a positive quadratic term of occupations' wages. In contrast, a positive linear effect of occupations' wages on occupations' employment would mean that employment grows the more, the higher an occupation's median wages is.

The results are shown in Table 3. For Ireland, the coefficients for the 1970s, 1990s and 2000s confirm our earlier finding of clear-cut upgrading with a positive linear and a negative quadratic term. In the 1980s, the result points to polarization, as before with the quintiles, as the linear term is negative and the quadratic term positive. For Switzerland, the results are more ambiguous. In three out of four decades the linear term is negative and the quadratic term positive. The only exception is the 1990s (with a positive linear and a negative quadratic term), a decade for which the quintiles also show an overwhelming trend towards upgrading. Note, however, that none of the coefficients for Switzerland are statistically significant.

Plots of the coefficients give us a better idea of what our regressions predict in terms of occupational change (see Figures A.2 and A.3 in the appendix). We graph two time periods, one prior to (1970/1-1990/1), and one after (1990/1-2006/10), the arrival of mass computerization. These results confirm the insights obtained using quintiles: upgrading instead of polarization. Even using the more fine-grained unit of analysis, we find job growth biased towards the top-end occupations and severe job losses in the lower-middle end for both countries and both time periods.

A third concern in our allocation of occupations into quintiles is the assumption that a country's occupational ranking by median earnings (or educational levels) stays constant over time. A comparatively low-paid occupation in 1970 should still be low-paid in 2010. We test this assumption by plotting occupations' wage rankings in 1991-1993 against their wage rankings in 2009-2011 for Switzerland, the period for which we have wage data. The result is shown in figure A.4 in the appendix. Spearman's correlation coefficient is 0.89 and suggests that occupations' rank-order in terms of their median earnings is very stable over time. In both the 1990s and the 2000s, dentists, engineers and legal professionals were set close to the top-end whereas farmhands, waiters and shop assistants consistently cluster at the bottom-end.

Table 3. Change in occupational employment: Effect of median wages

<i>Ireland</i>	1970s		1980s		1990s		2000s	
Wage	2.20	(0.84)	-4.35	(1.98)	3.93	(1.62)	0.89	(1.38)
Wage2	-0.33	(0.17)	0.84	(0.38)	-0.7	(0.31)	-0.11	(0.27)
Constant	-3.34	(1.06)	5.32	(2.54)	-5.41	(2.07)	-1.23	(1.78)
R ²	0.32		0.05		0.1		0.08	
N	89		89		89		89	
<i>Switzerland</i>	1970s		1980s		1990s		2000s	
Wage	-2.44	(2.32)	-5.96	(5.52)	6.44	(7.91)	-6.33	(4.08)
Wage2	0.43	(0.33)	0.94	(0.79)	-0.63	(1.12)	0.96	(0.57)
Constant	3.18	(4.03)	9.25	(9.69)	-15.22	(13.88)	10.21	(7.21)
R ²	0.15		0.04		0.18		0.05	
N	177		177		177		177	

Source: Irish Census (IPUMS) 1971-2006; Swiss Census 1970-2000; Swiss Structural Survey 2010

Notes: Regressions are weighted by an occupation's size in each initial year. We log measures of employment levels and an occupation's median wages to reduce the influence of extreme values and skew. OLS coefficients and standard errors shown in parentheses, statistical significance is shown in bold $p < 0.05$.

A further check as to the stability of occupational rankings we use Irish census data to rank occupations on the basis of their average education level in 1971 and 1981 and compare this ranking to the one from 1996 and 2006 pooled (see figure A.5 in the appendix). While the mean education of occupations increased considerably, the Spearman correlation coefficient of 0.90 implies again that positioning – occupational rankings – are very stable over time.

The last concern with our analysis is that ranking occupations by earnings may yield different results from ranking occupations by skills. Notably the debate about gender pay discrimination suggests that female occupations may rank lower on an earnings-based than on a skill-based scale. Accordingly, occupational change may look differently depending on whether job quality is measured with earnings or skills. We check this possibility by rank-ordering occupations based on the mean education of job-holders, the idea being that job-holders' education serves as proxy for the skill requirements of an occupation. The results – occupational change by decade – are displayed in Figure A.6 in the appendix.

The substantial conclusions to be drawn from an analysis based on earnings-ranked occupations remain unchanged. In all four decades, employment growth was strongest in the top quintile 5 – with the exception of the 1980s when quintile 4 grew somewhat more in Ireland and quintile 1 somewhat more in Switzerland. We thus still find clear-

cut occupational upgrading for the 1970s and 2000s in Ireland as well as the 1970s and 1990s for Switzerland. What changes for Ireland is that we no longer observe polarization for the 1980s, but for the early 1990s before the onset of the Celtic Tiger boom. What changes for Switzerland is that the 2000s are not only marked by strong employment growth in quintile 5, but also by some growth in quintile 1. This j-shaped pattern of occupational change is entirely driven, at the bottom end of quintile 1, by employment gains among foreign men and, above all, foreign women.

7 Occupational change disaggregated by gender and migrant status

Prior studies have tended to exclude large segments of the labor force. We avoid this and show how different worker groups contribute to the upgrading or polarization of the employment structure. We decompose the pattern of occupational change for four gender-nationality groups: national men and national women, foreign men and foreign women.⁸ It is striking that in both countries native men's employment increased only in the top quintile 5. The exception is the (early) 1990s when Switzerland suffered a recession and Ireland's 'Celtic Tiger' era had yet to take off. The trajectory of native men was the primary cause of falling employment in the middle of the occupational hierarchy, most noticeably in Switzerland during the 1980s. In parallel, the share of native men also decreased heavily in quintile 1 – for Irish men over the whole period, for Swiss men during the oil crisis of the 1970s, the recession of the 1990s and the boom of the 2000s.

In any account of structural change over the last decades, the major increase in female employment is pivotal (see Kriesi et al. 2010). We observe a gradual secular increase in native women's employment shares in Ireland, the largest increase taking place in quintile 5 in the 1970s and 1990s, and in quintile 4 in the 1980s. Surprisingly, this evolution almost comes to a standstill in the last boom period 1996-2006. In Switzerland, native women also gradually outpaced native men in terms of employment growth in the two top quintiles 4 and 5. While job growth in quintile 5 for Swiss women was less than half that of Swiss men's in the 1970s, Swiss women equalled men's employment gain in the top quintile in the 1980s and clearly surpassed it in the 2000s.

