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*Essays on the Political Economy of Employment Polarisation:
Global Forces and Domestic Institutions*

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Declaration

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Abstract

This thesis investigates the political economy of employment polarization focusing on the implications of this phenomenon along three main research fronts. The first paper follows a methodology which resembles closely the one adopted by Goos, Manning and Salomons (2014), however it further extends this framework by testing the joint effect of routinization and labour market institutions on employment structures. The evidence provided suggests that the claim of a pervasive technology-induced polarization should be revised in order to comprise a role for the institutional component. The second paper explores whether job polarization has a feedback effect on labour market institutions and policies, so that different degrees of polarization lead to different articulations of institutions at the domestic level, thus reinforcing or altering differences in national models across the European space. The analysis finds that the job polarization experienced by a particular country in the 5 years before a reform instance is consistently among the strongest predictors of reform activity, as significant as other drivers such as GDP growth and government net debt. Moreover, a higher degree of polarization tends to be associated with more deregulation and a decrease in the generosity of the policy measure. The empirical framework is also tested against more conventional taxonomies of welfare capitalism revealing that LMEs tend to harness job polarization dynamics whereas CMEs are incompatible with job polarization which destabilizes the system leading to an increased need for reforms. The final paper asks whether the U-shaped impact on the wage distribution predicted by the job polarization literature has actually materialized in Europe. The findings show that job polarization increased upper-tail inequality (90/50) and decreased lower-tail (50/10) inequality but that employment protection legislation restrained the wage effects.

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A variety of reasons drove me to understand more thoroughly the labour market dynamics while embedding them in the institutional and political economy context of each European country, but I think they stem originally from my own roots. Being not only Southern European, but also Southern Italian, I guess I have developed a particular interest in coming to terms with the reasons for some of the significant regional disparities we are still experiencing. There are a certainly number of lessons I have learned throughout this PhD. In the early stage, most of my efforts were concentrated in the construction of a research puzzle: the identification of an empirical or theoretical inconsistency, which cannot be explained by the literature, and how to build a solid analytical framework, exhaustive enough to address this discrepancy and fairly innovative to represent a real contribution. As you can imagine, this exercise often resulted in vain attempts with the rare eureka moments later turning into missteps. However, it was crucial to overcome the rising sense of frustration and keep trying, because it is through fine-tuning and multiple revisions that our work becomes truly unique, later setting us apart from the rest of the field. In the second and final phase of the doctoral program, we undergo a dialectic process through the interaction with our advisors, in seminar and conference presentations or simply discussing our research with our peers. Throughout this journey one learns that to truly move forward you need to abandon your comfort zone, even if this means losing most of your certainties; secondly, to excel you need to apply constancy and persistence; finally, but probably most importantly, you need to optimize your efforts to avoid excessive fatigue and exhaustion.

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INTRODUCTION

*We are being afflicted with a new disease of which some readers may not yet have heard the name, but of which they will hear a great deal in the years to come - namely, **technological unemployment**. This means unemployment due to our discovery of means of economising the use of labour outrunning the pace at which we can find new uses for labour.*

But this is only a temporary phase of maladjustment. All this means in the long run that mankind is solving its economic problem. I would predict that the standard of life in progressive countries one hundred years hence will be between four and eight times as high as it is to-day. There would be nothing surprising in this even in the light of our present knowledge. It would not be foolish to contemplate the possibility of a far greater progress still.

John Maynard Keynes

Economic Possibilities for our Grandchildren (1930)

1. Motivation and Broader Relevance

Over the last years innovation has gained a central stage in both the academic and public debate. On one side of the spectrum we have researchers who claim that the era of big innovation is over and economic growth could slow dramatically as a result. On the opposite side we find those who are convinced that innovation is far from over and that instead “we are simply feeling the growing pains of a shift from an economy based on production to one based on ideas” (TED 2013, Long Beach Conference). In his latest book *The Future*, Al Gore asserts, “the Luddites, who feared that the Industrial Revolution would create structural unemployment, were wrong. The new jobs that emerged in factories not only outnumbered those lost on farms but produced higher incomes, even as farms became far more

productive and food prices sharply declined. Yet there is no guarantee history will repeat itself". He is not alone in raising concerns over the implications for the labour force and the broader society of the rapid technological innovation, which is transforming our civilization into a robot economy. Robert Gordon, at Northwestern University in his *Beyond the Rainbow*, in which the economist discusses the evolution of the standards of living in the US, depicts a very gloomy picture for the next decades. He claims that we have reached the end of progress, the digital economy does not have the same multiplier effect of the industrial revolution, and the last great innovations belong to the mid twentieth century: "shifting from 10km/h of a horse to 900 of a Boeing is a unique episode in history". He questions Solow's assumption of permanent economic growth and affirms that the frontier growth rate could indeed decline. The more "optimistic" side is instead represented by E. Brynjolfsson and A.McAfee at MIT who believe that technological creativity is having an unprecedented impact on our lives and that this will continue to accelerate in the coming years. However as already hinted at in the title of their bestseller *Race Against the Machine*, the technological revolution has genetically modified our society destroying more jobs than it creates: "A lot of economists felt that as long as productivity was growing, things would take care of themselves. That's no longer true". In the last decades we have observed a gradual decoupling of wages from productivity, which has widened inequality and although new

markets have been created this has mainly benefited innovators, investors and consumers to the detriment of workers. This has highlighted what can be considered “one the most puzzling aspects of the modern economy: why so much technological creativity can co-exist with stagnating wages and mass unemployment” (*The Economist*, May 2013).

The recent dispute over the third industrial revolution (computers, mobile phones, the web) and its repercussions on the global labour force had already been extensively investigated in 1995, when Jeremy Rifkin in his *The End of Work* pointed out that in the decades to come the most pressing concern facing society would be represented by rethinking the very nature of work. In the last chapter of his book he puts forward several proposals, from reengineering the work week to a new social contract that in his view would allow us to adapt to the new reality and capture the gains of this technological revolution without creating unsustainable social trauma. But, as it was written in *The Economist* May 2013 *Schumpeter* editorial, are we condemned to live in a Vonnegut’s dystopia in which both our brain work and manual work are taken over by machines? Also, is the middle class doomed to disappearance as provokingly suggested in a public interview at the World Economic Forum in Davos, in January 2013, by Larry Summers who said: “as economists like to explain, the system will equilibrate at full employment. But maybe the way it will equilibrate at full employment is

there'll be specialists at cleaning the shallow end and the deep end of rich people's swimming pools."

2. A Literature Review on Job Polarization

The prediction of Skill Biased Technical Change (SBTC) involves a shift in employment of a uniform nature, moving away from low-skilled jobs towards high-skilled occupations. Nevertheless, studies for the US and the UK have demonstrated that there exists a growth in employment in both the highest-skilled (managerial and professional) occupations as well as in the lowest-skilled (personal services) jobs, with a deterioration of employment in the middle of the distribution (manufacturing and routing office jobs). Goos, Manning, Salomons (2009) thus define job polarization as an increase in high-paid and low-paid employment and a relative decline in middle-paid occupations. Their study puts forward three main hypotheses as explanations for the phenomenon of job polarization:

- *Routinization*: the progress of technology has the effect of replacing "routing" labour –which often involves clerical tasks– and crafting jobs in the middle of the wage distribution (Autor, Levy, Murnane, 2003, hereafter ALM).
- *Globalization-Offshoring*: in the richest nations, this is an important source of change in the job structure (Blinder 2007).

- *Wage inequality*: the rise in the share of income that goes to the rich sector of the population may have caused a rise in the demand for low-skill workers, whose employment progressively amount to the provision of services to the rich (Manning 2004, Mazzolari and Ragusa 2007).

The authors aimed to discern the prevalence of the phenomenon of job polarization, and understand in particular whether it is confined to Anglo-Saxon economies, which at the top of the wage distribution have had very significant increases in wage inequality. In this regard, a review of preliminary evidence coming from West Germany indicates that job polarization is also taking place there. The query that follows, appropriately, is whether the phenomenon occurs in other European nations that have undergone similar technological changes but have not experienced the same trajectory in terms of wage inequality generally. For this inquiry, the data utilised was the harmonized European Union labour force Survey (ELFS), supplemented by German data from social security records (IABS), which was used to map occupational employment changes in sixteen European countries for the 1993-2006 period. Occupations, in turn, were classified by the 21 two-digit International Standard Classification of Occupations (ISCO), and employment was considered as weekly hours worked but identical results with number of persons employed. Furthermore, ISCO occupations

were ordered by 1993 mean European wage rank (employment pooled in occupation-industry cells across the sixteen countries), and jobs were considered as industry-occupation cells weighted by their 1993 employment shares, pooled across countries, and finally ranked by their UK 1994 log mean wage. The results of this analysis showed that low-paying and high-paying jobs expand their employment shares by 6 and 2 percentage points, respectively. The middling occupations, however, show a decrease of their employment share of 8 percentage points. Regarding *routinization*, 96 variables from the US Occupation Information Network (O*NET) database were used for the construction of the following three measures:

- *abstract tasks* (intense in non-routine cognitive skills) → high-paid service jobs
- *service tasks* (intense in non-routine non-cognitive skills) → low-paid service jobs
- *routine tasks* (intense in both cognitive and non-cognitive routine skills) → middling jobs

As for *off-shoring*, counts of news reports concerning the offshoring of European jobs from the European Restructuring Monitor indicated that routine occupations are most often offshored. Still, it is discernable that some non-routine jobs are much more offshorable than others. For the analysis of *wage inequality*, data for each of the countries from the European Union

Survey on Income and Living Conditions (EU-SILC), the European Community Household Panel (ECHP), as well as the Organisation for Economic Co-operation and Development (OECD) was used to establish measures of wage inequality as well as time-varying measures of occupation wages. The expectation was that countries with compressed occupational wage distributions would have a relatively modest portion of employment in low-wage jobs given that relative wages affect factor demands – and not least because inequality in general has a positive effect on the demand for low-skill workers through the demand of the rich for the provision of personal services. Nevertheless, results showed that there was no cross-sectional link of significance between the structure of employment and wage inequality. In fact, in the four lowest-paying occupations, overall wage inequality ($\log(p90/p10)$) was not positively correlated with the share of employment in any remarkable manner. A question that lingers, still, is whether there may be a relationship between changes in wage inequality and changes in the structure of employment through a series of regressions that apply the above-mentioned factors to a linear time trend in order to model the idea of a process, with the results of changes in technology being assumed to be the same for all countries. In this scenario, although the signs of all variables are in line with predictions, evidence appears strongest for the hypothesis of routinization. Interacting country dummies with these

variables and testing for their joint significance further confirms the conjecture of routinization.

In Goos and Manning's (2007) *Lousy and Lovely Jobs: the rising polarization of work in Britain*, SBTC is primarily used to explain rising wage inequality. However, as anticipated above, Autor, Levy, and Murnane (2003) have proposed a more nuanced way of understanding the impact of technology, in which the latter can replace human labour in routine tasks (step-by-step procedures or rules) but cannot do so in non-routine duties. The main argument in Goos and Manning's (2007) therefore is that the impact of technology will be to bring about an increase in the relative demand for both well-paid skilled occupations (that frequently require non-routine cognitive aptitudes) as well as for low-paid least-skilled jobs (that commonly require non-routine manual skills). Likewise, it is assumed that there will be a decrease in the relative demand for the "middling" jobs that have characteristically needed both routine manual and cognitive skills — a process we call job polarization. The data utilised in this study was the New Earnings Survey (NES) and the Labour Force Survey (LFS). For the NES, annual panel data started in 1968, although the first computerized records date from 1975 (the sample includes all individuals whose UK National Insurance number ends in 14). In order to retrieve information on pay, hours, occupation and industry for the employees, tax records were used to contact employers. In theory, this was a random sample, but the review did indeed

undersample part-time workers (whose income is too low to be recorded through the National Insurance system) and those that had changed jobs recently. The LFS, in turn, provided a different set of data: it was first conducted in 1975, and done every two years until 1983, then annually until 1992, and thereafter quarterly. Although this provided no wage information until 1993, and despite it being a smaller sample overall, the LFS data was closer to a random sample. Moreover, job was defined as a particular occupation, or as a particular occupation in a particular industry, with very similar results. Three-digit occupation codes (approximately 370 jobs) were considered, and the interaction of three-digit occupation and one-digit industry classification was also considered. The combined approach resulted in a maximum of 3700 jobs, but in practice only 1600 jobs were reviewed, given that not all occupations are represented in all industries. Among the main results that arose from this inquiry, the use of US data from ALM (2003) suggests that the occupations that involve non-routine tasks tend to be at the top and bottom of the wage spectrum. At the same time, it appears that the jobs that require routine tasks tend to be in the middle, thus leading to job polarization as a predicted result. Specifically for the 1975-1999 period, a review of job polarization in the UK using median wage as a proxy for job quality, demonstrates that there has been growth in *lousy* jobs together with a much larger growth in *lovely* jobs. It also shows a decline in the number of middling jobs. Notably, the usage of the method of Juhn, Murphy and Pierce

(1993), which predicts employment growth at each percentile of the wage distribution, backs the hypothesis of job polarization. This is commensurate with the ALM provision but also with other factors of significance, such as the changes in the configuration of consumer demand and trade and the composition of the labour force (the rising labour market participation of women, as well as changes in age and education structure). As regards the employment of non-manual workers, the pattern of within and between-industry developments in employment that flows from the one-digit occupation level is consistent with the ALM assumption that technical progress has uprooted the labour of manual and clerical workers across all sectors of the economy. It is also observed that a differential productivity growth between service and manufacturing sectors has led to an increase in low-wage service employment. It is also noticeable that the noted change towards a more educated type of labour has taken place mostly within jobs, and that even in the worst jobs there has been a rapid rise in the educational development of workers. Two possible interpretations of this circumstance are offered. The first one is that there has been SBTC within jobs as we define them, so that the consensus view on the importance of SBTC remains correct. The second one is that, while the job distribution has become more polarized, the educational attainment of all groups in the population has risen, and some educated workers have ended up being forced into low-skill jobs at the bottom end of the distribution. The advantage of this second argument is

that it helps explain why there has been a simultaneous increase in both the return to education (the demand for educated workers has risen since the number of good jobs has multiplied), as well as in the level of over-education, as some authors have claimed. A distinction between these hypotheses requires evidence on changing skill requirements within jobs that is difficult to find if one considers the extent to which the observed job polarization can explain the rise in wage inequality between the 1970s and 1990s. A further observation is that only a small proportion of the increase in wage inequality could be explained by the polarization of jobs alone, whereas most of the evolution of wage inequality could be elucidated by taking into account the fact that wage growth appears to be, monotonically, in a positive correlation to the level of quality of jobs. The inference is that the rise in “within-group” wage inequality that other authors have highlighted is rather a by-product of a limited notion of a “group.” It is also observed that this rise largely vanishes if one examines job controls. Having said that, the conclusion that the wages in the lousy jobs are decreasing by comparison to wages in the middling jobs appears somewhat problematical for the ALM hypothesis: on the assumption that relative demand is rising in the lousy jobs relative to the middling ones, one could, in fact, expect the exact opposite.

The work by Autor, Katz, Kearney (2006) stems from a reconsideration of the revisionist view, triggered by the episodic wage inequality in the 1980s and

inconsistency with SBTC. Among the circumstances analysed are the rapid growth of employment in jobs at the top and bottom relative to the middle of the skill distribution, as well as the solid expansion of 90-10 wage differential by 21 log points. In the late 1980s, upper-half wage inequality growth continued to rise steadily, while lower-half inequality growth ceased. From 1973 to 1988, specifically, there was also an almost linear spreading out of the entire wage distribution. By contrast, since 1988 wage growth has polarized, with the bottom quartile exhibiting a faster wage growth as compared to the middle two quartiles: the top quartile, for its part, shows the most accelerated increase and a continued spreading out of the wage distribution. The study further observes that the first-order effect of computerization is the displacement of “middle skilled” tasks: that is, repetitive production work as well as routine cognitive and manual duties such as bookkeeping. If these type of tasks are more complementary to high-skilled abstract tasks than to “non-routine manual” tasks (such as those performed by truck drivers, for instance), then the computerization of routine work can generate labour market polarization. The suggested model therefore predicts that wage polarization is to be accompanied by employment polarization. The work also investigates trends in the “quality”, skill content, and task content of US jobs since 1980. Following the analysis by Goos and Manning’s (2003), it further explores how US employment growth by occupation has been related to skill proxied by initial educational levels or wages. The evidence

used in the survey sorted 3-digit occupations into percentiles by mean years of schooling in 1980, using information from the 1980 Census' Integrated Public Use Microsample (IPUMS). This set of data indicated a polarization in the 1990s, with the most accelerated rises in high-skill jobs, while low-skill jobs showed a modest growth and the middle-skill jobs showed the slowest growth. The data also suggested a robustness of the pattern with an alternative skill definition (median hourly wage in an occupation in 1980). During the 1980s, employment growth was roughly monotonic in skill, and then polarized in the 1990s. Likewise, by using CPS data through 2002, variations in employment structure trends that require changes in employment by job task content are analysed by looking at industry-gender-education cells. This showed that employment growth was most rapid in the 1990s for jobs intensive in non-routine cognitive tasks (those most complementary with computerization). Meanwhile, for jobs intensive in routine cognitive and manual tasks (those most substitutable for computers), the 1990s, was a period of a considerable decline. Furthermore, for job intensive in non-routine manual tasks (typically required by low-wage occupations), their decline ceased in the 1990s. These paradigms of employment growth by education, wages, and task intensity suggest that, over the last 15 years, labour demand shifts have availed low- and high-wage workers relative to middle-wage workers. In contrast to this

conclusion, the labour demand shifts of the 1980s appear to have been monotonically rising in skill.