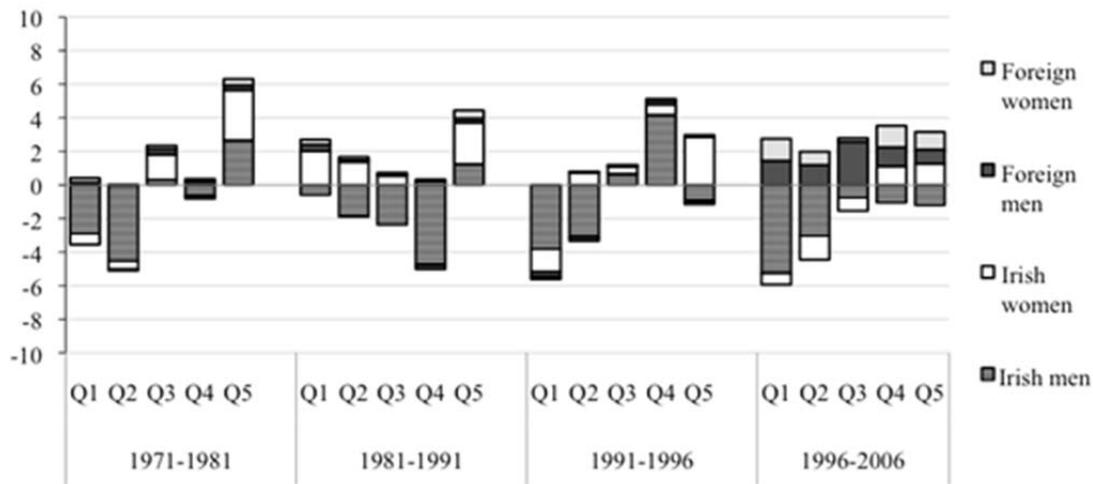
Combinations of national migration policies and business cycles are critical in shaping changes in the occupational structure. We argued above that an inflow of low-skilled immigrants should contribute to a polarized pattern of job growth – such as during Ireland’s Celtic tiger years or during Switzerland’s construction boom of the late 1980s. In periods of strong economic growth, state policies in Switzerland actively promoted the recruitment of low- and mid-skilled immigrants for jobs in factories, farms, hotels and restaurants (Flückiger 1998). The influence of migration policy is evident for the 1980s. Over this decade, growth in the number of foreign men and women accounted for two thirds of job expansion in Switzerland’s bottom quintile 1. After the unemployment crisis of the early 1990s, Switzerland shifted towards a migration policy that targeted high-skilled foreign workers. Correspondingly, the employment of migrant workers fell massively in quintile 1 in the 1990s, while migrants employed in quintile 5 saw a modest increase during the 1990s and a huge increase in the 2000s. Contrary to Britain (Oesch 2013: 96), Spain (Oesch and Rodriguez 2011: 531) or the US (Wright and Dwyer 2003: 309), the inflow of migrant workers in Switzerland did not lead to polarization, but to occupational upgrading after 1990.

In Ireland, the inflow of foreign-born workers significantly contributed to occupational change only between 1996 and 2006. The burst of technology firms over this period did not lead to employment polarisation. Instead, Irish employers used the influx of male migrants to bolster growth in the mid-ranking occupations, whereas female migrants were hired at both ends of the occupational structure.

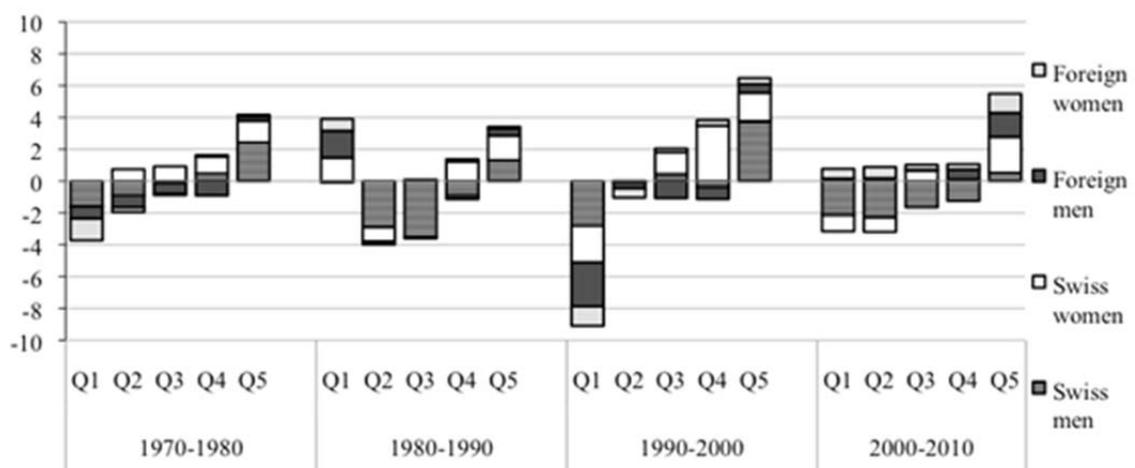
Another way to highlight our point is to follow previous papers and only keep native men in the working sample. This would lead to the conclusion of polarization because of a marked tendency for male native employment to decrease in the middle quintiles. At the same time, upgrading through expansion in the top quintiles would halved by the removal of women.

Figure 4. Occupational change in Ireland and Switzerland by gender and migrant status (relative change in percentage points)

Ireland



Switzerland



In a last set of analyses, we examine the shifts in educational supply by combining three educational levels – low, medium and high – and gender (see Figure A.7 in the appendix).⁹ The most noticeable change is the labor market entry of mid- and higher educated women in Ireland and Switzerland. In the 1970s, women with upper secondary education contributed to job growth across the board of the occupational structure. In the 1980s, women’s employment evolved in a U-shaped way in both countries, with gains both in the bottom quintile 1 and the top quintile 5. From 1990 onwards, mid- and highly educated women were the main architects of occupational upgrading, spurring job growth in quintile 4 and 5 in both countries. The labor market impact of tertiary educated women is particularly strong in the last period; they

contributed much more to employment growth in the top quintile 5 than tertiary educated men in both Ireland during 1996-2006 and Switzerland during 2000-2010. While tertiary educated women and men both spurred employment expansion in high-end occupations, the decrease among men with only mandatory schooling was responsible for the job decline in quintiles 1 to 4 in the 1970s and 1980s. In the 1990s and 2000s, it was the employment share of men with upper-secondary education that decreased in the two bottom quintiles in both countries.