The work examines further how a fall in the real price of computing power may be conducive to a polarization of work. In routine cognitive and manual tasks, such as clerical work and repetitive production duties, computer capital –denoted by K and measured in efficiency units– is a close substitute for human labour. Moreover, routine tasks input –as embodied in either human labour or computer capital– is a complement to workers that are engaged in abstract reasoning tasks, such as coordination and problem solving. Finally, there exists an array of non-routine manual duties for which computers cannot at present neither directly substitute nor strongly complement, such as those performed by truck drivers, waiters, and janitors. The precipitous decline in the price of computing power in recent decades appears as an exogenous driving force, since it lowers the price of routine task input and increases demand for routine tasks. A key observation of the suggested model is that computer technology does not seem to offer a direct substitute for the lowest-skilled workers; rather, computers appear to displace a set of “middle-skilled” routine tasks. The displacement of these intermediate-skilled tasks generates job polarization, and it does so through three mechanisms. First, computing power directly reduces the wage of middle-skill tasks. Computing power also boosts the wages of high-skilled (abstract) occupations through q -complementarity. On the wages of low-

skilled (manual) tasks, the impacts are ambiguous, mainly due to offsetting effects of q-complementarity vis-à-vis the additional labour supply of workers that have been displaced from routine tasks. Therefore, although computerization lifts the wage gap between abstract and routine tasks –the “upper-tail” inequality in the model–, it can either increase or compress the wage gap between routine and manual tasks –the model’s “lower-tail” inequality–, depending on whether the q-complementarity or labour supply effect dominates.

Kaplanis (2007) provides another interesting empirical work which extends the work of Goos and Manning (2003) in order to look at regional geographical patterns in employment polarization in Britain. The analysis uses data from the New Earnings Survey (NES) on employees aged between 16 and 64. The NES is an employer-based survey with a panel element, in which the same individuals are tracked from year to year. It started to be compiled in 1975 and provides information on approximately 160,000 employees each year. Nevertheless, the research had to base its main results on the 1991-2001 period only, given that the occupational coding that the Office for National Statistics uses for NES changed in 1991. The eleven Standard Statistical Regions (SSRs) of Britain were used as the main regional classification. In this study, pay is used as a proxy for job quality. Employees in the NES are classified into 366 different jobs, based on the 3-digit Standard Occupational Classification (SOC90). For each occupation, a median pay

level is used as a measure of average job quality. Employment polarization is thus defined as an increase in the number of individuals employed in low-paid and high-paid jobs relative to 'average-paid' occupations. In the period between 1991 and 2001, it is observed that many of the lowest-paid jobs underwent a significant growth in the share of all employees they enrolled – for example, bar staff (up 32 per cent relative to total employment growth) and sales assistants (up 47 per cent). Simultaneously, many jobs at the highest-paid end also experienced a very remarkable increase in their share of employment – for instance, financial institutions managers (up 73 per cent) and marketing and sales managers (up 54 per cent). According to median hourly pay, each of the 366 occupations was ranked from worst to best and then grouped into ten equally sized 'job quality categories', with 'job quality category 1' being the lowest-paid category of the spectrum, and 'job quality category 10' being the highest. For Britain as a whole for the 1991-2001 period, the results show that the share of high-quality jobs increases. For low-quality jobs, there is also an increase, albeit to a lesser extent. Finally, for jobs of middling quality, the share declines. Looking within each region, a general pattern (with the sole exception of East Anglia) can be discerned of rising shares for both the high-paid and the low-paid jobs and of falling shares for the middle jobs. In London, this pattern is strongest, and a correlation review of job quality categories 1 and 10 (i.e. the

lowest and the highest) indeed demonstrates that the region with the strongest correlation between the two categories is London.

The study by Cortes (2012) shows that the share of employment in high-skill, high-wage jobs as well as in low-skill, low-wage occupations has been on the rise relative to the share in occupations in the middle of the distribution. It also indicates that wages have grown faster at the top and the bottom of the distribution than in the middle sections. The innovative aspect of the research is the focus on the individual level predictions in terms of wage changes and occupational switching patterns. The main input from this paper are to formulate these individual-level predictions within this type of model, and to test them using data from the Panel Study of Income Dynamics (PSID) from 1976 to 2007. The PSID is a longitudinal survey of almost 9,000 families across the country. Its data is available at an annual frequency between 1968 and 1997, and bi-annually from 1997 onwards. Following the same families since 1968, the PSID collects data on economic, health, and social behaviour, including the occupational affiliation of the household head and spouse, the wage on their main job at the time of a survey interview, and their total labour earnings in the previous calendar year. This instrument tracks individuals over time, making it possible to document the likelihood of transitions between different types of jobs, and to analyse the wage variations for workers with different labour market experiences. Occupations are then grouped based on an aggregation of 3-

digit occupation codes into the three categories used in the model: routine (craftsmen, clerical, sales, foremen, labourers, operatives), non-routine manual (service occupations), and non-routine cognitive (managerial and professional jobs). The use of micro-level type of evidence allow a closer scrutiny of the dynamics that underpin the aggregate patterns of employment and wage polarization: in particular, the manner in which particular subsets of workers have been impacted by routinization, as well as the changes over time in occupational wage premia , once selection has been accounted for. The results of the study show that for workers switching out of routine job, the evidence is strong for a selection based on ability. Likewise, it appears that low ability routine workers are more likely to switch to non-routine manual jobs, while high ability routine workers are more likely to switch to non-routine cognitive jobs. On the other hand, workers that stay in routine jobs tend to perform significantly worse than workers staying in any other type of occupation. From 1976 to the mid-2000, the wage premium for routine jobs is estimated to have fallen by 17% relative to the one for non-routine manual occupations (when taking account of changing returns to education, this is slightly reduced, to 14%). At the same time, the wage premium for non-routine cognitive jobs is estimated to have increased by 25% over the same period relative to the wage premium for non-routine manual occupations (although when taking account of changing returns to education, this goes significantly down, to 7%) . In terms

of wage growth between routine workers who stay or switch to other occupations, noticeable differences can also be observed. Over a short-run period, those who switch to non-routine manual jobs experience a lower wage growth vis-à-vis those who stay (around 14% lower over a two-year period). Subsequently, however, they recover from these losses; in fact, in the long run, they benefit from a much faster wage growth than stayers (5 to 12% higher over a 10-year period). In turn, those who switch to non-routine cognitive ones will experience a much higher wage growth than stayers, and this applies to a variety of time horizons (6 to 12% higher over a two-year period, and 14 to 16% higher over a 10-year period). The predictions of the model concerning the general equilibrium effects of a positive shock to \ln_{rt} can be outlined as along two main lines. First, in terms of switching patterns, the workers at the bottom of the ability distribution within routine occupations tend to switch to non-routine manual jobs. Likewise, the workers at the top of the ability distribution within routine occupations do switch to non-routine cognitive jobs. Finally, for non-routine workers (either manual or cognitive), no switching is induced. Secondly, as regards wage changes, workers staying in routine occupations experience a decrease in real wages relative to those staying in non-routine manual jobs. Moreover, workers who stay in non-routine cognitive jobs experience an increase in real wages relative to those staying in routine. Then, workers who switch from routine to non-routine occupations (either cognitive or manual) experience

an increase in real wages relative to those who stay in the routine occupation.

The paper used wages reported for the current occupation, as they can be directly linked to the job that the respondent was working in at the time of the interview. The information regarding wages for salaried workers is only available from 1976 onwards, so the analysis only uses data from that year and thereafter. The most recent data the paper reviews corresponds to 2007. The analysed sample was limited to male household heads only, aged 16 to 64, who are employed in non-agricultural, non-military jobs, and who are also part of the Survey Research Center (SRC) sample. This is the main original sample from the PSID. Consequently, the over-sample of low-income households (SEO sample) as well as the immigrant samples added in the 1990s were excluded from the review. Throughout the research a broad classification of jobs is used. Jobs are categorised into three groups, and this distinction is in turn based on the categories used by Acemoglu and Autor (2011). The groups are: a) non-routine cognitive jobs (that is, management, professional, technical, financial and business occupations); b) routine occupations, such as clerical, administrative support, craftsmen, sales workers, foremen, operatives, installation, production and transportation jobs, maintenance and repair occupations, labourers; and finally, non-routine manual jobs, ie. service workers. The classification is based on the aggregation of 3-digit occupational codes that map into these broad

categories. As explained in Acemoglu and Autor (2011) and supported by data from the Dictionary of Occupational Titles, each group is labelled with the name of the main task performed by workers in that occupation. The outcome of the study was consistent with the prediction of the model. The data indicated a strong evidence of selection on ability in occupational mobility out of routine occupations: while workers of relatively high ability are more likely to switch to non-routine cognitive jobs, workers of relatively low ability are more likely to switch to non-routine manual ones. Notably, after the 1990s, the likelihood of switching to non-routine cognitive jobs increases more than the probability of switching to non-routine manual jobs for routine workers at all ability quintiles. This suggests that there has not been a large displacement of middle-skill workers towards low-skill jobs in the 1990s or 2000s, as it has been sometimes assumed.

Autor and Dorn (2012) offer a comprehensive empirical review as well as an explanation of the polarization of employment in the United States. It analyses wages between 1980 and 2005, and the concomitant growth of low skill service jobs. The authors attribute polarization to the interaction between consumer preferences, which favour variety over specialization, and the falling cost of automating routine, codifiable job tasks. The work applies a spatial equilibrium model, with four implications of this hypothesis being derived, tested and confirmed. The research observes that local labour markets that were specialized in routine activities differentially adopted

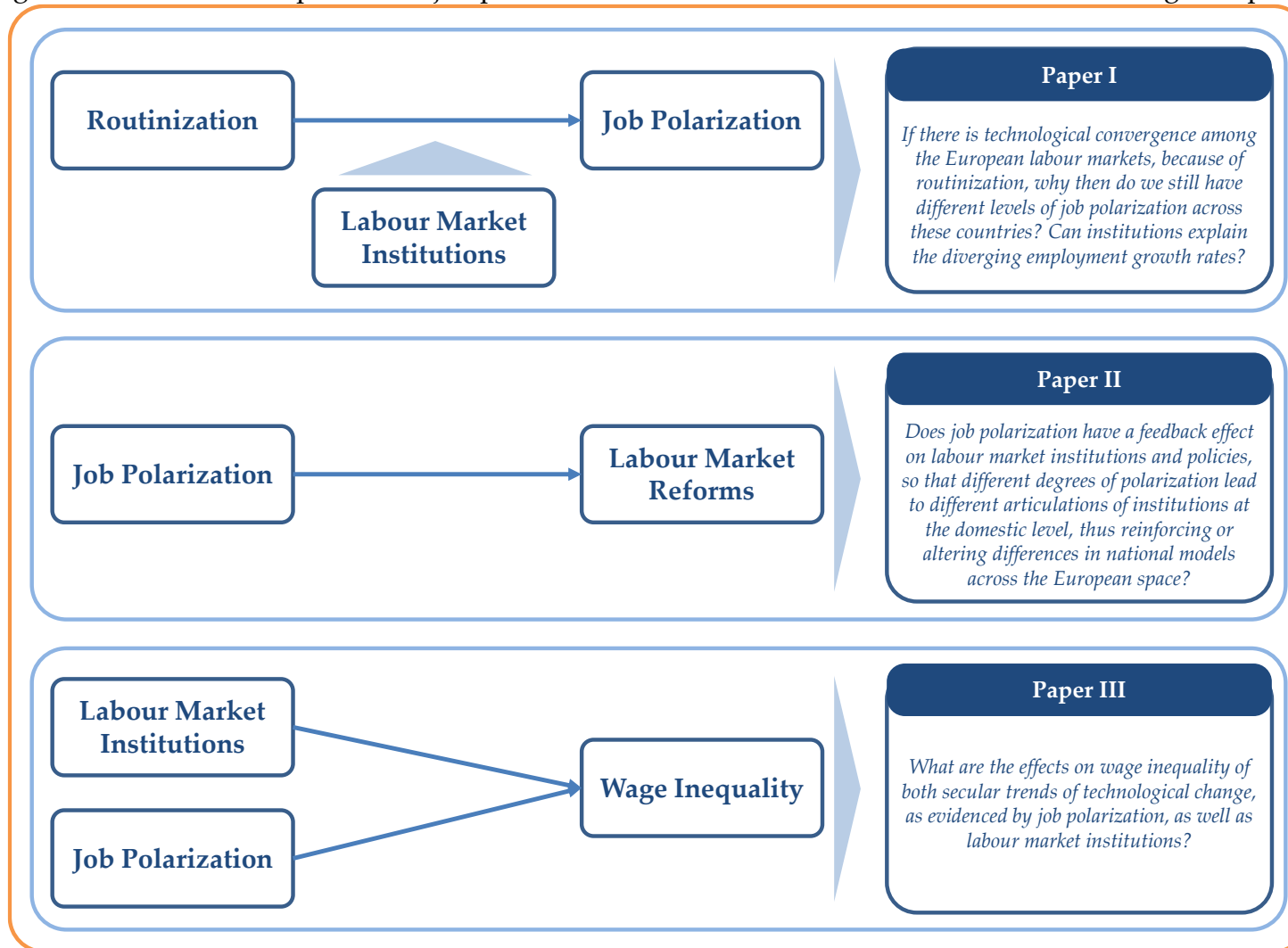
information technology, reallocated low skill labour into service occupations (employment polarization), experienced earnings growth at the tails of the distribution (wage polarization), and received inflows of skilled labour.

Finally Jaimovich and Siu (2012), explore the relationship between the phenomena of job polarization and jobless recoveries. The concept of job polarization is understood as the recent disappearance of employment in occupations in the middle of the skill distribution, while the notion of jobless recoveries refers to the slow rebound in aggregate employment following recent recessions, despite recoveries in aggregate output. The authors note that job polarization is actually not a gradual process; essentially all of the job losses in middle-skill occupations occur in economic crises. Moreover, jobless recoveries in the aggregate are accounted for by jobless recoveries in the middle-skill occupations that are disappearing. The fact that 92% of the job loss in these occupations since the mid-1980s occurs within a 12-month window of NBER dated recessions (that have all been characterized by jobless recoveries) confirms the view that job polarization is not a gradual phenomenon. The loss of middle-skill, routine jobs is concentrated in economic downturns. A job polarization trend thus appears as a business cycle phenomenon. Employment in routine occupations account for an important fraction of aggregate employment averaged over the jobless recovery era, these jobs account for more than 50% of total employment. Jobless recoveries are observed only in these disappearing, middle-skill jobs.

The high- and low-skill occupations to which employment is polarizing either do not undergo contractions, or if they do, after the turning point in aggregate output they soon experience a rebound. Jobless recoveries can be traced to the disappearance of routine occupations in recessions. Notably, in routine occupations (nor in aggregate employment) prior to the era of job polarization, jobless recoveries were not observed.

3. Conceptual Framework

Figure 1: The relationship between job polarization, labour market institutions & reforms, wage inequality



4. Operationalisation

The main research questions in this thesis are addressed in three empirical papers. In this section I briefly outline the puzzle in each paper, the working hypotheses, the empirical methodologies adopted and the main findings.

PAPER 1 – *Structural Employment Changes and the Disappearing Middle-Class*

The puzzle at the heart of this first paper concerns the main failure of the literature on job polarization: if there is technological convergence among the European labour markets why then do we still have different levels of polarization across these countries? What is behind the diverging employment growth rates? The main aim of this paper is to show that, although the routinization hypothesis remains the most plausible cause of job polarization, the type of institutional framework peculiar to each country shapes the distinctive patterns that can be observed.

Oesch (2013) among others pointed out two main views as to what kind of impact institutions may have on the occupational structure. Krugman (1994) argues that institutions lead among lowly educated workers to a trade-off between wages and employment. High wage floors and powerful trade unions lead to low growth in low-skilled services, high unemployment, low inequality. Whereas deregulation leads to job creation in low-end services

but higher inequality. Therefore setting high wages floors favors the creation of decent jobs but leads to weak growth in low-skilled services and to high unemployment. Deregulation of wage-setting institutions promotes job creation in low-end services. The second view is associated to Streeck(1997) and Acemoglu(2003) and asserts that employers opt for a "high road" vs "low road" job strategy depending on the institutional permissiveness: low-wage, low-skill, low training and low productivity jobs vs high-skill and high-productivity (upgrading).

These theoretical premises can therefore be tested by concentrating on the effect on employment changes of three main labour market institutions: employment protection legislation (EPL), trade union density and minimum wages.

The three main hypotheses I am putting forward are:

- Hypothesis *H1*: *EPL insulates insiders which dampens down the routinization effect*
- Hypothesis *H2*: *Trade unions resist technology-induced occupational changes*
- Hypothesis *H3*: *Minimum wages constrain the growth of low skilled jobs*

The paper relies on the analysis of seven sets of data: the European Union Labour Force Survey (EU LFS), the United Kingdom Labour Force Survey (UKLFS), the European Union Statistics on Income and Living Conditions (EU-SILC), the Routing Task Intensity (RTI) index, the Princeton Data Improvement Initiative (PDII) dataset, and the CEP-OECD Institutions

Dataset. It starts by looking at the employment patterns in the European Labour Force Survey (EU LFS) and follows a methodology which resembles closely the one adopted by Goos, Manning and Salomons (2014), however, it further extends this framework by testing the joint effect of routinization and labour market institutions on employment structures.

Moving to the discussion of the results against the hypotheses set above I find *H1* to be confirmed: job polarization operates through routinization, but this effect is mitigated by employment protection legislation. A higher strictness of regulation on dismissals and on the use of temporary contracts thus constrains the job polarization patterns, making the hollowing out of the labour market more subdued. I don't find evidence for *H2* of trade unions resisting the routinization effect. It may be that trade unions dampen the effect of firing within a firm, thus the slightly positive coefficient, however we could have entire firms going bankrupt because of automation therefore the interaction effect between routinization and trade unions becomes not significant. For the last hypothesis *H3*, minimum wages do not seem to exert a significant effect on job polarization patterns when interacted with routinization. The evidence provided thus suggests that the claim of a pervasive technology-induced polarization should be revised in order to comprise a role for the institutional component.

PAPER II – *The Routinization of Labour Market Reforms*

In the second paper I ask whether job polarization has a feedback effect on labour market institutions and policies, so that different degrees of polarization lead to different articulations of institutions at the domestic level, thus reinforcing or altering differences in national models across the European space. This paper is thus aimed at establishing whether there is a relationship between the extent of polarization exhibited by each European country and their specific labour market reform processes. The political economy channel at the core of the analysis sees a decreased bargaining power of trade unions due to the hollowing out of their power base (particularly relevant for manufacturing) translated into a weakened intermediating effect in the labour market reform process. The decrease in concerted power thus reflects into an increased reform activity, a move towards deregulation and a decrease in the generosity of the policy measures.

The hypotheses that the paper sets out are the following:

- Hypothesis H1: *The erosion of privileged interest representation and a weakened power of intermediation translate into a heightened intensity of labour market reforms*
- Hypothesis H2: *The erosion of privileged interest representation and a weakened power of intermediation translate into a higher degree of deregulation and decreased generosity of policy measures*
- Hypothesis H3: *LMEs are polarization consistent leading to a lower pressure to reform*
- Hypothesis H4: *CMEs are polarization incompatible leading to an increased reform activity*

The analysis finds that the job polarization experienced by a particular country in the 5 years before the reform instance is consistently among the strongest predictors of reform activity, as significant as other drivers such as GDP growth and government net debt. Moreover a higher degree of polarization tends to be associated with more deregulation and a decrease in the generosity of the policy measure. Finally, the empirical framework is tested against more conventional taxonomies of welfare capitalism (Esping-Andersen and VoC) revealing how both the continental and liberal regimes have been profoundly affected by job polarization.

The results thus show that job polarization increases both the number and direction of labour market reforms in Europe and major differences arise across the different models of capitalism. LMEs, because of their reliance on flexibility and the harnessing of market dynamics, are found to be polarization consistent. CMEs instead are polarization incompatible: technological advancement destabilizes the system and therefore more reforms are needed. This results that seems to raise again questions about the possible Convergence of CMEs toward LMEs.

PAPER III – Falling Behind: The Decoupling of Job and Wage Polarization in Europe

The hollowing out of the middle in the US labour market produced both job and wage polarization patterns which persisted throughout the period 1985-

2005. However, while wage inequality has been on the rise also in Europe, this paper will try to understand whether wage polarization, and the distinctive U-shaped impact on the wage distribution has materialized across European countries as well.

The hypotheses in this paper build on the theoretical framework provided by Lemieux(2008) who argues that where wage-setting institutions are weak, a negative technological change depresses the wage growth in the sector where automation is stronger, instead where they are strong, wages in the medium sector remain stable despite the same negative demand change.

I set out a number of hypotheses to understand what is happening to the wage distribution in terms of upper-tail (90/50) inequality and lower-tail inequality (50/10) and build on the results from the two previous papers. In particular I will test:

- Hypothesis *H1*: *EPL reduces upper-tail inequality (90/50) while maintaining or increasing lower-tail (50/10) inequality*
- Hypothesis *H2*: *Job polarization increases upper-tail inequality (90/50) while reducing lower-tail (50/10) inequality*

In my empirical analysis, I start by looking at wage dynamics and evolutions across sectors for the EU and US in the last three decades in order to find evidence of wage polarization. Secondly, my analysis includes fixed effects regressions of wage inequality ratios (upper 90/50 and lower tail 50/10) on wage determinants common in the literature and separately on an

institutional factor (employment protection legislation) and on job polarization. Finally, I try to unveil wage dynamics over time according to the Varieties of Capitalism taxonomy.

By relying on the Occupational Wages around the World (OWW) Database compiled by Richard B. Freeman and Remco H. Oostendorp, which contains wage data covering 171 countries from 1983 to 2008 derived from the ILO October Inquiry database, I thus investigate the effects on wage inequality of both secular trends of technological change, as evidenced by job polarization, as well as institution-based explanations.

The findings show that no sign of wage polarization can be found in the EU: the wage dynamics show that the middle sector has not been hollowed out in terms of wage growth as in the case of the US, which I also show. Secondly, job polarization increased upper-tail inequality (90-50) and decreased lower-tail (50-10) inequality but that employment protection legislation restrained these wage effects. Finally, after splitting my sample for standardised hourly wages into the LMEs vs CMEs I find that wages in LMEs are much more dispersed than in CMEs and this pattern is preserved when looking at the evolution over time.

PAPER I

Structural Employment Changes and the Disappearing Middle-Class

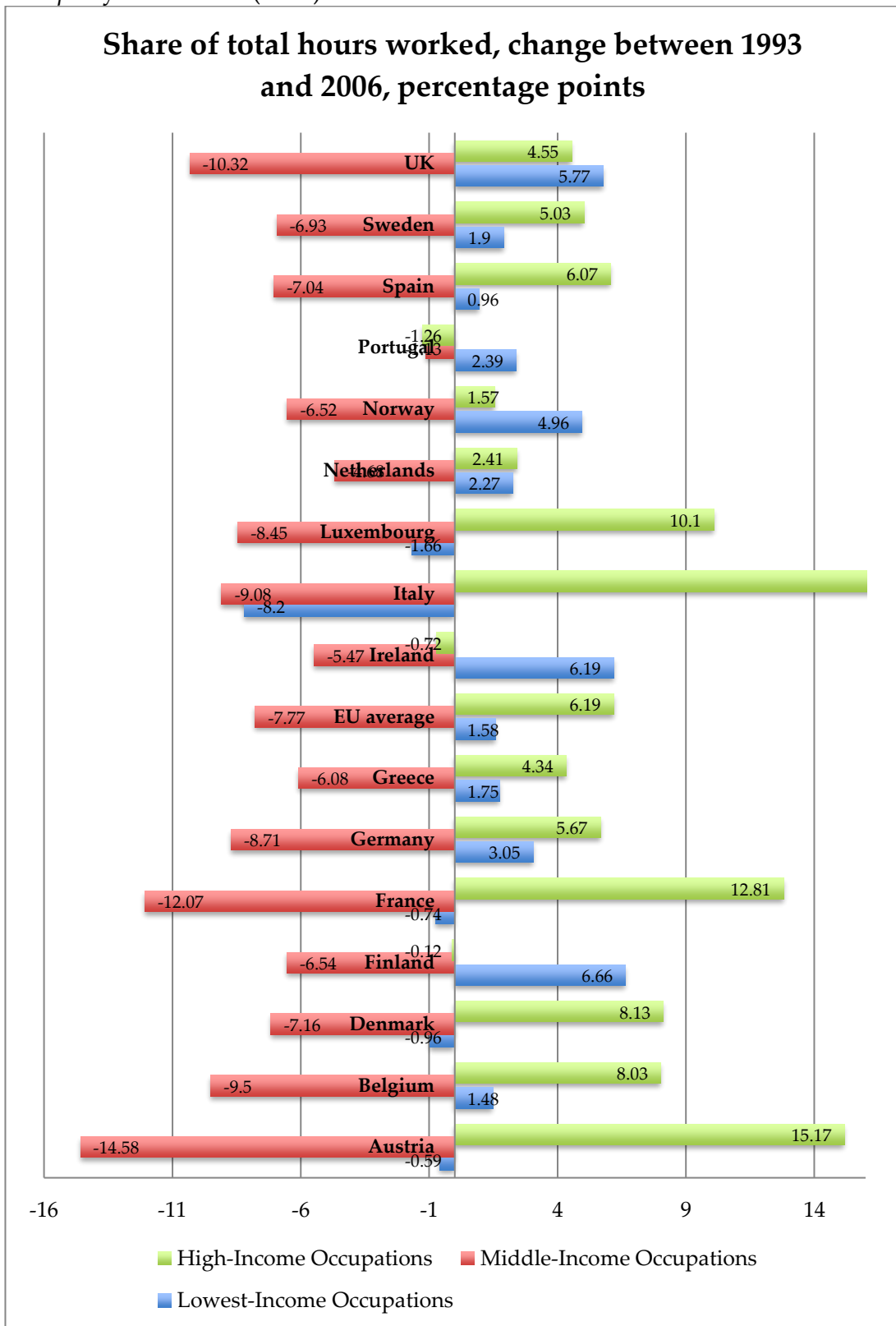
Abstract

This paper investigates the evolution of employment patterns in the European labour markets over the period 1993-2011 and attempts to show that, although the routinization hypothesis remains the most plausible cause of job polarization, it is the peculiar type of institutional framework that ultimately shapes the distinctive patterns that can be observed. Based on the analysis of the European Labour Force Survey (EU LFS) data, this paper follows a methodology which resembles closely the one adopted by Goos, Manning and Salomons (2014). However, it further extends this framework by testing the joint effect of routinization and labour market institutions on employment structures. The evidence provided suggests that the claim of a pervasive technology-induced polarization could be revised in order to comprise a role for the institutional component.

1. Puzzle and Relevance

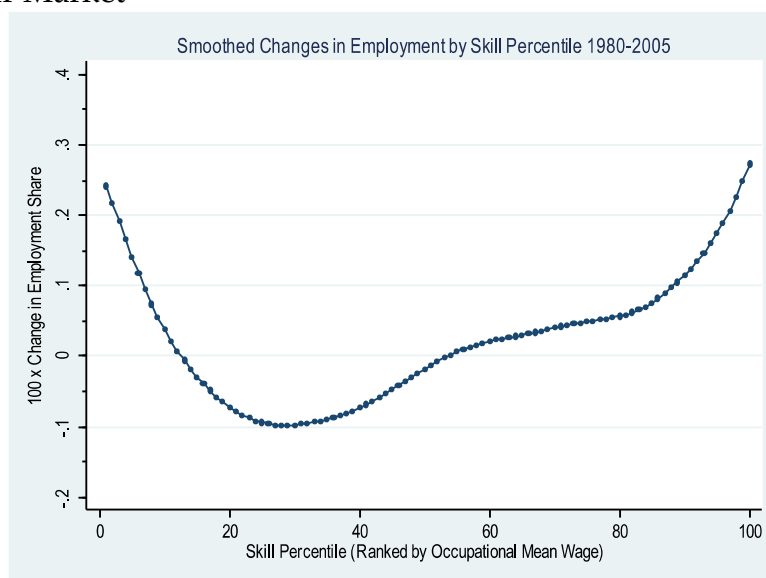
The puzzle at the heart of this paper concerns the main failure of the literature on job polarization: if there is technological convergence among the European labour markets why then do we still have different levels of polarization across these countries? What is behind the diverging employment growth rates? Looking at Figure 1 on the next page, why is Italy for instance exhibiting a shrinking of both lowest and middle-income occupations and an enormous increase in highest-income occupations, while the United Kingdom and The Netherlands exhibit patterns more in line with the classic job polarization phenomenon? The main aim of this paper is to show that, although the routinization hypothesis remains the most plausible cause of job polarization, the type of institutional framework peculiar to each country shapes the distinctive patterns that can be observed.

Figure 2: elaborated by the author based on the data from *Job Polarization in Europe* by Goos et al. (2009).



From the review of the economic literature analysing the impact of technological change on production (Autor, Katz, Karney, 2006; Acemoglu and Autor, 2010; Goos & Manning, 2007) the dominant picture that emerges is that routinization has led to a hollowing out of the employment distribution in the middle and a simultaneous expansion at the top and bottom (see Figure 3 below).

Figure 3: The Growth of Low Skill Service Jobs and the Polarization of the U.S. Labour Market



Source: Autor and Dorn (2012)

The dramatic implication of this literature is that such a “pervasive pattern of technology-induced polarization” will inevitably shape the global socioeconomic structures leaving no room for the intervention of policymakers. However, are we sure that over the last decades the European labour markets have exhibited a uniform pattern of job polarization? If this is not the case, what is the role played by labour market institutions in

explaining diverging magnitudes of this phenomenon? These are the questions this paper will try to address and by uncovering the evolution in the employment patterns it will also provide a tentative answer to the broader questions raised above.

As also argued by Fernández-Maciàs, Hurely and Storrie in their recent book *Transformation of the Employment Structure in the EU and USA, 1995–2007*, although these papers have a solid theoretical framework, Skill-Biased Technical Change(SBTC), proposed by Autor, Levy and Murnane in 2003, their main support comes from the empirical analyses of the labour markets in the US and Europe since the 1990s (Autor, Dorn, 2009; Goos et al, 2009).

The findings of Fernández-Maciàs(2012) are extremely insightful since they reveal a picture of job polarization which is very fragmented across Europe. Despite the lack of a regression analysis, which transforms the empirical exercise into a mere qualitative comparison, the author is able to classify the changes in the employment structures into three main categories: Polarization, Upgrading and Mid-Upgrading, associated respectively with the three main families of welfare capitalism (Continental Europe, Scandinavian countries and Southern Europe). Two other interesting works to understand the contribution of this paper are Pertold-Gebicka(2013) and Nellas and Olivieri(2013) which highlight a negative relationship between employment protection strictness and the extent of polarization; these add further support for the role played by labour market institutions.

My paper is based mainly on the analysis of the data from the European Labour Force Survey(EU15) and follows a methodology which resembles closely the one adopted in Goos et al. 2014, but will diverge from it for the presence of a set of variables capturing the effect of labour market institutions. The main divergence from the original paper lies in the introduction of a set of institutional variables extracted from the CEP-OECD Institutions Dataset. These are the sections along which this paper will be structured: first, I will start by exploring thoroughly the literature on SBTC and job polarization that has emerged in the last decade and I will try to highlight where the main failure lies. Subsequently, I will set forth my main hypothesis concerning technological convergence and job polarization patterns. A section dedicated to the test of this hypothesis will follow this and finally I will confront my results with the existing theoretical and empirical findings of the literature.

2. Literature Review

This paper hinges on three main streams of literature. First the shift in the modelling of technology from a theoretical framework based on skills to one based on tasks will be considered. Secondly, the impact of labour market institutions on occupational changes. Finally, this paper contributes to a

more recent literature that looks at the interaction between the technological and institutional components and its impact on employment growth and occupational patterns.

2.1 From Skilled biased to Routine biased technological change

The theoretical framework of Skill-Biased Technical Change has been comprehensively reviewed by Acemoglu(2002). In his work the author tries to give an answer to two main questions: first, why have technological advances been skill-biased in the twentieth century while in the nineteenth-century they replaced skilled workers and expanded tasks performed by the unskilled? Second, are technological changes the major cause of the recent increase in inequality? The main argument put forth by the author is that “the development and use of technology is, at least in part, a response to profit incentives. When developing skill-biased techniques is more profitable, new technology will tend to be skill-biased.” Therefore we can explain the difference between the two centuries by claiming that in the nineteenth-century we had skill-replacing developments because of the increased supply of unskilled workers, which made the production of these technologies profitable. On the other hand technical change became skilled-bias in the next century because “the rapid increase in the supply of skilled workers has induced the development of skill-complementary technologies”. The vast literature he reviews relies mainly on a dichotomous model of the

labour market in which the demand for skilled labour expands while the one for unskilled labour shrinks when we introduce technical change. This suggests that the main prediction is upgrading rather than polarization of employment. In 2003, Autor, Levy and Murnane in their paper *The Skill Content of Recent Technological Change: An Empirical Exploration* provide a simple model based on a task framework which puts forth the argument of *routinization*: “computer technology substitutes for workers in performing routine tasks that can be readily described with programmed rules, while complementing workers in executing nonroutine tasks demanding flexibility, creativity, generalized problem-solving capabilities, and complex communications”. In their analysis on how computerization affected job-skill demand between 1960 and 1998, the authors thus took in consideration two principal types of tasks: (1) tasks that may be carried out by following a definite set of rules (this includes both cognitive and manual tasks), and (2) tasks which entail problem-solving or complex communication. Tasks pertaining to the first category may also be defined as ‘routine’ tasks, while tasks pertaining to the second category may be referenced as ‘non-routine’ tasks. The results of the study show a shift in the level of worker-input with regards to each type of task. Specifically, for routine tasks a significant decrease in labour-input was registered following the advancement of computer technology. On the contrary, non-routine cognitive tasks experienced an increase in the amount of labour-input. Thus, the authors

developed the hypothesis that computers may substitute workers performing routine tasks while aiding workers in the performance of non-routine jobs.

In the same year Goos & Manning further elaborated the routinization hypothesis with its four categories (manual vs. cognitive, routine vs. non-routine) into an argument for polarization. The authors analyse the UK employment structure since the 1970s emphasizing that there was a strong growth in “lousy and lovely job” (bottom and top) relative to the middle of the distribution. They explained this by claiming that there was a general equilibrium effect, which shifted employment towards the jobs in which productivity was low, where, in other words, technology could not be applied.

Two further publications made the *job polarization* argument prominent. In 2006 Autor, Katz and Kearney provide a set of empirical findings, which suggest that “demand shifts are likely to be a key component of any cogent explanation for the changing US wage structure”. A wage structure, which has become polarized in the last three decades mainly because of the impact of information technology and indirectly because of outsourcing. The evidence for the European labour markets comes few years later when Goos, Manning and Salomons (2009) expand their previous work on the UK and argue strongly for a pervasive technology-induced polarization across all the employment structures of the Old Continent. Their analysis covers the

period 1993-2006 and suggests that like in the United States and the United Kingdom, also in Europe we have experienced a disproportionate increase in high-paid and low-paid employment. Their claim is the following: “pervasive job polarization is in line with the evidence that in advanced countries, technologies are becoming more intense in the use of non-routine tasks concentrated in high-paid and low-paid service jobs, at the expense of routine tasks concentrated in manufacturing and clerical work. The evidence for alternative explanations –offshoring and wage inequality(used as a proxy for institutions) – is much weaker”. This is a very powerful statement because it implies that routinization is the main cause behind the polarization of employment and that countries belonging to distinct welfare systems exhibit a “similar” pattern, despite differences in unionization rates or collective bargaining systems, in other words *institutions*, are completely ignored.