8 Conclusion

Our analysis of occupational change in Ireland and Switzerland over four decades provides us with four key findings. First, both labor markets created more jobs in high-level than in mid-level occupations, and more jobs in mid-level than in low-level occupations. In the course of the last 40 years the overarching structural shift in the employment structure has been towards upgrading and up-skilling. Job growth was more concentrated, in the latter periods, on high-end occupations in Switzerland than Ireland. Still, we observe unambiguous occupational upgrading for both countries.

Second, occupational change has varied substantially across decades. This variability points to specific educational, gender and migratory regimes that work in tandem with technological progress. A polarised pattern of employment change is found in only one of the four time periods under study, in the 1980s, and before the mass introduction of affordable ICT. There is thus little evidence for the routinization hypothesis, which makes it difficult to extrapolate the hourglass pattern of employment change from Britain and the United States to other European countries with different labor market institutions, educational systems and migratory regimes.

Third, when we examine the supply side dynamics underlying the evolution of employment in Ireland and Switzerland, we observe a well-defined interaction between gender and educational profiles. For native men, employment substantially upgraded as job growth was confined to the top quintile and less educated native men's employment dwindled from the bottom four quintiles. However, the main force behind occupational upgrading were women with tertiary education. While women's employment, both native and foreign, evolved in a slightly more polarised pattern than men's employment, women's rising educational attainment contributed to strong job growth in high-end occupations.

Fourth, our findings outline the role played by labor migration. In Switzerland, low-skilled migrant labor fuelled the polarization in the 1980s, which entailed a disproportionate rise in quintile 1. They were then hardest hit by the manufacturing and construction crisis of the early 1990s, shouldering much of the job loss in quintile 1. In the 2000s, the policy turn towards more skilled immigration led foreign workers to contribute as much to job growth in quintile 5 as native women, and more so than native men. Similarly, foreign-born workers in Ireland provided ample supply for low-and mid-level occupations during the recent boom.

In light of these findings, it is hard to interpret technology as the sole driver of national employment outcomes. Labor market institutions, educational systems and migration policies play a key role. Policies set different wage floors, and provide abundant supply of different types of workers and skill groups. In so doing, they affect the incentive structures for employers to apply technology in certain ways and to destroy or create certain jobs. As a result, it should not come as a surprise that the same evolution in ICT in Western Europe and North America does not lead to the same type of employment structure.

9 References

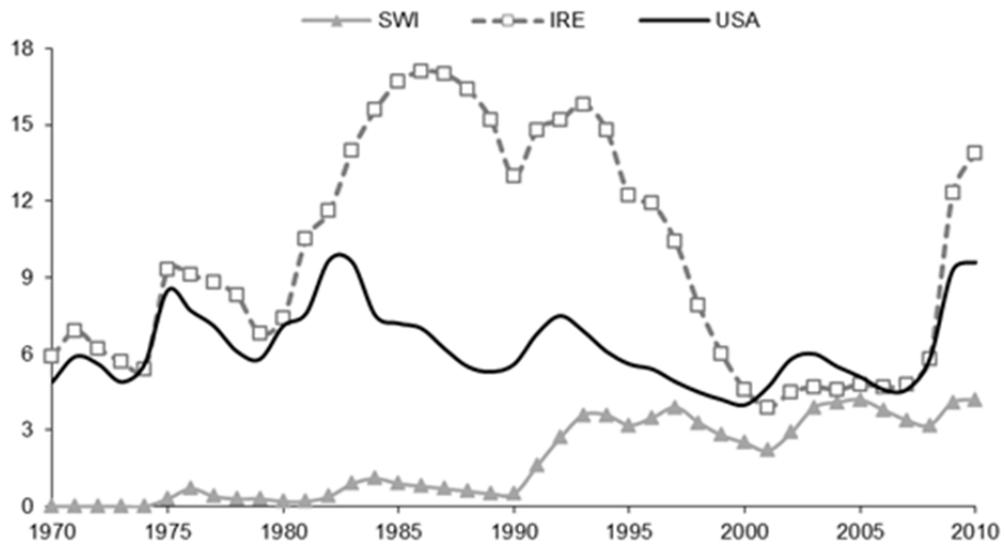
- Acemoglu, D. (2003). Cross-Country Inequality Trends. *The Economic Journal*, 113(485), 121-149.
- Autor, D. H., Katz, L. F. and Kearney, M. S. (2008). Trends in U.S. Wage Inequality: Revisiting the Revisionists. *Review of Economics and Statistics*, 90(2), 300-323.
- Autor, D. H., Levy, F. and Murnane, R. J. (2003). The Skill Content of Recent Technological Change: An Empirical Exploration. *Quarterly Journal of Economics*, 118(4), 1279-1334.
- Baccaro, L., and Simoni, M. (2007). Centralized Wage Bargaining and the “Celtic Tiger” Phenomenon. *Industrial Relations*, 46(3), 426-455.
- Barrett, A., and Kelly, E. (2010). The impact of Ireland’s recession on the labor market outcomes of its immigrants. *European Journal of Population* 28(1), 91–111.
- Barrett, A., Callan, T., and Nolan, B. (1999). Rising wage inequality, returns to education and labor market institutions: Evidence from Ireland. *British Journal of Industrial* (March), 77–100.
- Barrett, A. (2002). Return migration of highly-skilled Irish into Ireland and their impact on GNP and earnings inequality, in: OECD (Ed.) *International Mobility of the Highly Skilled*, Paris, 151-56.
- Becker, R., and Zangger, C. (2013). Die Bildungsexpansion in der Schweiz und ihre Folgen. *Kölner Zeitschrift für Soziologie und Sozialpsychologie*, 65(3), 423–449.
- Bernardi, F., Garrido, L., and Miyar, M. (2011). The recent fast upsurge of immigrants in Spain and their employment patterns and occupational attainment. *International Migration*, 49(1), 148-187.
- Buchmann, M., Sacchi, S., Lamprecht, M. and Stamm, H. (2007). Tertiary Education Expansion and Social Inequality in Switzerland. In: Shavit, Y. et al. (eds.), *Expansion, Differentiation and Stratification in Higher Education: A Comparative Study*. Stanford: Stanford University Press, 321-348.
- Breznitz, D. (2012). Ideas, structure, state action and economic growth: Rethinking the Irish miracle. *Review of International Political Economy*, 19(1), 87-113.
- Card, D., Kramarz, F. and Lemieux, T. (1999). Changes in the Relative Structure of Wages and Employment: a Comparison of the United States, Canada, and France. *Canadian Journal of Economics*, 32(4), 843-877.
- DiPrete, T., and McManus, P. A. (1996). Institutions, Technical Change, and Diverging Life Chances: Earnings Mobility in the United States and Germany. *American Journal of Sociology*, 102(1), 34-79.
- Dustmann, C., Frattini, T., and Preston, I. P. (2013). The Effect of Immigration along the Distribution of Wages. *Review of Economic Studies*, 80(1), 145–173.
- Dustmann, C., Ludsteck, J., and Schönberg, U. (2009). Revisiting the German Wage Structure. *Quarterly Journal of Economics*, 124(2), 843-881.