Before moving to the next section, I would like to focus on another criticism that was moved against Goos et al. (2009) and that concerns the supporting evidence behind their main claim. Fernández-Maciás asserts that “there is no direct evidence of the existence of a mechanism linking the IT evolution and the alleged polarization of developed economies’ employment structures. Simply, the IT revolution and its task-biased impact on labour demand seems like a plausible explanation for such a pervasive polarization pattern, and the practical absence of any variation suggests that other factors must have

played just a very minor role in the recent evolution of employment structures across Europe". Two recent studies have actually tried to fill this gap. Michaels, Natraj, Van Reenen in their 2010 paper, *Has ICT Polarized Skill Demand? Evidence from Eleven Countries over 25 years*, carry out a cross-country study and suggest that the industries that adopted IT at faster rates (in terms of IT spending and spending on R&D) saw the highest demand for highly-skilled workers and a simultaneous shrinkage of the individuals with intermediate skills. To avoid a possible identification issue posed by the endogeneity of IT adoption to globalisation, a second paper was written by Bloom, Draca and Van Reenen which shows that the industries that were more exposed to Chinese imports responded by "innovating more in order to move up the value chain" (*The Economist*, Sept 2010). However, when one confronts these findings with Goos et al.(2009) the IT and job polarization patterns do not appear to match completely, most probably because of the different databases used in their analyses and the different time periods covered. Therefore a definitive answer to the lack of a convincing mechanism explaining the patterns has not been found yet.

2.2 Labour Market Institutions and Occupational Change

The second stream of literature considered in this paper looks at the impact that labour market institutions have on occupational structures. Far from reaching a convergence of views on the magnitude and direction of this

effect, there is a consensus that wage-setting institutions ultimately shape the demand by employers and the workers' supply of labour, and this will be particularly crucial for the low-skilled. As highlighted by Oesch(2013) the view that dominated during the 1990s was put forward by Paul Krugman(1994), who emphasized how institutions lead to a trade-off between wages and employment. The second theoretical argument instead is based on the works of Streeck (1997) and Acemoglu (2003) who argue that employers are faced with the choice of either pursuing a "high road" or a "low road" job strategy. The "high road" hinges on the upgrading of the work force and has traditionally been followed by West European countries which have featured collective bargaining, stricter employment protection legislations, and welfare-state benefits. The opposite strategy instead was favoured by American employers who, in a more lenient institutional environment, chose the more profitable low-wage path.

Wage-setting institutions could therefore either have a constraining effect on employers' demand thus leading to greater unemployment or they could act as an opportunity for firms to increase investment in their lowly qualified workforce. The low-skilled interpersonal service jobs will be the most affected segment of the skill distribution primarily because its tasks are less subject to automation, more difficult to outsource and to trade. The compression of the wage structure does not only concern the bargaining system and the role played by trade unions, but entails also a consideration

of the level of the minimum wage. This will act as a powerful factor for the demand for personal services and will ultimately determine the choice between home production and market-supplied services. For instance Rogerson (2008) finds that between 1956 to 2003 European workers spent on average 45% less time on the job compared to their American counterparts. This trend can be easily explained when looking at the service sector of each of the two economies. Over the abovementioned time period, Europe's service market sector expands at a significantly lower rate compared to that of the United States.

2.3 Job polarization and Labour Market Institutions

In this section I focus on the critical analysis of three recent papers that have attempted to introduce a role for institutions in their investigation of the job polarization phenomenon.

I. *Job Polarization in Europe? Changes in the Employment Structure and Job Quality, 1995-2007* by Enrique Fernàndez-Maciàs (2012)

This paper by Fernàndez-Maciàs provides the most critical assessment of the work by Goos et al.(2009), both with regards to the construction of the empirical framework and the conclusions reached by the authors; probably its main weakness is the lack of a proper regression analysis. The fundamental argument of Fernàndez-Maciàs is that Goos et al. assume that

labour is not unstructured and uniform, but “structured by technology and the division of labour into different occupations or types of jobs”, however differently from the “New Structuralist” approach in sociology, here no role for institutions is envisaged. The author provides a very solid theoretical framework to support his thesis of the importance of labour market institutions. He defines institutions very broadly, as “power relations in work/labour market and regulation”. Firstly, he exploits the arguments of the segmentation theorists and of occupational sociology. “The division of labour is an object of struggle” which sees on one side employers trying to get the most from production and on the other the workers which try to resist; from sociology the concept of “occupational power” used not only against employers but also against other groups of workers. Second, he focuses on the argument that some occupations are generated by regulation and they remain “institutionally protected”: the mechanisms at work in this case are mainly through the structure of labour costs and these institutions will affect occupational groups differently. He has two main hypotheses that he intends to test:

- ‘the type of diversity we find in the patterns of occupation change should be somehow related to the well-known institutional families of Europe’ (Esping-Andersen 1999)

- 'there should be more diversity in the middle and bottom of the employment structure than in the top' since he claims that the institutional arrangements usually have an effect on these segments in particular.

The analysis framework adopted by the author resembles the one of Goos et al. (2009) but differs from it in three fundamental ways: the definition of jobs, the job quality rankings and the construction of the job quality tiers. Instead of the 21 occupational titles here the author use a list two digit occupation-by-sector definition of jobs, which should be more consistent across the 15 European countries. Jobs are ranked according to country-specific wage levels rather than using only the UK 1994 median hourly wages. Finally, and this is I think the most crucial difference, Fernàndez-Maciàs does not follow Goos et al. who classify the ranked jobs in three categories (good, middling, and bad jobs) but rather he groups jobs in five "equal-sized groups" ranked by their median hourly wages, which are then called quintiles. It is extremely important to stress that they are "equal-sized groups" since Goos et al. have very unequal sizes for their groups, which could undermine their whole approach. The Table 1 from Fernàndez-Maciàs(2012) is presented here in order to clarify this point.

Table 1: Comparison of occupational groupings between Goos et al.(2009)
and Fernàndez-Maciàs(2012)

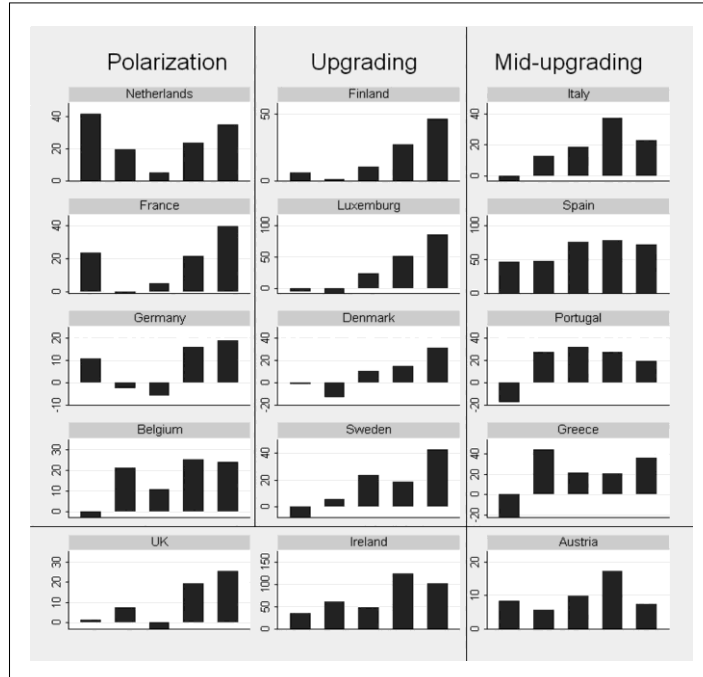
Changes in shares of hours worked over 1993-2006 for occupations ranked by their mean 1993 European wage				1. Goos, Manning, & Salomons (GMS) grouping of jobs		2. Alternative grouping of jobs	
Wage ranking	Occupations	Initial share	Relative growth	Initial share	Relative growth	Initial share	Relative growth
1	Corporate managers	4.54	1.25	28.78	7.75	34.26	7.58
2	Physical, mathematical, engineering professionals	2.92	1.02				
3	Life science and health professionals	1.86	-0.14				
4	Other professionals	2.82	0.7				
5	Managers of small enterprises	3.6	1.28				
6	Physics, mathematics, engineering associate professionals	3.99	0.91				
7	Other associate professionals	6.77	2.07				
8	Life science and health associate professionals	2.28	0.66				
9	Drivers and mobile plant operators	5.48	-0.17	48.98	-8.98	33.6	-5.43
10	Stationary plant and related operators	1.75	-0.39				
11	Metal, machinery, and related trades workers	8.33	-2.33				
12	Precision, handicraft, and related trades workers	1.31	-0.4				
13	Office clerks	12.04	-1.98				
14	Customer service clerks	2	0.19				
15	Extraction and building trades workers	8.17	-0.52				
16	Machine operators and assemblers	6.71	-2.01				
17	Other craft and related trades workers	3.19	-1.37	22.25	1.23	32.15	-2.15
18	Personal and protective service occupations	6.94	1.15				
19	Laborers in construction, manufacturing, transport	4.11	0.48				
20	Models, salespersons, demonstrators	6.73	-1.42				
21	Sales and services elementary occupations	4.47	1.02				

Source: Fernández-Macias(2012)

Looking at the results, the author frames them mainly around two figures: 'Relative change in employment by wage quintiles 1995-2007' and 'Relative change in employment by education quintiles, 1995-2007' which are aimed at disproving the hypothesis of a pervasive job polarization across Europe. As

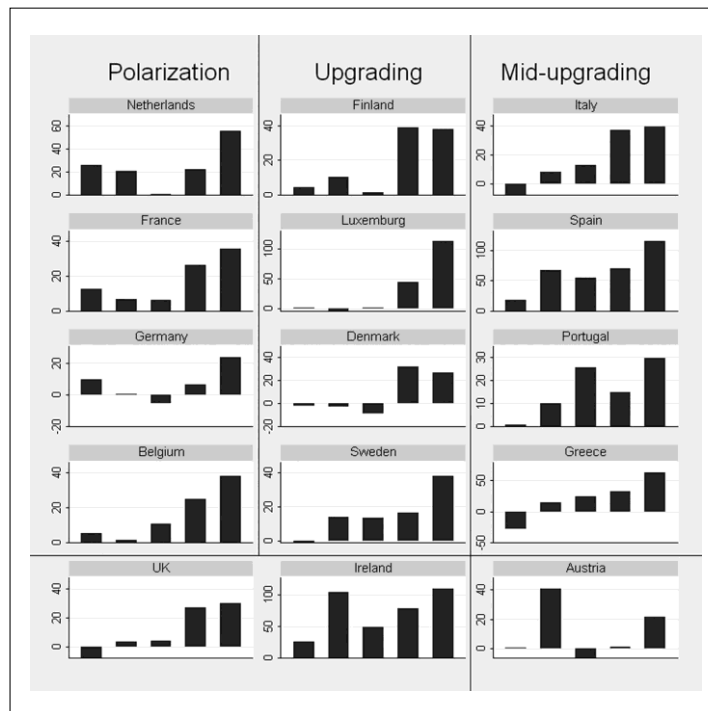
you can observe below, both figures were divided into three columns: Polarization, Upgrading and Mid-Upgrading.

Figure 4: Relative change in employment by wage quintiles, 1995-2007



Source: Fernández-Macias(2012).

Figure 5: Relative change in employment by education quintiles, 1995-2007.



Source: Fernández-Macias(2012).

The division appears slightly artificial for some countries but it definitely supports the claim of heterogeneity of patterns across Europe. The first column should exhibit a “near symmetric polarized pattern of job polarization” however the only clear example for this is the Netherlands. The second classification, upgrading, is mainly occupied by the Nordic countries and is characterized by a very high increase in the highest quintiles. Finally the last column has been termed mid-upgrading because the expansion of employment occurred also in the quintiles in the middle. Based on these findings, the author therefore claims that job polarization was only one of three phenomena that characterized the European labour markets. He stresses that these three main patterns match with the usual European institutional families: Continental Europe is usually associated with polarization, the Nordic countries have undergone an upgrading process and finally Southern Europe can be related with a pattern of expansion in both middle and high quintiles.

The author also provides an historical reconstruction of the possible institutional changes that could have affected the patterns across the European labour markets and that could explain their dissimilarities. Continental Europe experienced a process of labour market deregulation in the 1990s and early 2000s, which led to a “destandardization of their lowest paid jobs”. The three Nordic countries have very strong unions and very compressed wage structures, which has meant a shift in production to

“higher-value added activities”. Finally according to the author, for Southern Europe the creation of the European Monetary Union has resulted in a “very fast pace of employment expansion”.

II. *Job Polarization and Labour Market Institution* by Viki Nellas and Elisabetta Olivieri

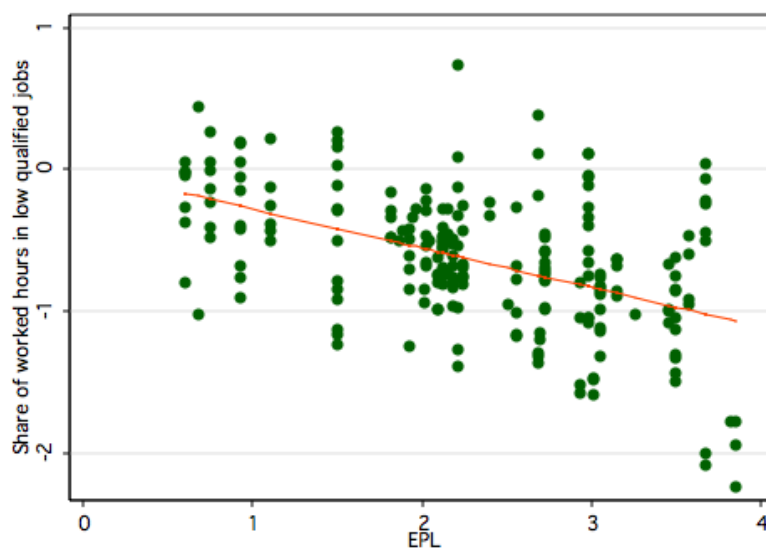
In this paper the authors propose a theoretical model to study the effects of a technological shock on a unionized economy, which tries therefore to test for the joint effect of technology and institutions on labour market changes. Their study focuses on six European countries: Italy, Spain, France, Greece, Belgium and the UK and accounts for the respective collective bargaining processes thus trying to explain the observed cross-country heterogeneity. Their claim is that in Continental Europe differently from the US, the shrinkage of the middling paid occupations has not been accompanied by an increase in the share of low-paid employment. Rather than job polarization the authors emphasize the emergence of low-skill unemployment.

The model can be understood as one in which an employment target is defined and the union can choose different policies depending on this. What emerges from this framework is therefore a clear trade-off between low skilled wage growth and low skilled employment growth. The main concern I believe is that the outcome of their theoretical model is not consistent with the empirical analysis they provide. Also, the results are not in line with

what obtained by Goos et al.(2009). They claim that in the last 15 years there has been an upgrading trend rather than a polarization one because of the clear bias towards high-paid jobs occupations and decrease in mid-range and lowest paid occupations.

However, I think that the added value of this paper rests with two the correlations that have been carried out and that are shown below. In the Figure 6, the authors use employment protection legislation(as elaborated by the OECD) and the difference of the employment shares of low-skilled and middling-skilled jobs: according to them the higher the difference, the more polarized is the employment structure. This correlation appears to be negative. Therefore more polarization is associated with less strict EPL. Once also my results are elaborated it will be useful to make a comparison.

Figure 6: EPL index and the share of low-quality jobs.



Source: Nellas, Olivieri (2013)

The second interesting graph is the one that looks at the pattern of the low-paid employment and the unemployment rate. The correlation also in this case is negative and the authors claim that “countries where job opportunities in low qualified tasks have increased the most have experienced less unemployment”, however we need to be careful here, since this remains a statistical correlation and I would not use it as a strong proof to state “the *wage effect* prevails on the *employment effect*”.

Figure 7: Unemployment rate and the share of low-quality jobs



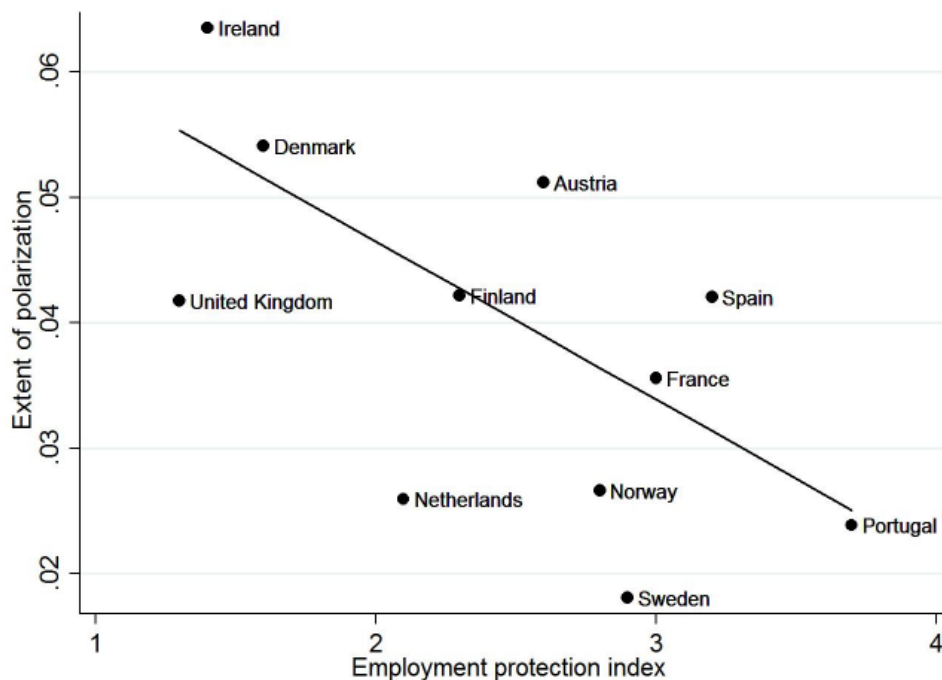
Source: Nellas, Olivieri (2013)

III. *Job Polarization and Employment Protection in Europe* by Barbara Pertold-Gebicka

In this paper the author constructs a measure of the skill requirements of occupations, which is supposedly independent of country-specific labour supply conditions. This is achieved by using an alternative measure, which corresponds to the relative productivity of more and less skilled workers employed in each occupation. According to the author "it measures how crucial workers' skills are for the tasks performed within a specific occupation" and skill requirements are measured on the US labour market for two reasons: first, being the USA leader in technological development, this should ensure that the estimated skill requirements capture recent technological changes; second, "the elasticity of substitution between more and less skilled workers, used to retrieve the skill-intensity measure, is based on US estimates". Despite the effort, I do not think this is an innovative measure, since the procedure followed by Goos et al.(2009) also exploited a dataset for occupations which was based on the US labour market. Again also for this paper the interesting part is represented by the section which looks at the relationship between the extent of job polarization (1993-2001) and the strength of employment protection. Differently from above, here the extent of polarization is measured as the difference between the lowest change in employment share and the highest change in employment share and the graph is constructed controlling for country-specific average

educational attainment and the industrial structure in 1993. Again, it is interesting to note that from Figure 8 it is suggested that the countries with the most strict employment protection legislation experience lower polarization than other countries.