- Dwyer, R. (2013). The Care Economy? Gender, Economic Restructuring, and Job Polarization in the U.S. Labor Market. *American Sociological Review*, 78(3), 390–416.
- Elias, P. (1997). Occupational Classification (ISCO-88): Concepts, Methods, Reliability, Validity and Cross-National Comparability, *OECD Labor Market and Social Policy Occasional Papers*, No. 20, OECD: Paris.
- Fernández-Macías, E. (2010). *Changes in the Structure of Employment and Job Quality in Europe*. PhD Thesis, University of Salamanca, Spain.
- Fernández-Macías, E. (2012). Job Polarization in Europe? Changes in the Employment Structure and Job Quality, 1995-2007. *Work and Occupations*, 39(2), 157-182.
- Flückiger, Y. (1998). The labor market in Switzerland: the end of a special case? *International Journal of Manpower*, 19(6), 369-395.
- Gautié, J. and Schmitt, J. (eds.) (2010), *Low Wage Work in the Wealthy World*. New York: Russell Sage Foundation.
- Glyn, A. (2001). Inequalities of Employment and Wages in OECD Countries. *Oxford Bulletin of Economics and Statistics*, 63, 697-713.
- Goldin, C., and Katz, L.F. (2007). Long-Run Changes in the Wage Structure: Narrowing, Widening, Polarizing. *Brookings Papers on Economic Activity*, 2: 135-167.
- Goos, M., and Manning, A. (2007). Lousy and Lovely Jobs: The Rising Polarization of Work in Britain. *The Review of Economics and Statistics*, 89(1), 118-133.
- Goos, M., Manning, A. and Salomons, A. (2014). Explaining Job Polarization: Routine-Biased Technological Change and Offshoring, *American Economic Review*, 104(8): 2509-26.
- Honohan, P., and Walsh, B. (2002). Catching up with the leaders: the Irish hare. *Brookings papers on economic activity*, 1, 1-77.
- Kalleberg, A. (2012). Job Quality and Precarious Work: Clarifications, Controversies, and Challenges. *Work and Occupations*, 39(4), 427–448.
- Kriesi, I., Buchmann, M. and Sacchi, S. (2010). Variation in job opportunities for men and women in the Swiss labor market 1962–1989. *Research in Social Stratification and Mobility*, 28(3), 309–323.
- Lambert, P., and Griffiths, D. (2011). Dimensions and Boundaries: Comparative Analysis of Occupational Structures Using Social Network and Social Interaction Distance Analysis. RC28 paper: <http://www.camsis.stir.ac.uk>.
- Lewis, E. (2006). Immigration, Skill Mix, and the Choice of Technique. Federal Reserve Bank of Philadelphia, March, 1-43.
- Manning, A. (2004). We can work it out: The Impact of Technological Change on the Demand for Low-Skill Workers. *Scottish Journal of Political Economy*, 51(5), 581-608.
- Méhaut, P., Berg, P., Grimshaw, D., and Jaehrling, K. (2010). Cleaning and Nursing in Hospitals: Institutional Variety and the Reshaping of Low-Wage Jobs. In: Gautié J. and Schmitt J. (Eds.). Op. cit., 319-366.

- Mishel, L. Schmitt, J. and Shierholz, H. (2013). Assessing the job polarization explanation of growing wage inequality, Working paper presented at Labor Economics Seminar, University of California, Berkeley (March).
- OECD (2008). *A Profile of Immigrant Populations in the 21st Century. Data from OECD countries*, OECD: Paris.
- Oesch, D. (2011). Swiss Trade Unions and Industrial Relations after 1990: a History of Decline and Renewal. In Trampusch, C. and Mach, A. (eds.), *Switzerland in Europe. Continuity and Change in the Swiss Political Economy*, London: Routledge, 82-102.
- Oesch, D., and Rodríguez Menes, J. (2011). Upgrading or Polarization? Occupational Change in Britain, Germany, Spain and Switzerland, 1990-2008. *Socio-Economic Review*, 9(3). 503-532.
- Oesch, D. (2013). *Occupational Change in Europe. How Technology and Education Transform the Job Structure*. Oxford: Oxford University Press.
- Rauscher, E. (2015). Educational Expansion and Occupational Change: US Compulsory Schooling Laws and the Occupational Structure 1850-1930. *Social Forces*, 93(4), 1397–1442.
- Rodríguez, N. (2004). “Workers Wanted”: Employer Recruitment of Immigrant Labor. *Work and Occupations*, 31(4), 453–473.
- Roche, W. (2007). Social partnership in Ireland and new social pacts. *Industrial Relations*, 46(3), 395–425.
- Rosenfeld, J. (2006). Widening the gap: The effect of declining unionization on managerial and worker pay, 1983–2000. *Research in Social Stratification and Mobility*, 24(3), 223–238.
- Spitz-Oener, A. (2006). Technical Change, Job Tasks, and Rising Educational Demands: Looking Outside the Wage Structure. *Journal of Labor Economics*, 24(2), 235-270.
- Streeck, W. (1997). Beneficial Constraints: On the Economic Limits of Rational Voluntarism. In: Hollingsworth, J. R. and Boyer, R. (eds), *Contemporary Capitalism: The Embeddedness of Institutions*, Cambridge: Cambridge University Press, 197-219.
- Turner, T., and McMahon, J. (2011). Women’s Occupational Trends in the Irish Economy: Moving towards High-skilled Occupations or Evidence of Deskilling? *Gender, Work and Organization*, 18(1), 222–240.
- Whelan, C. T., and Layte, R. (2006). Economic boom and social mobility: The Irish experience. *Research in Social Stratification and Mobility*, 24(2), 193–208.
- Whelan, C. T., and Hannan, D. F. (1999) Class inequalities in educational attainment among the adult population in the Republic of Ireland. *Economic and Social Review*, 30(3), 285-308.
- Wright, E. O. and Dwyer, R. E. (2003). The Patterns of Job Expansions in the USA: A Comparison of the 1960s and 1990s. *Socio-Economic Review*, 1, 289-325.

10 Appendix

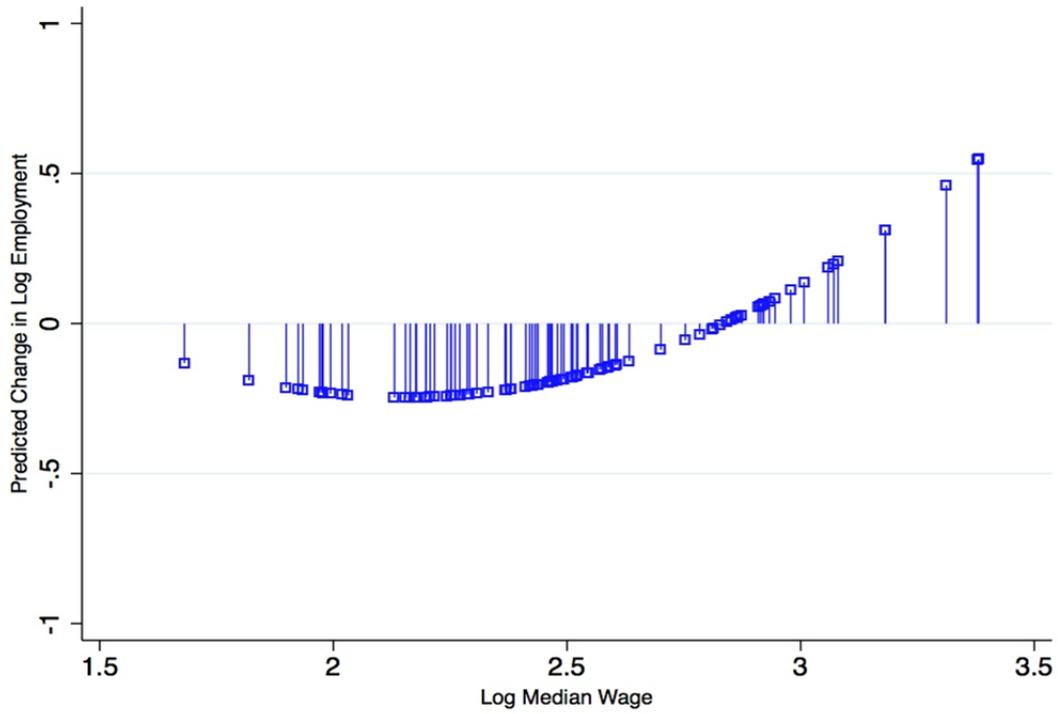
Figure A.1 Unemployment rates 1970-2010 (in percent)



Source: OECD.Stat Extracts

Figure A.2 Change in occupations' employment by occupations' median wages – Ireland

1971-1991



1991-2006

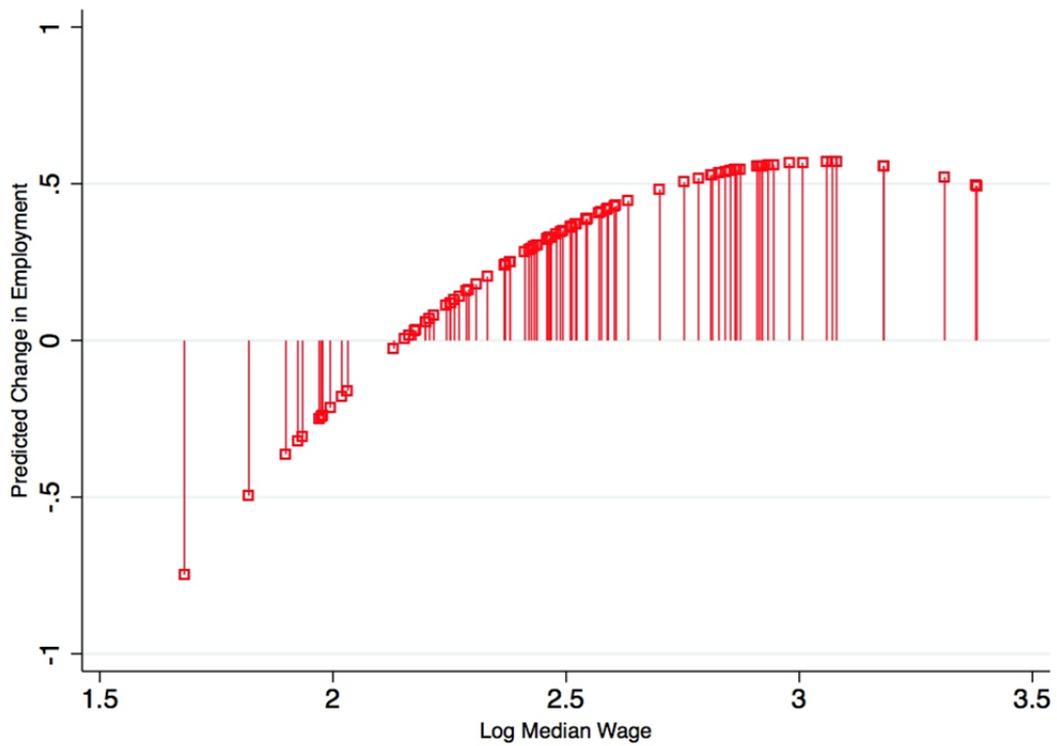
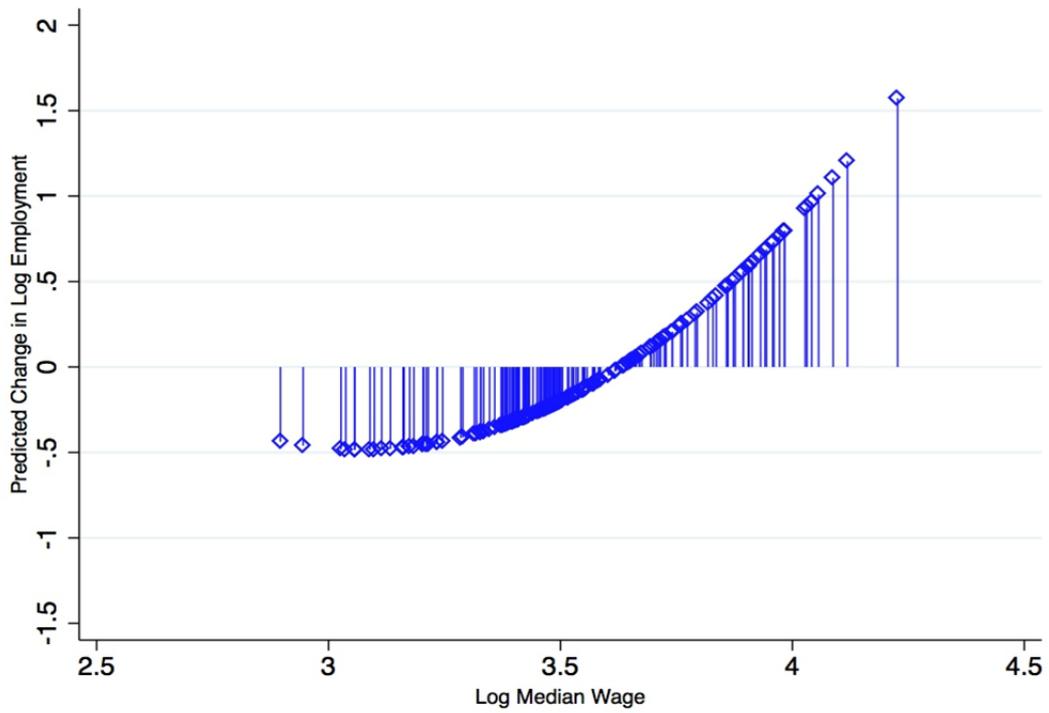