Figure 8: Relationship between EPL and the Extent of polarization



Theoretical Framework and Hypotheses

The work by Esping-Andersen, *The Three Worlds of Welfare Capitalism*, provided a typology of welfare states and claimed the independence from the market that welfare states offer to citizens. As emphasised extensively by Oesch (2013 and 2015) the book's argument about the stratifying impact welfare states have on post-industrial societies was clearly forward looking.

Oesch highlights that Esping-Andersen predicted a variety of future employment scenarios for post-industrial societies:

Different welfare-state/labour market interactions produce different post-industrial trajectories. They influence not only the rate of growth of services, but also the relative emphasis on social-welfare activities as opposed to personal services; they influence the skill and occupational composition of the labour force (Esping-Andersen, 1990:192)

How wage-setting institutions affect occupational changes

In Oesch (2013) we have two main views as to what kind of impact institutions may have on the occupational structure:

- (i) Krugman (1994) argues that institutions lead among lowly educated workers to a trade-off between wages and employment. High wage floors and powerful trade unions lead to low growth in low-skilled services, high unemployment, low inequality. Whereas deregulation leads to job creation in low-end services but higher inequality.
 - Setting high wages floors favors the creation of decent jobs but leads to weak growth in low-skilled services and to high unemployment
 - Deregulation of wage-setting institutions promotes job creation in low-end services

(ii) The previous view was primarily concerned with the labour supply side, whereas for what regards demand, the second view is associated to Streeck(1997) and Acemoglu(2003) and asserts that employers opt for a "high road" vs "low road" job strategy depending on the institutional permissiveness: low-wage, low-skill, low training and low productivity jobs vs high-skill and high-productivity (upgrading).

The operationalization of the theoretical premises above can therefore be carried out by concentrating on the effect on employment changes of three main labour market institutions: employment protection legislation (EPL), trade union density and minimum wages.

The three main hypotheses I am putting forward are:

H1: EPL insulates insiders which dampens down the routinization effect

H2: Trade unions resist technology-induced occupational changes

H3: Minimum wages constrain the growth of low skilled jobs

3. Data

This paper employs seven sets of data: the European Union Labour Force Survey (EU LFS), the United Kingdom Labour Force Survey (UKLFS), the European Union Statistics on Income and Living Conditions (EU-SILC), the

Routing Task Intensity (RTI) index, the Princeton Data Improvement Initiative (PDII) dataset, and the CEP-OECD Institutions Data Set.

European Union Labour Force Survey (EU LFS)

The European Union Labour Force Survey (EU LFS) is conducted in the 28 Member States of the European Union, 2 candidate countries and 3 countries of the European Free Trade Association (EFTA). This dataset is collected from the national statistical offices and is currently the best attempt at having a comparable cross-country analysis of the European labour force, centrally assembled by Eurostat with common classifications and definitions. As explained by Eurostat¹, the EU LFS consists of a large household sample survey providing quarterly results on labour participation of people aged 15 and over and also those outside the labour force. For these reasons all definitions apply to persons aged 15 years and over living in private households. The target group of the survey does not include neither those carrying out obligatory military or community service, nor persons in institutions/collective households. The dataset covers the period from 1983 onwards and depending on the accession date of each country data is

¹ The European Union Labour Force Survey (EU LFS) data description can be found at the following link: <http://ec.europa.eu/eurostat/web/microdata/european-union-labour-force-survey>

available for them. Each national statistical institute is in charge of the selection of the sample, the preparation of the questionnaires, the conduct of the direct interviews among households and sending the results to Eurostat as required by the common regulation. The harmonisation of the available data at the European level is therefore carried out by:

- using the same concepts and definitions
- following International Labour Organisation guidelines
- using common classifications (NACE, ISCO, ISCED, NUTS)
- recording the same set of characteristics in each country

In the latest version available, 2015, the quarterly LFS sample size across the EU was about 1.6 millions of individuals.

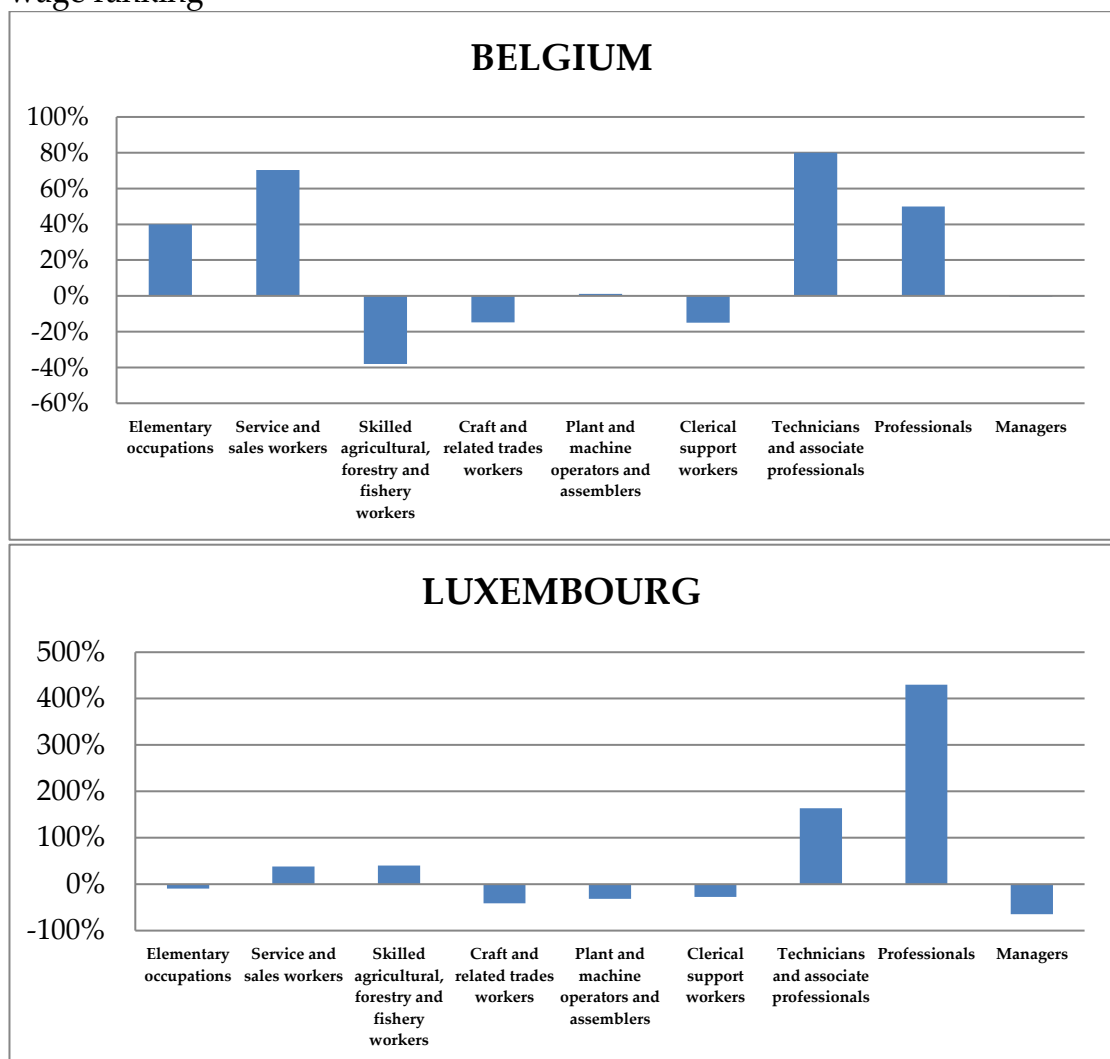
Following the methodology in Goos et al. (2014) I will restrict my analysis to 16 European countries and only to the period 1993-2011 (the data availability is shorter for some of the countries), since in the previous years there is no occupational and industrial information available. I will exploit this dataset also to retrieve the occupations' average education level. In order to make this dataset comparable I follow the instructions provided by Goos et al. 2009. Therefore the annual datasets for the 16 countries are pulled together and following the ILO categorization we keep only the employed, dropping the employed with no industry (proxied by the NACE major group) and no

occupation (2-digit ISCO) codes. All the employees reporting zero or no usual weekly hours worked will also be dropped. For two countries, Ireland and Italy, the panel is incomplete and therefore we drop some of the time periods. In order to obtain an hours-weighted measure of employment I aggregate the individual weighting factor to have a combination at the country-occupation-industry-year level and once this is obtained I multiply it by usual hours worked to obtain an hours-weighted measure of employment. This same dataset is also used to obtain the information necessary for the education variable which is used only as an alternative ranking of occupations. This variable is classified according to ISCED and it is broken down into three categories: lowest level of education corresponds to ISCED 0,1,2 which is pre-primary education, primary and secondary education; this is followed by ISCED 3 and 4 which is upper secondary and post-secondary non-tertiary education); finally the highest level is represented by ISCED 5 and 6 which is tertiary and postgraduate education.

The second and third set of data, the United Kingdom Labour Force Survey (UKLFS) and the European Union Statistics on Income and Living Conditions (EU-SILC) have been used only to retrieve the wage information to rank the occupations since the employment data is already contained in the EU LFS. Wages are collapsed to the occupation-country-year level using the provided sample weights that had been pre-multiplied by hours worked.

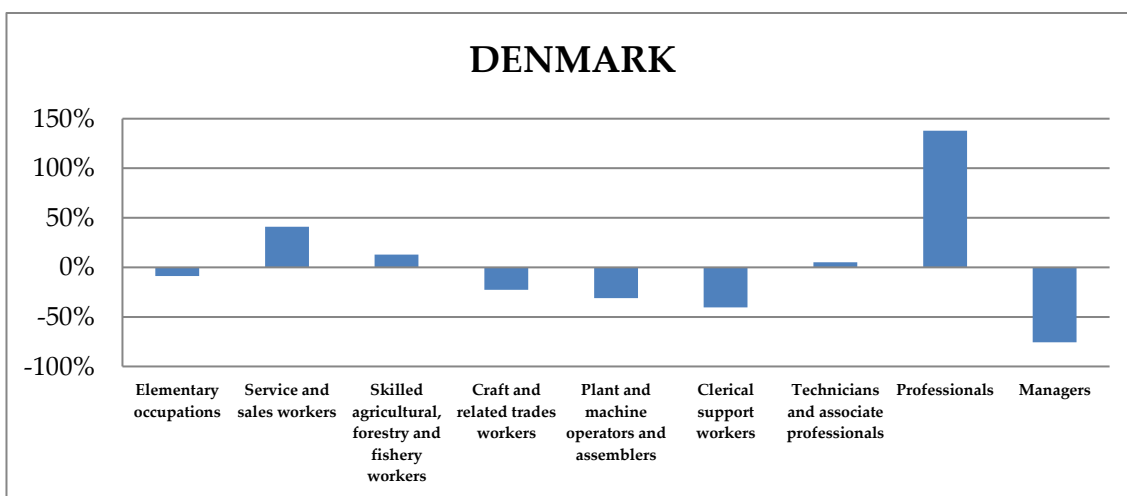
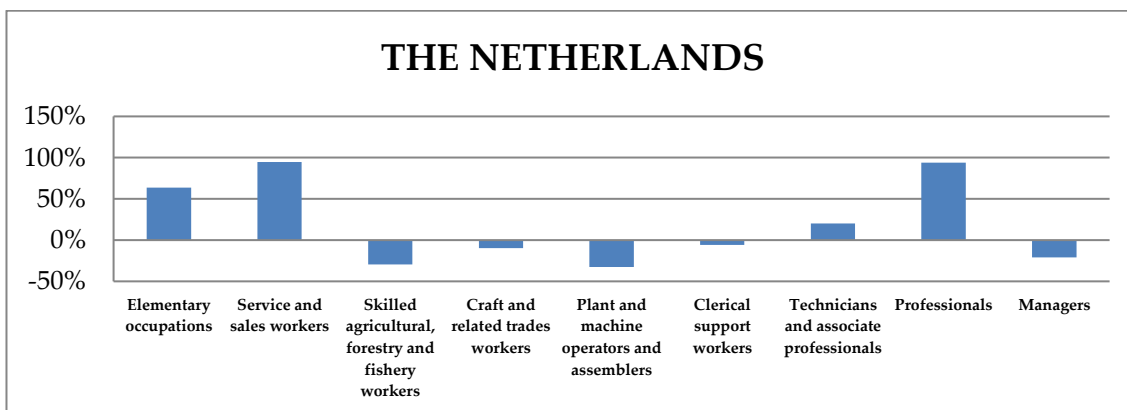
In order to have an aggregate visualization of these first two datasets by country I have plotted the evolution of employment by occupation measures over the period 1993-2013 using the EU-LFS and the EU SILC for the wage ranking:

Figure 9: Employment by occupation (1993-2013) – Order based on EU SILC wage ranking



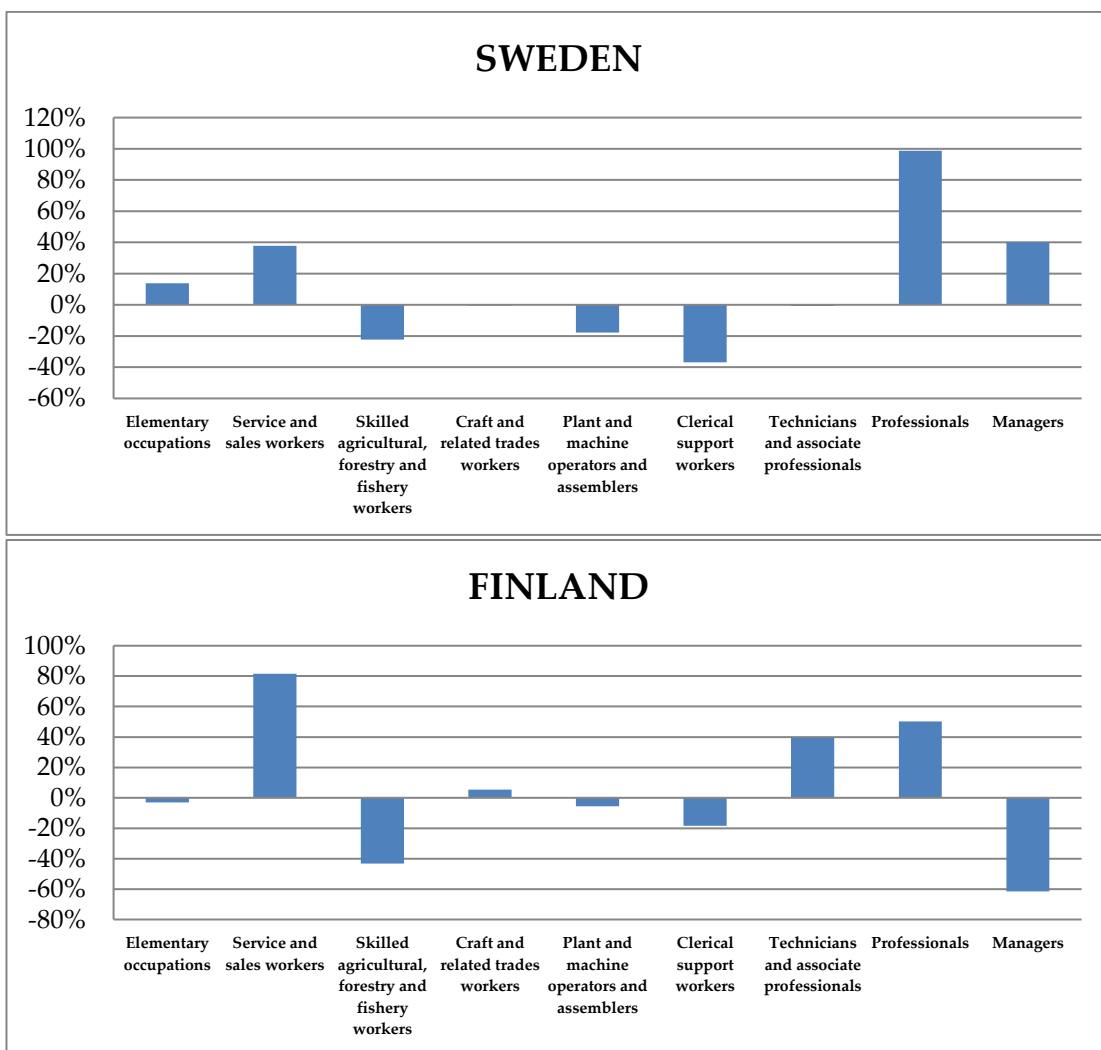
The charts in these section cover the period from 1993 to 2013. Occupations were ordered based on EU SILC on earnings in 1993 and divided into nine main categories, which resemble the classification in the first figure where we

had three main blocks: lowest income, middle and high income. The distribution ranges from elementary occupations and low-end service workers on the far left to professionals and managers at the high end on the right. Belgium seems to have experienced increases in employment especially at the two poles (except for stagnant employment for the category of managers) with a relative decrease of occupations in the middle. Luxembourg on the other hand has experienced a pattern closer to upgrading with the three high income occupations growing the most. The Netherlands seems to have experienced a pattern closer to the classic job polarization with a hollowing out of the middle.