Figure A.3 Change in occupations' employment by occupations' median wages – Switzerland

1970-1990



1990-2010

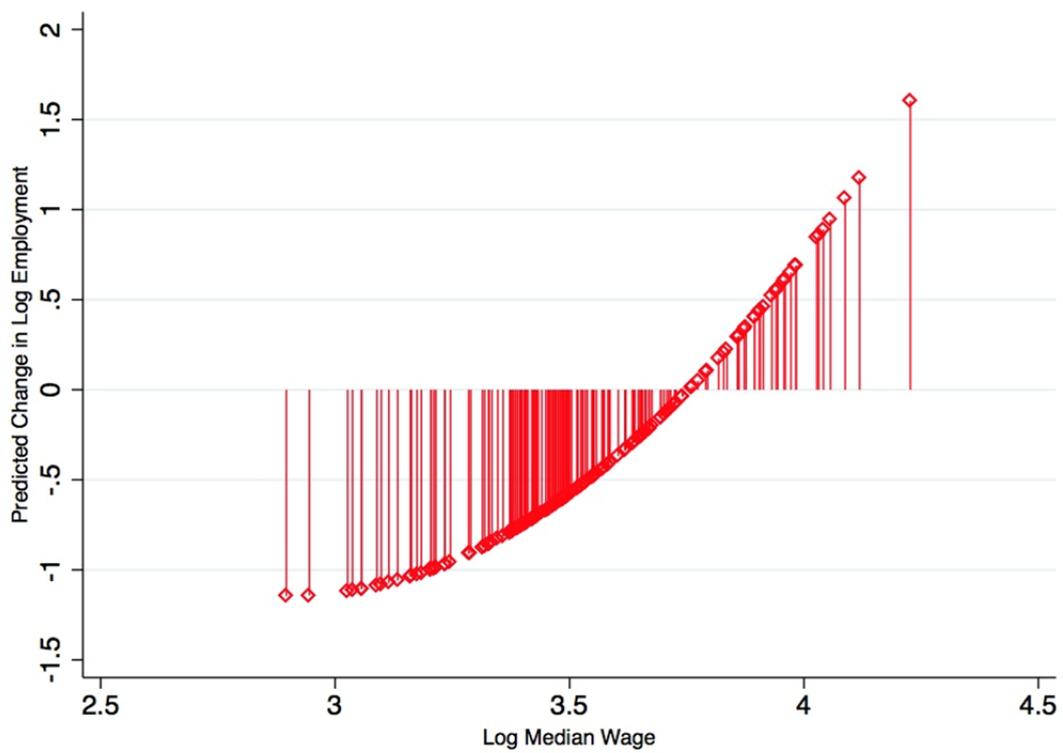
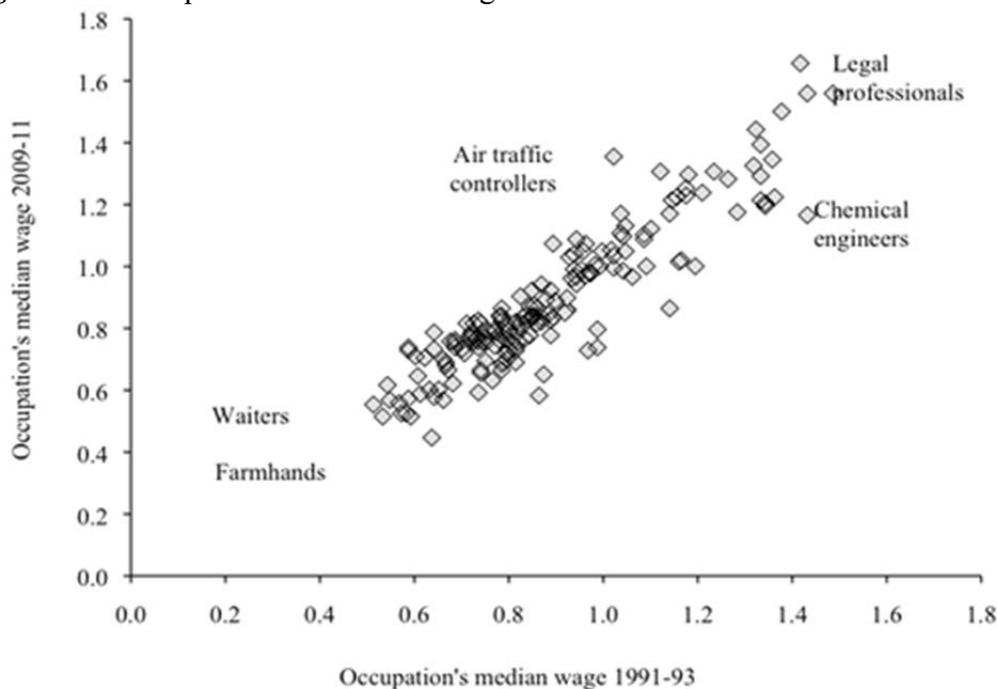