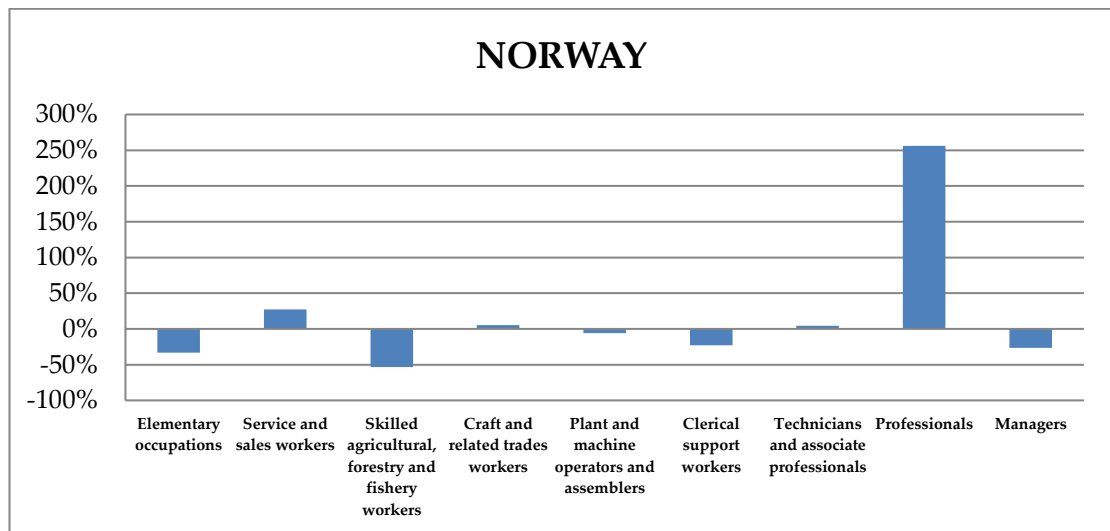
Whereas Denmark saw a very high increase in the occupational category of

professionals with slight decreases in the middle and an increase of service and sales workers at the low end of the distribution. Sweden seems also to have witnessed a pattern of upgrading with professionals and managers being the drivers of employment growth, but it also experienced decreases of clerical work occupations and increases in low-end services.

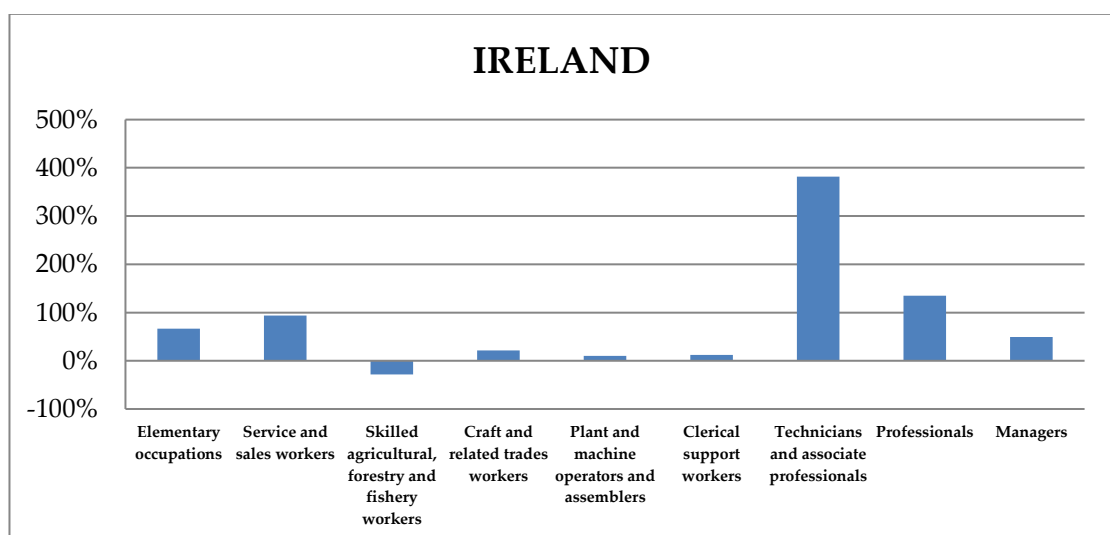


Finland saw a dramatic rise in service and sales workers at the low end of the distribution with slight decreases in the middle and increases at the high end except for the managers category. Norwegian occupational changes on the

other hand have moved towards a major upgrading of the labour force with a considerable increase in professionals.

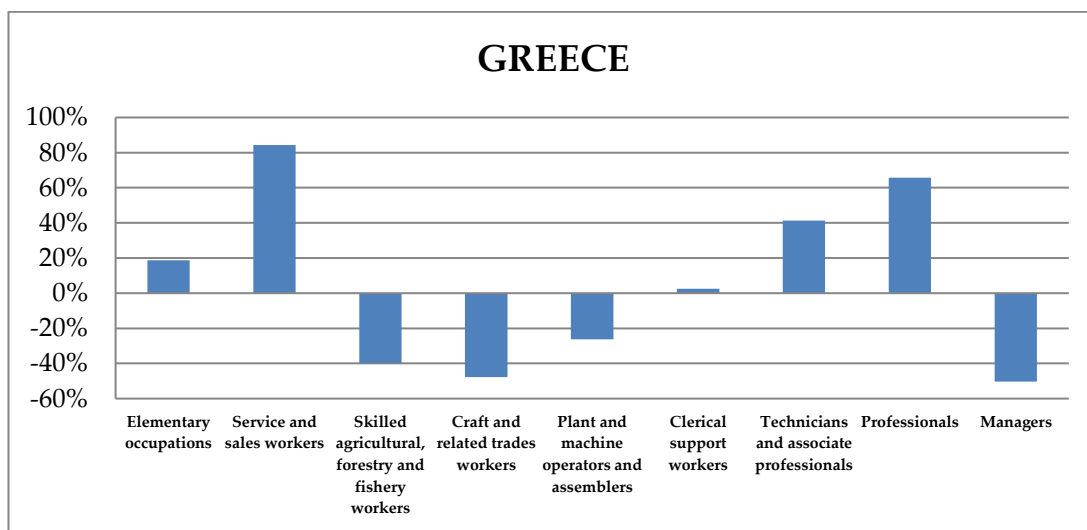


Ireland is another country which has experienced an increase especially at the high end of the distribution, with a particular rise in technicians and associates, probably due to the large presence of multinationals in the tech sector.

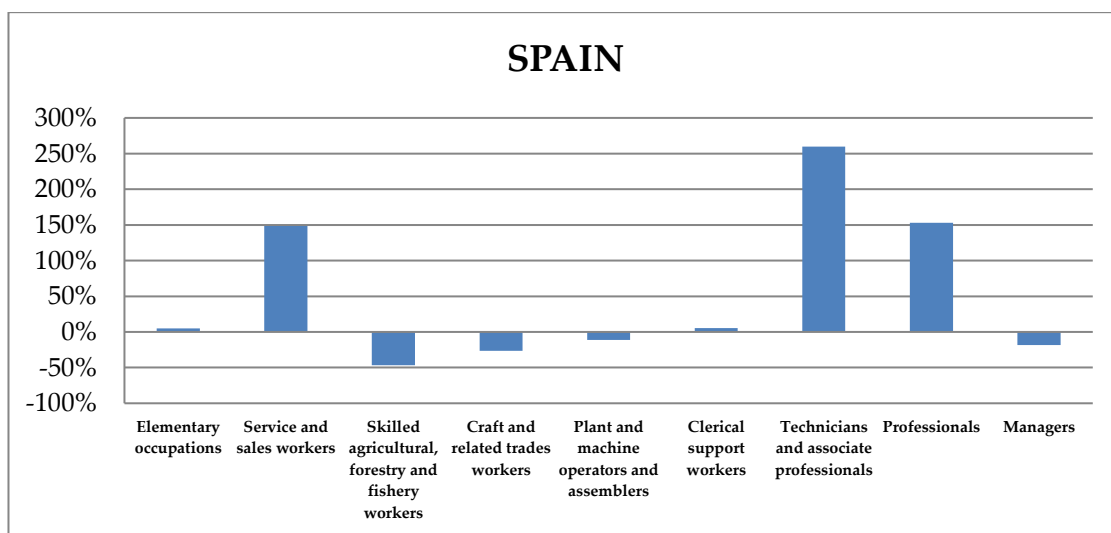


Greece in this period saw an increase increases in both service and sales workers in the low end of the distribution, with considerable decreases in the

middle and increases in the occupations of professionals, technicians and associate professionals.



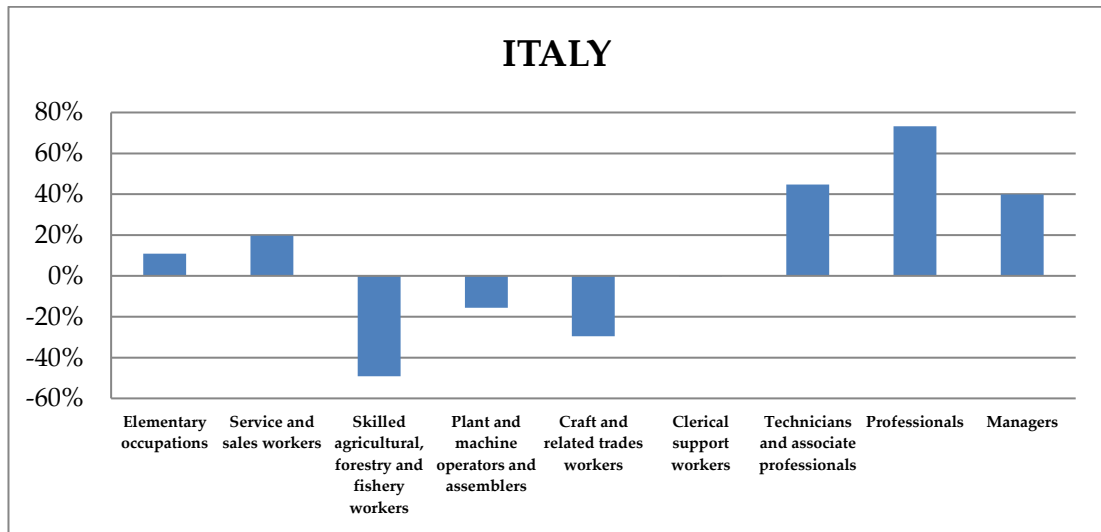
The middle of the distribution in Spain has not experienced significant changes throughout this period, with increases instead concentrated among two of the high income occupations and among service and sales workers.



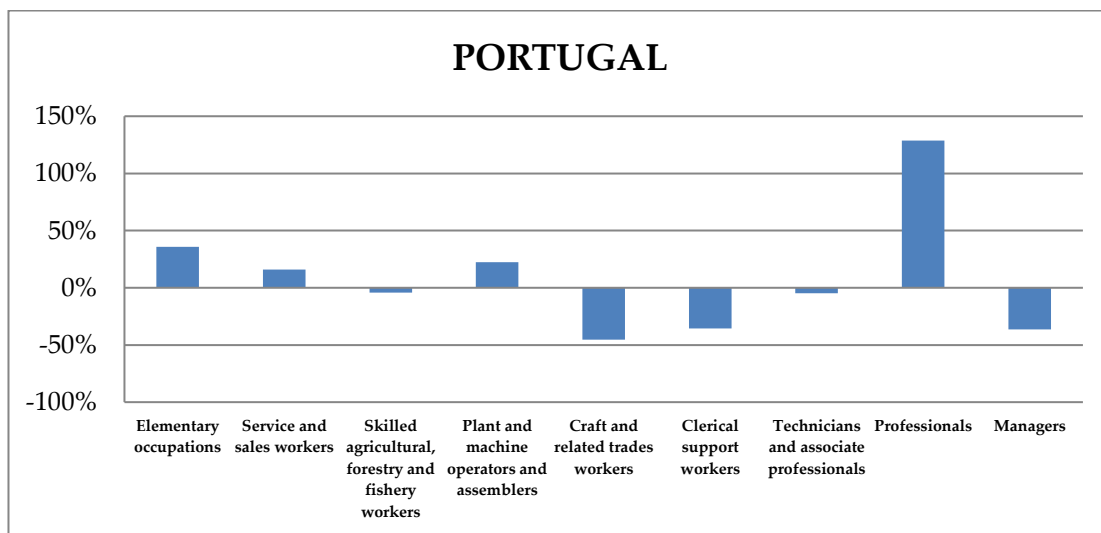
Italy experienced a dramatic decrease in skilled agricultural workers in the low end of the distribution with decreases also in middle income occupations. But the most important rises were concentrated at the top of the

occupational distribution, which confirms what we saw in the initial chart in

Figure 2.

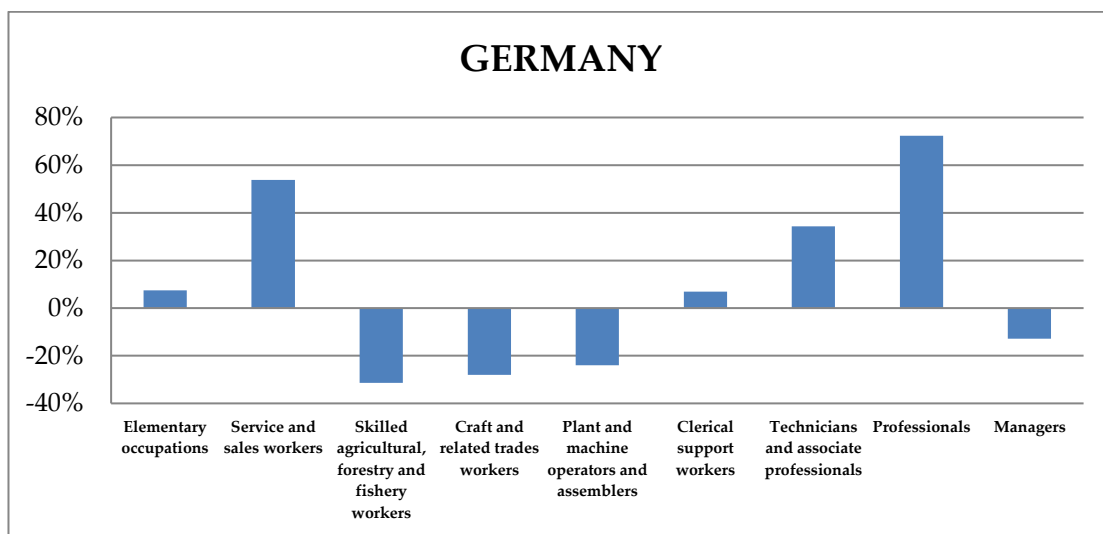


Portugal has seen a major increase in the occupational category of professionals, with considerable decreases in the middle of the distribution and a rise in elementary occupations.

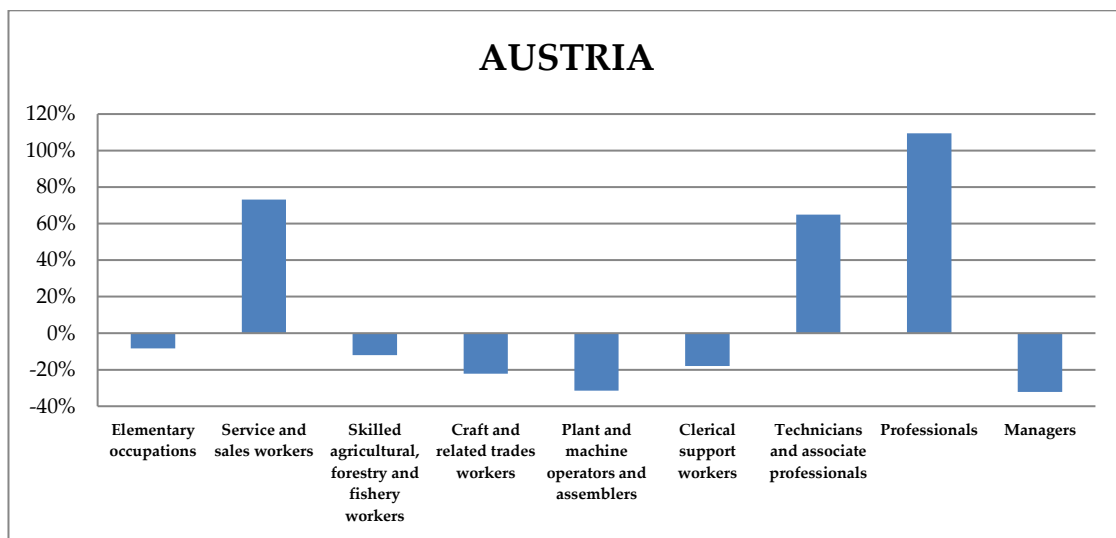


In the next chart instead we can see that the occupational changes in Germany saw increases in technicians, associate professionals and

professionals at the top of the distribution and in service and sales workers with declines of occupations in the middle.