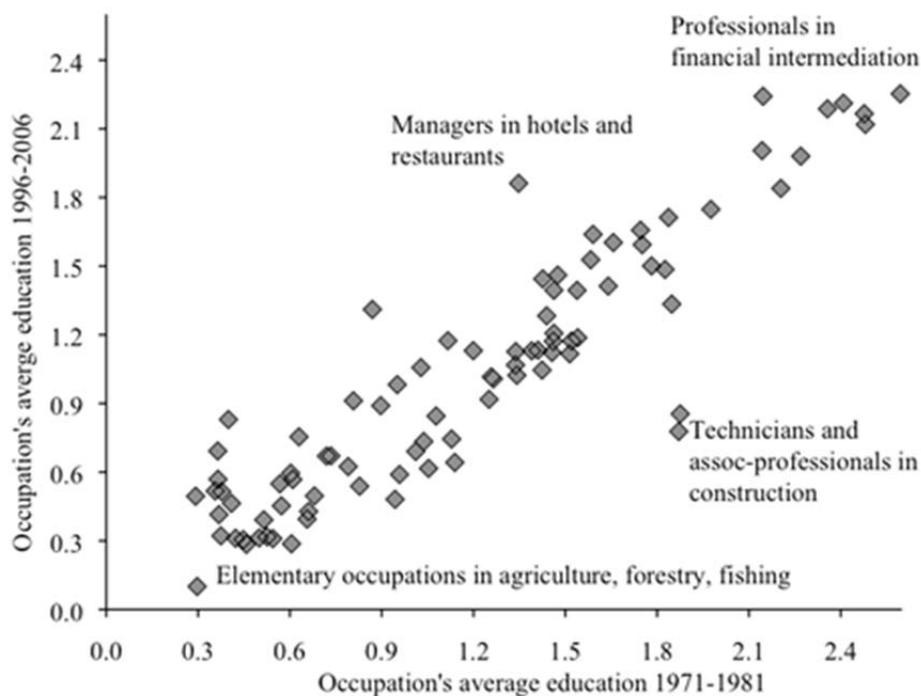
Figure A.4 Occupational median earnings in 1991-1993 and 2009-2011 in Switzerland



Source: Swiss labor force surveys 1991; 1992; 1993; 2009; 2010; 2011

Note: the sample's mean earning has been computed as 1. The median earnings of different occupations are then expressed as a proportion of the mean earning (ranging from 50% to 170% or 0.5 and 1.7 respectively).

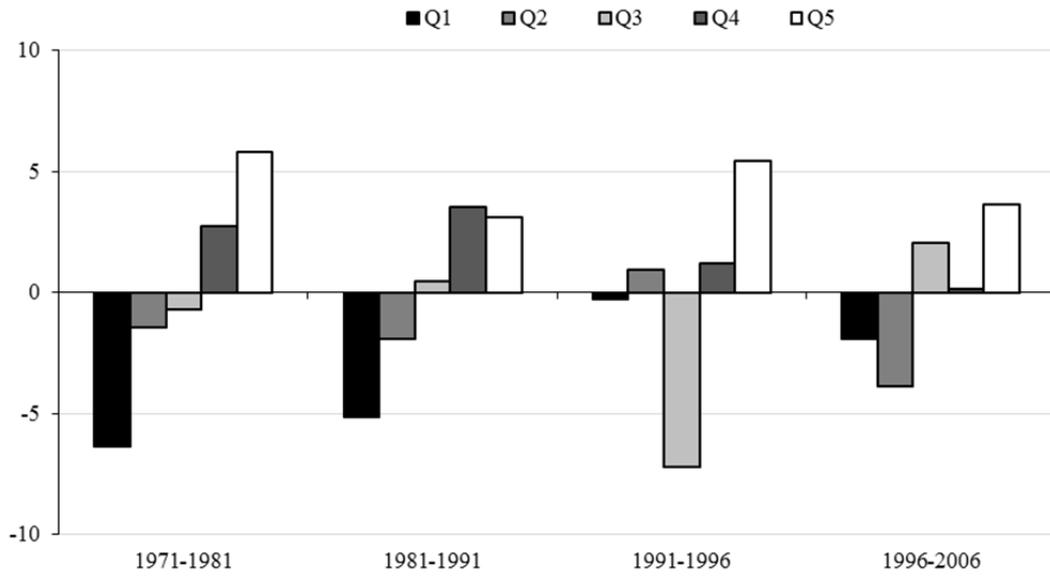
Figure A.5 Average education of occupations in 1971-1981 and 1996-2006 in Ireland



Source: (IPUMS) Irish Census data 1971; 1981; 1991; 2006

Figure A.6. Occupational change across quintiles based on education-ranked occupations by decade (relative change in percentage points)

Ireland



Switzerland

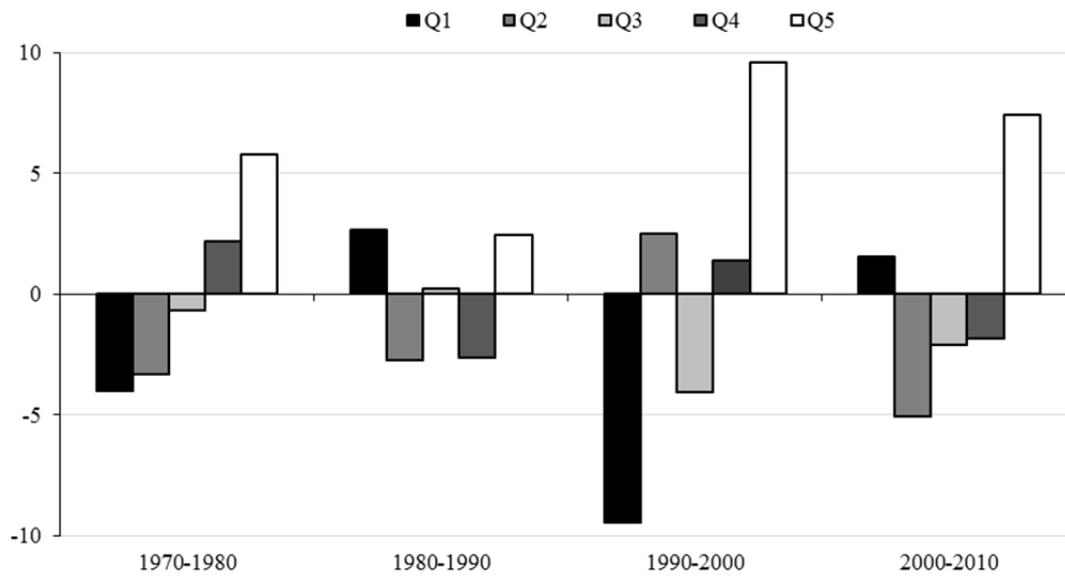
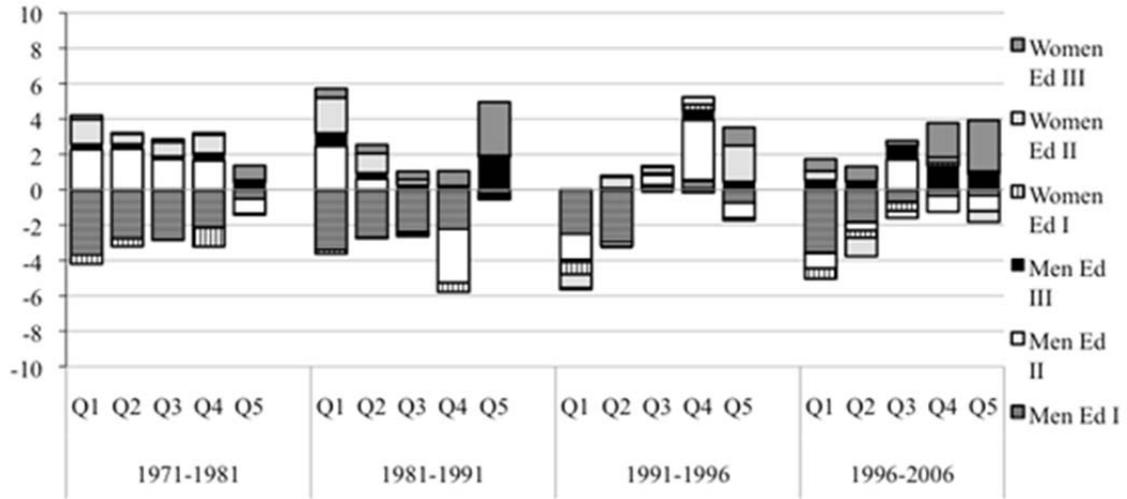
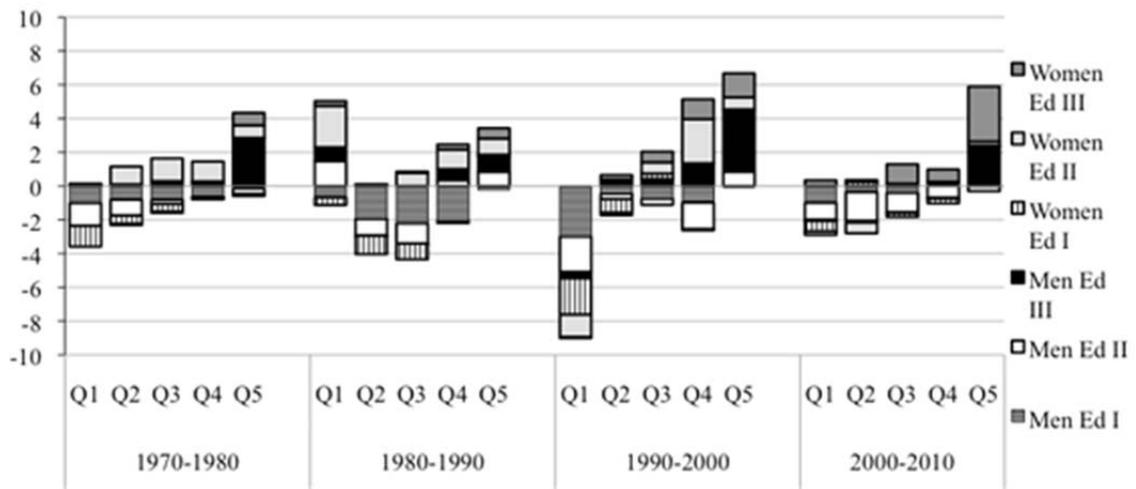


Figure A.7 Occupational change in Ireland and Switzerland by gender and education (relative change in percentage points)

Ireland



Switzerland



Endnotes

¹ The Irish Census samples are restricted by age groups, and consequently the oldest individuals for these analyses are aged 62. In Switzerland, we impose the age-limit of 63 for our sample of women.

² The exceptions are unpaid family workers and apprentices in Switzerland and unfortunately, the Irish data do not allow for an exclusion of unemployed persons between 1971 and 1991. The 2002 Census coding used an ILO definition of active employed population and this was checked with our sample; numbers are relatively similar.

³ These occupational classifications share many similarities to the UK SOC-68 and SOC-90. For this reason, we make use of the generated 1-digit ISCO-88 variable that spans all decades. While this is harmonised to some extent across the years, a major coding break occurs in 1991, such that the ISCO-88 classification stems from the same underlying classification schema between 1971 and 1991, and another between 1996 and 2006.

⁴ The combination of an aggregated ISCO-major grouping and industry should reduce some of the issues inherent in a finer level of detail given the varying classification systems (Elias 1997).

⁵ Following Fernández Macías (2010: 90), we distinguish and assign a value to three different educational levels: lower secondary schooling or less (value of 0); upper secondary – general or vocational – education (value of 0.5); tertiary education (value of 1). Occupations are then rank-ordered on the basis of the mean educational attainment of the workers, values going from 0 to 1. Quintile 1 comprises the 20 per cent of employment set in the occupations with the lowest average educational level, quintile 5 includes the 20 per cent of employment set in the occupations with the highest average educational level.

⁶ Interestingly, Mishel et al. (2013) also report no continuation of the 1990s polarisation trend in the 2000s for the US.

⁷ The equation is as follows (Goos and Manning 2007: 122):

$$\Delta n_j = \beta_0 + \beta_1 w_j + \beta_2 w_j^2$$

where Δn_j is the change in log employment in occupation j , w_j is the log median wage of occupation j , and w_j^2 is the squared log median wage of occupation j .

⁸ In Figure 5b, ‘foreign’ workers refer to men and women who report having a foreign nationality. This is not directly comparable with Ireland as in figure 5a ‘foreign’ refers to foreign-born workers. While Ireland has a lengthy history of emigration, and return migration of Irish nationals, it only began receiving large numbers of foreign immigrants during the 1990s. The Census only started to differentiate between foreign-born, and nationality, in 2002. For 2006, our sample of foreign-born contains 5% who are born abroad but hold Irish nationality.

⁹ Due to how education was originally recorded between 1971 and 1991, the education groups in Ireland for this time period refer to I) primary or less II) some secondary or vocational schooling II) any tertiary. In Switzerland, and Ireland for 1991-2006, level I refers to those with less than upper secondary education; II) upper secondary and post-secondary schooling; III) tertiary-level degree.