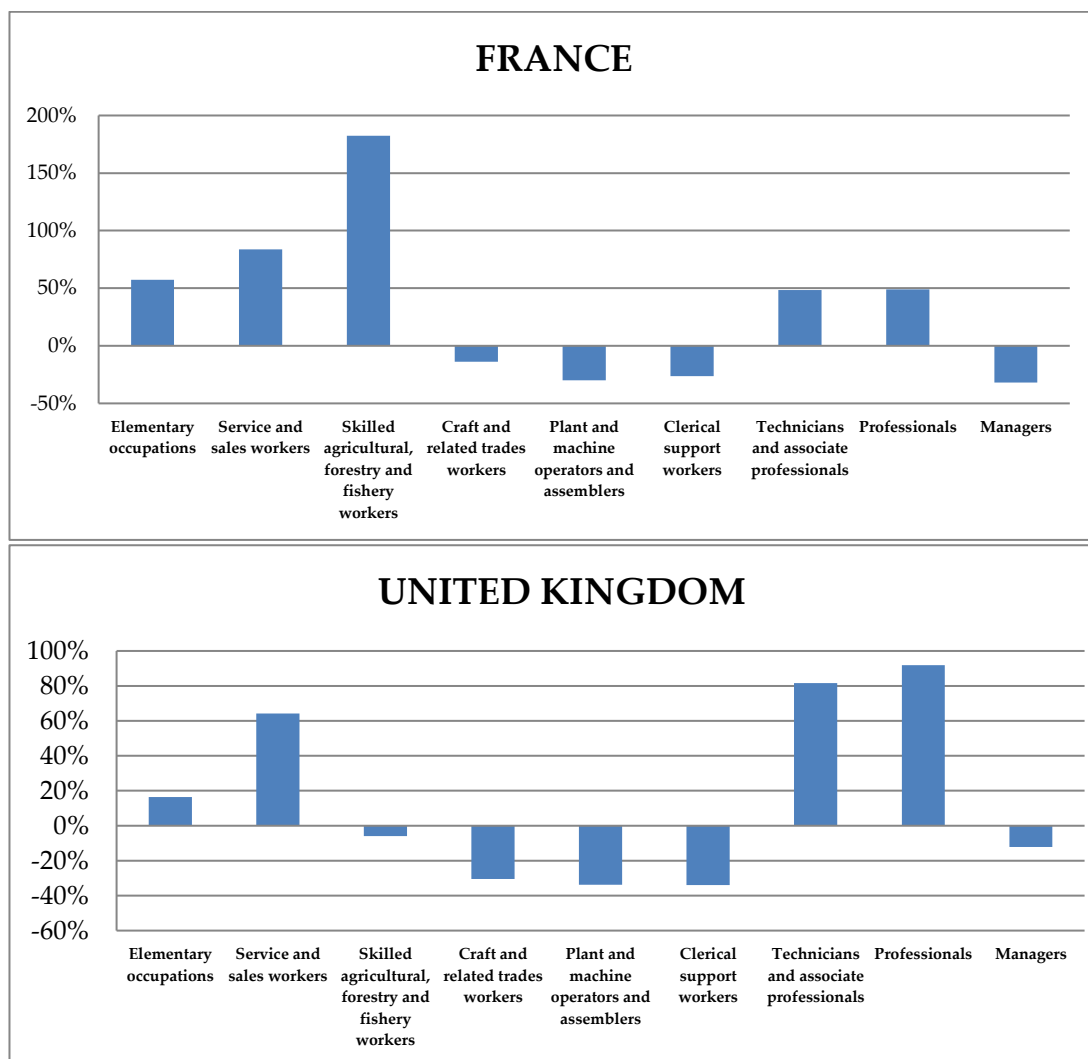


A similar pattern can be found in Austria, where professionals also saw the largest increase and there was a hollowing out in the middle of the occupational distribution.



The last two countries to be analysed are France and the United Kingdom. In the first we experience a notable increase in low-income occupations, with moderate decreases in the middle and slight increases in the high end of the distribution. Finally in the United Kingdom the patterns of the classic job

polarization are more recognisable with a hollowing out in the middle and growth in both the low and high end of the occupational distribution.



Overall, the service and salers workers category seems to witness consistent increases across almost all the countries. A number of explanations can be put forward. This can be due to the direct effect of hollowing out affecting the most proximate category (through downgrading) which should be accompanied also by an impact on wages. On the demand side, the retail and services sector may have expanded greatly. The student population and the increase in part-time work may have contributed to this increase. Finally,

some of the jobs in these category probably required a skill upgrading which led to a shift from the middle and also an effect on wages.

Routine Task intensity and Offshoring index

The fourth dataset, Routine Task Intensity (RTI) index, is based on Autor, Levy, and Murnane (2003) and Autor, Katz, and Kearney (2006, 2008) and reports the measure of routiness of an occupation. The index is mapped into the European occupational classification and normalized to have zero mean and unit standard deviation.

As explained in Goos et al (2014) the five original DOT task measures are combined to produce three task aggregates:

- Manual task measure corresponds to the DOT variable measuring an occupation's demand for "eye-hand-foot coordination"
- Routine task measure is a simple average of two DOT variables, "set limits, tolerances and standards" measuring an occupation's demand for routine cognitive tasks, and "finger dexterity," measuring an occupation's use of routine motor tasks;
- Abstract task measure is the average of two DOT variables: "direction control and planning," measuring managerial and

interactive tasks, and "GED Math," measuring mathematical and formal reasoning requirements.

Then from these three measures the Routine Task Intensity (RTI) index is then built as the difference between the log of Routine tasks and the sum of the log of Abstract and the log of Manual tasks

The fifth dataset that will be used is the Princeton Data Improvement Initiative (PDII) dataset, which will be exploited to provide the information for the offshoring variable. This dataset was created by Blinder and Krueger(2013) and reports several measures of offshorability, from the news reports to professional coders' assessments. Data from actual instances of offshoring of European companies as measured by the European Restructuring Monitor (ERM) are recorded. The fact sheets provided by the ERM measure a large set of key information on the offshoring events up to which occupations are being offshored. The processing of these fact sheets allows the construction of an index of actual offshoring by occupation. The robustness of this index is verified by regressing these measures of actual offshoring by occupation on Blinder and Krueger's (2013) preferred measure of an occupation's offshorability, which leads to a positive and strong correlation. Goos et al. (2014) actually show that there is great variation in the explanatory power of these competing indices of an occupation's offshorability used in the literature. With a crosswalk file I extract the

information concerning the occupations that were being offshored. The number of cases are counted and categorized by the ISCO occupations, which then gives the final offshorability rank.

CEP-OECD Institutions

The last dataset that I am going to employ is the CEP-OECD Institutions dataset, which was not used in Goos et al.(2014) since no role for institutions was included in their analysis. To understand how labour market institutions have evolved from 1993 to 2011 the Center for Economic Performance and the OECD have developed a common dataset for twenty OECD countries. However their data coverage differs depending on the variable and country chosen. Also, I have had to update all the measures of labour market institutions from 2006 onwards. From this dataset I am going to exploit the variables belonging to the following sections: Employment Protection, Union Density, Minimum wage (an additional institutional measure which was used is Bargaining Coordination and Centralization but was not included in the final specifications but details can be found in the Appendix). In particular I will be exploiting the following measures to be interacted with the index of routinization:

- *epl*: Employment protection legislation data from the OECD labour market statistics database using version 1 of the

indicator: the strictness of employment protection legislation. Scale from 0 (least stringent) to 2 (most restrictive). The indicators of employment protection are synthetic indicators of the strictness of regulation on dismissals and the use of temporary contracts. For each year, indicators refer to regulation in force on the 1st of January².

- ***udnet(%)***: Union density is Union membership/Employment and was calculated using administrative and survey data from the OECD labour market statistics database. This is the ratio of wage and salary earners that are trade union members, divided by the total number of wage and salary earners (as explained in the OECD *Labour Force Statistics*). Density is calculated using survey data, wherever possible, and administrative data adjusted for non-active and self-employed members otherwise³.

² For further details and full methodology:
<http://www.oecd.org/employment/emp/oecdindicatorsofemploymentprotection.htm>

³ For more information and full methodology:
http://www.oecd.org/employment/emp/UnionDensity_Sourcesandmethods.pdf

- *Real minimum wage, minw_med* and *minw_mean*: I adopt the three usual measures for the minimum wage. Firstly, real hourly and annual minimum wages are statutory minimum wages converted into a common hourly and annual pay period for the countries for which they are available. The resulting estimates are deflated by national Consumer Price Indices (CPI). The data are then converted into a common currency unit using US \$ Purchasing Power Parities (PPPs) for private consumption expenditures. In order to allow for cross-country comparisons, data on minimum wage levels are further supplemented with another measure of minimum wages relative to average wages, that is, the ratio of minimum wages to median earnings of full-time employees. Median rather than mean earnings provide a better basis for international comparisons as it accounts for differences in earnings dispersion across countries. However, while median of basic earnings of full-time workers - i.e. excluding overtime and bonus payments - are, ideally, the preferred measure of average wages for international comparisons of minimum-to-

median earnings, they are not available for a large number of countries. Minimum relative to mean earnings of full-time workers are also provided⁴.

Furthermore to make sure that other labour market developments are not driving my results I have decided to provide a diagrammatic visualization of some the crucial variables that influence the employment structure patterns in the period covered by my research work which you can find represented below, taking also into account the data assembled for the evolution in the employment rate: Unemployment rate by country, Labour force participation rate and Employment/Population Ratio.

Figure 10: Unemployment rate by country

⁴ Methodological specificities can be found at:
<http://www.oecd.org/employment/emp/Minimum-wages.pdf>

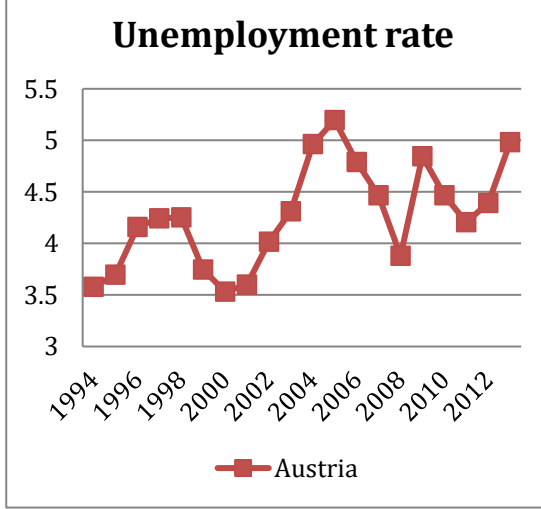
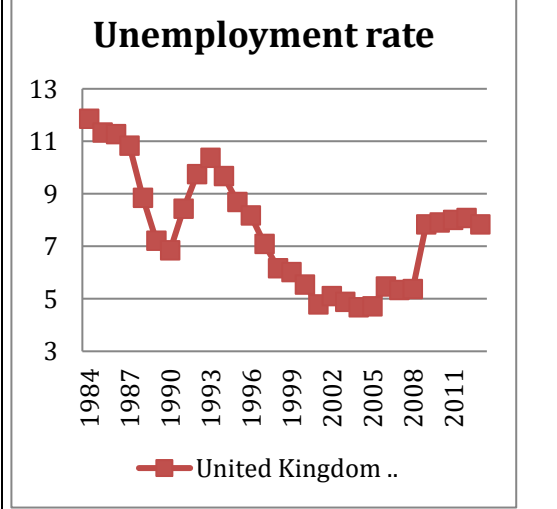
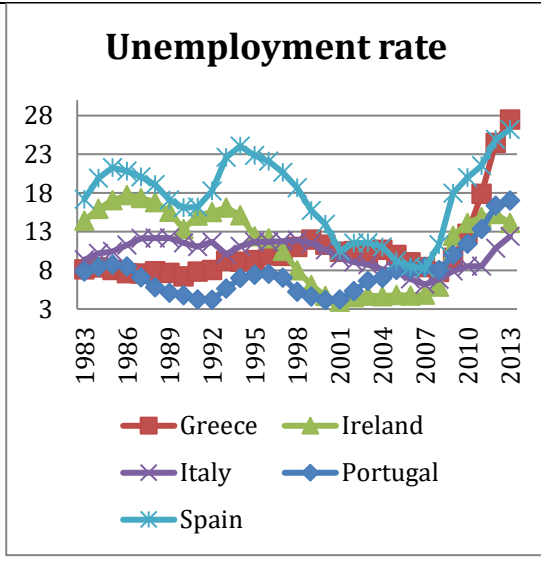
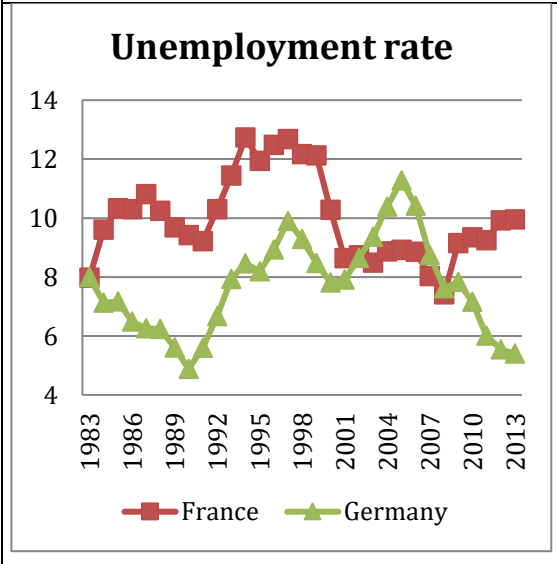
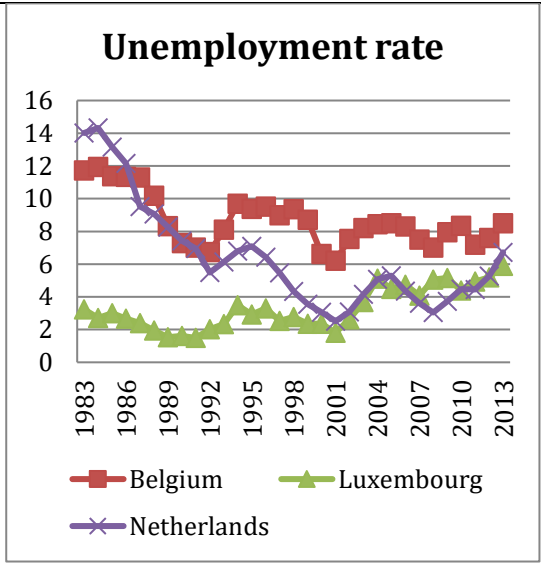
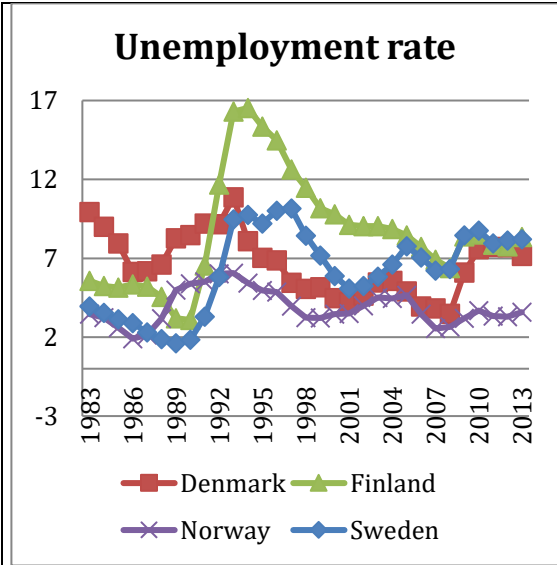
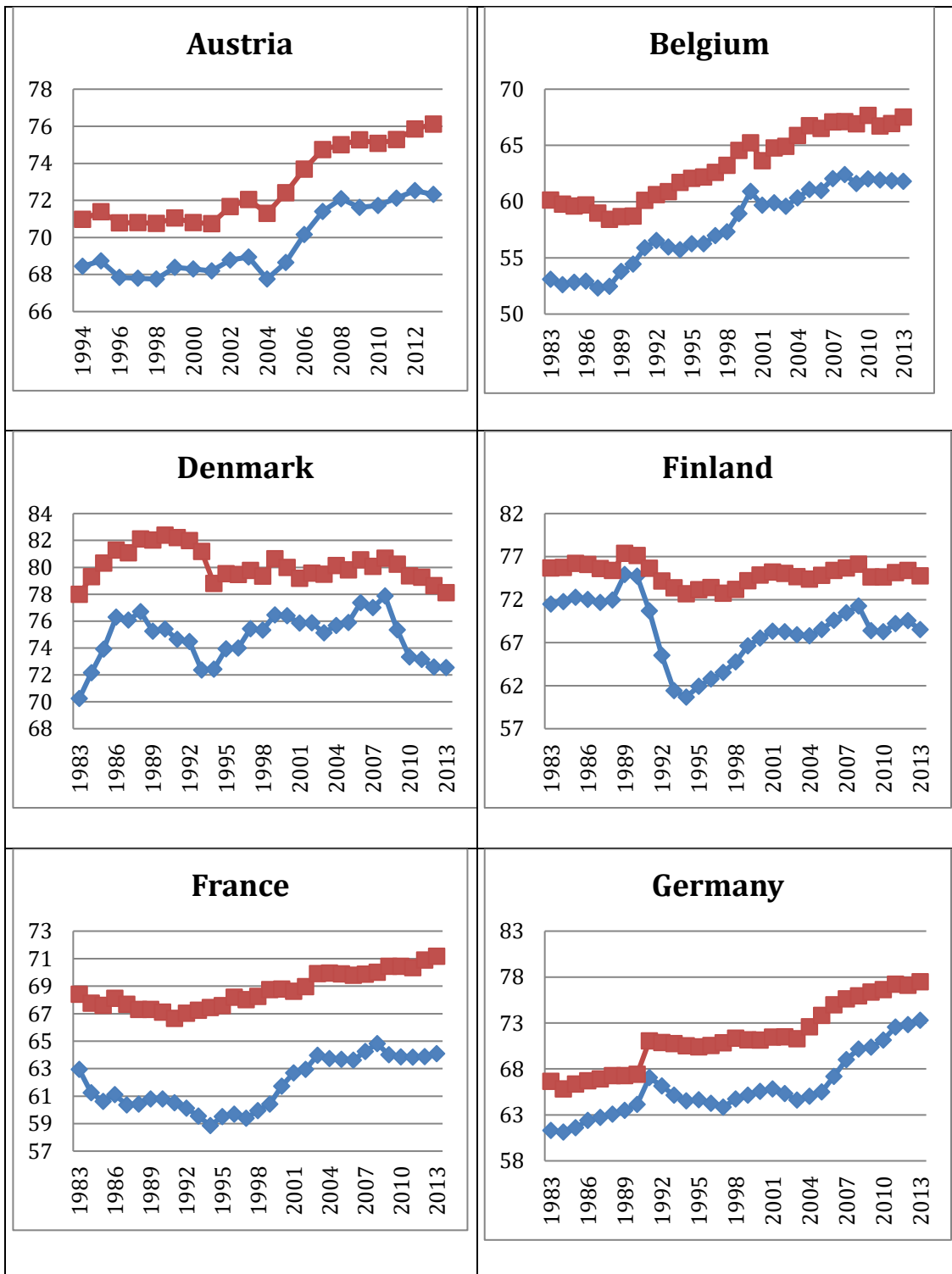
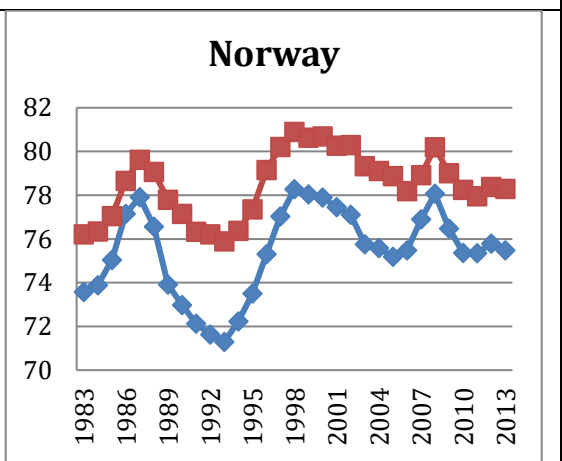
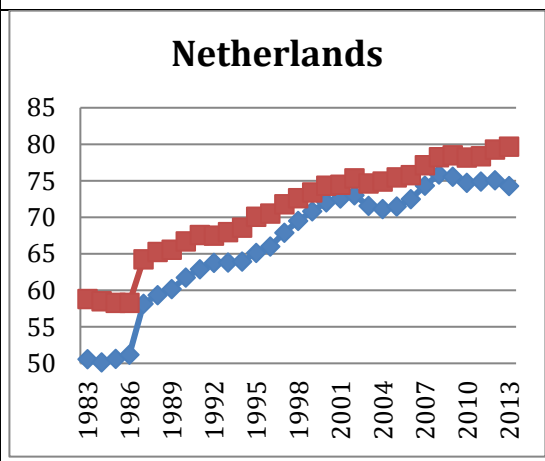
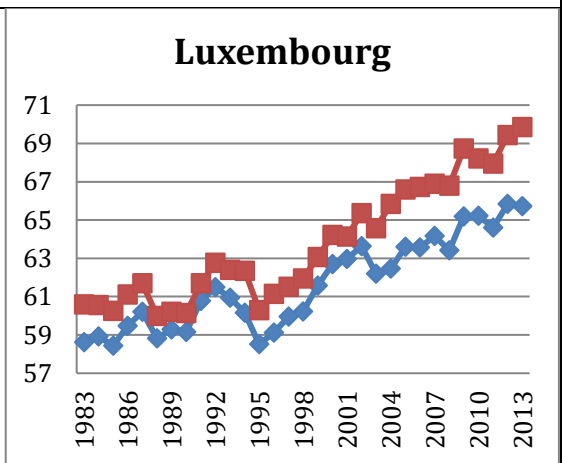
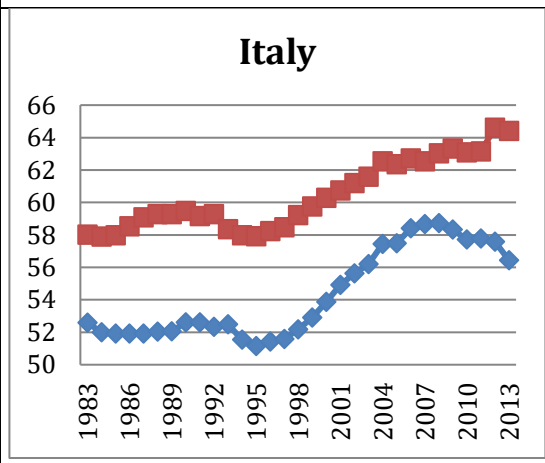
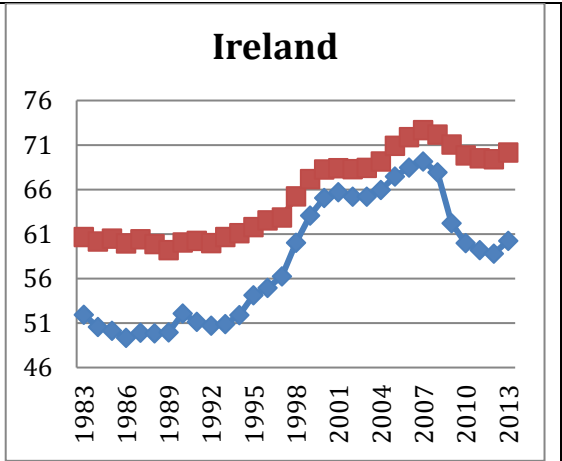
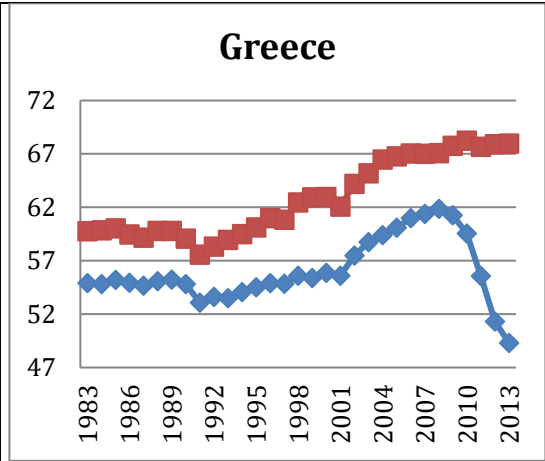
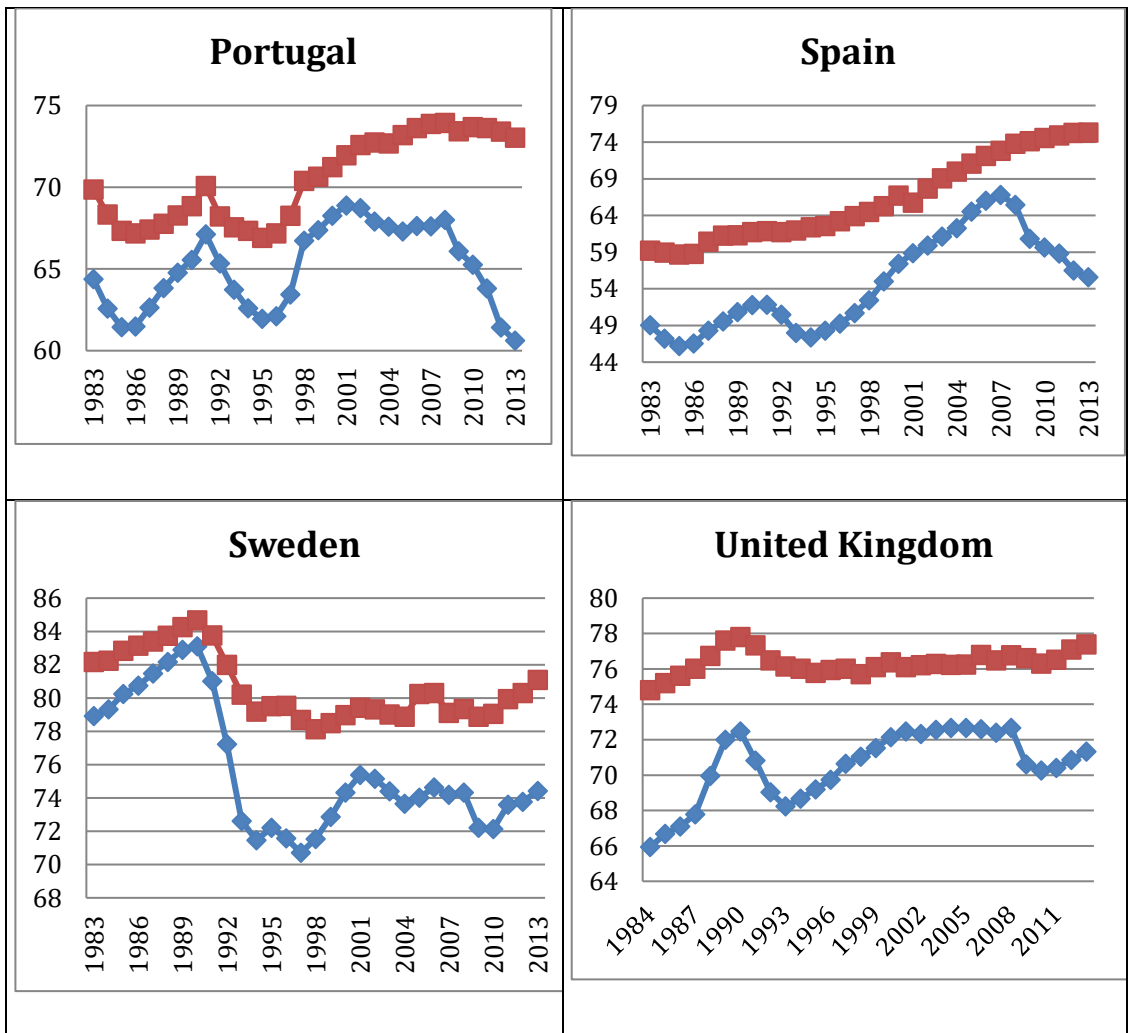


Figure 11: LFP rate and Employment/Population Ratio

RED: Labour Force Participation Rate **BLUE:** Employment/Population Ratio







4. Empirical Framework

The main specification used in Goos et al. (2014) assumes that the effects of technological change are the same for all countries. The authors regress the log of employment in occupation-country-year cells onto occupation-specific task measures and offshorability. Furthermore they control for the country-occupation-year specific log wage and country-occupation and country-year

dummies. All these measures are standardized in order to make their impacts comparable. The clustering of standard errors is done at the occupation-industry-country level.

The model being estimated is therefore the following:

$$\ln hwcoeff = \beta_0 + \beta_1 RTI + \beta_2 OFF + i.ict + i.ijc + \varepsilon$$

Where the dependant variable $\ln hwcoeff$ is the change in log employment regressed on RTI and OFF which stand respectively for routinization and offshorability. The regressions includes occupation-industry-country fixed effects and industry-country-year fixed effects. As written above, standard errors are clustered by occupation-industry-country.

What I intend to perform resembles the approach given above but includes an interaction role for three institutional variables: epl , $union\ density$ and $minimum\ wages$ (also these three measures are standardized in order to make their impacts comparable).

The model I am going to estimate changes into:

$$\ln hwcoeff = \beta_0 + \beta_1 RTI + \beta_2 OFF + \beta_3 EPL + \beta_4 UD + \beta_5 MW + \gamma_1 RTI_EPL + \gamma_2 RTI_UD + \gamma_3 RTI_MW + i.c + i.t + i.ijc + \varepsilon$$

Obviously this specification has required some further adjustments: I needed to introduce country and year fixed effects separately in order to obtain country-specific idiosyncratic variation at the year level. This allows me to include my institutional variables, which would have otherwise been absorbed by the country-year dummies.

5. Results and Discussion

The results reported in the Table 2 below therefore are based on the revised specification above estimating the drivers of our dependent variable, *lnhwcoeff*, change in log employment which accounts for employment growth on routinization and offshoring, columns (1) and (2), on our three labour market institutions, column (3), on the individual interactions of these institutions with the routinization variable, columns (4)-(6) and on a full interactions model in column (7).

Dependent variable (lnhwcoeff)	(1) Baseline	(2) Baseline	(3) Institutions	(4) Routinization* EPL	(5) Routinization* Union Density	(6) Routinization* MinWage	(7) All interactions
Routinization (rti)	-0.176*** (0.0201)	-0.160*** (0.0200)	-0.113*** (0.0270)				
Offshoring (off)	0.645*** (0.0250)	0.533*** (0.0278)	0.557*** (0.0338)				
Employment protection legislation (epl)			-0.0468 (0.0849)				
Union density (ud)			-0.00566 (0.00944)				
Minimum wage (mw)			4.33e-05 (4.29e-05)				
rti_epl				0.181*** (0.0601)			0.176*** (0.0418)
rti_ud					0.00330 (0.00397)		-0.00726 (0.00722)
rti_mw						-1.35e-05 (1.61e-05)	-1.03e-05 (1.97e-05)
Constant	5.718*** (0.0955)	3.771*** (0.105)	3.898*** (0.648)	5.209*** (0.220)	4.956*** (0.192)	2.137*** (0.140)	2.189*** (0.421)
Observations	17,041	17,041	8,371	16,113	17,041	9,299	8,371
Country-Year FE	Yes	Yes	Yes	No	No	No	No
Industry-Country-Year FE	No	Yes	Yes	No	No	No	No
Ind-Occ-Country & Ind- Country-Year FE	No	No	No	Yes	Yes	Yes	Yes
<i>R-squared</i>	0.219	0.471	0.465	0.685	0.700	0.746	0.727
<i>R2_adj</i>	0.218	0.469	0.463	0.663	0.679	0.728	0.707

Robust standard errors in
parentheses
*** p<0.01, ** p<0.05, * p<0.1
Clustered at Country-Year
level

Table 2:
Explaining
employment
polarization with a
revised model to
account for labour
market institutions
and their
interaction with
routinization.

The results in Table 1 reveal some very interesting patterns. It is important to bear in mind that for all columns standard errors have been clustered at the country-year level. Clustering at this level allows the residuals of the observations from the same country-year to be correlated.

Let's start from column (1) which is our baseline scenario with only routinization and offshoring operating in which I run a specification with country and year fixed effects. Routinization as in Goos et al(2014) is confirmed to have a significant negative effective on the change in employment growth, whereas offshoring which was not significant in the specification is here positive and significant. In column (2) I run the same specification but here I apply a finer degree of fixed effects, introducing industry-country-year fixed effects. The magnitudes are reduced but the direction and significance of the effect is maintained. The offshorability variable shows a positive coefficient which is counterintuitive but it may signal some kind of race between routinization and offshorability. Column (3) was introduced for completeness, but we are interested in the interaction effect rather than these institutional variables in isolation, therefore we move to the analysis of the results in columns (4) to (6) where the interactions have been analysed separately and finally in column (7) where all of the interactions have been performed. These specifications have been run with industry-occupation-country and industry-occupation-country fixed effects, therefore both routinization and offshoring and our institutional variables in isolation are dropped. Looking at the

interactions we have a series of interesting results. Firstly and most importantly, when routinization, which had a significant negative effect on employment growth, interacts with employment protection legislation the coefficient is not only significant but the sign of the interaction becomes positive which suggests that EPL effectively mitigates the impact of routinization on the employment structures. Column (5) instead proceeds to run a specification in which another institution, trade union density, is interacted with routinization. The coefficient of this interaction effect has a much smaller magnitude, but most importantly the interaction between routinization and trade union density results not to be significant. An additional test was run using the `co_oecd`, a measure of coordination in the bargaining framework and this also leads to similar results. Column (6) instead performs the interaction between the routinization factor and the minimum wage. The magnitude of this interaction effect is extremely small and the coefficient is also not significant. The results are unvaried when I use any of the three measures of minimum wage mentioned above. Also another important thing to highlight is that when the interaction with the minimum wage is added the number of observations drops, due to the fact that this labour market institution is in place only in certain countries in my sample. This is another reason why we want to look at the three interactions together, to see whether the interaction coefficient of routinization and EPL remains significant in the restricted sample for this information on the minimum wage is available. If we look at the last column,

column (7), where all the interactions have been performed we notice that the coefficient for the interaction between routinization and employment protection legislation is still significant and positive, confirming that the routinization effect is damped down when interacted with employment protection legislation. Also in this case the interaction with union density is not significant, the same for the minimum wage which delivers a non-significant coefficient. A further note concerns the explanatory power R^2 of the different specifications I have run which increases significantly as we move to the right of the table. It definitely increases because of the many fixed effects which have been added, but notice that also the adjusted measure increases, so that it is not the whole story and the interaction with the institutional variables does carry explanatory power.

I carry out a number of robustness checks to show that my results are not driven by a particular industry, a single country or a particular year, they all confirm the results from the specifications above. Also when I apply linear or quadratic time trends to my specifications the results held.

Let's now move to the discussion of the results against the hypotheses we put forward in the operationalisation carried out above:

- Hypothesis *H1* stated that *EPL insulates insiders which dampens down the routinization effect*. This seems to be confirmed by my results. Job polarization operates through routinization, but this

effect is mitigated by employment protection legislation. A higher strictness of regulation on dismissals and on the use of temporary contracts thus constrains the job polarization patterns, and making the hollowing out of the labour market more subdued.

- Hypothesis *H2* stated that *Trade unions resist technology-induced occupational changes*. From my results I don't find evidence for trade unions resisting the routinization effect. It may be that trade unions dampen the effect of firing within a firm, thus the slightly positive coefficient, however we could have entire firms going bankrupt because of automation therefore the interaction effect between routinization and trade unions becomes not significant.
- The last hypothesis *H3* affirmed that *Minimum wages constrain the growth of low skilled jobs*. From the evidence provided minimum wages do not seem to exert a significant effect on job polarization patterns when interacted with routinization. This may be because minimum wages affect in particular low-skilled interpersonal service jobs which are usually difficult to automate and outsource.

When adding the three interactions together, the only significant interaction keeps being the one of employment protection legislation with routinization.

This suggests that employment protection legislation, minimum wages and

unionization are capturing different features of labour market institutions that do not overlap with each other.

The results in the table thus seem to go in the direction of labour market institutions, in particular employment protection legislation, constraining the effect of routinization and therefore delivering job polarization patterns which are heterogenous across countries, rather than a uniform phenomenon as evidenced by Goos et al. (2009, 2014).

6. Conclusions

For Manning (2004) when looking at the evolution of the labour market over the course of time, it is clear that the creation and advancement of new technologies has had a multi-dimensional impact on said market. In particular, technological innovation has altered both the general demand for work and the types of tasks carried out by humans, thus affecting also the specific demand for certain types of labour. The view that the development of new technologies will in turn lead to an increase in the demand of skilled labour is widely accepted. Nonetheless, the demand for less skilled labour may arguably grow as a consequence of technological transformation. However, one must note, that the employment of the less-skilled workers may significantly depend upon their proximity to the highly qualified labour force.

The so-called “routinization” hypothesis proffered by Autor, Levy, and

Murnane was endorsed by Goos, Maarten, and Manning (2007) as a more plausible explanation for the increase in job polarization in the United Kingdom between 1975 and 2007. In fact, the authors refute the idea that a skill-biased technical change may account for the increase in labour-market shares of the highest and lowest paying professions.

This paper has argued that routinization remains the most plausible determinant of occupational changes over the last three decades, but that a role for labour market institutions needs to be accounted for. In a similar fashion to Oesch (2015) (see the Appendix for further evidence of his work) despite it is still difficult to assert whether technological change leads to upgrading or polarization, as long as the extent to which companies have access to similar types of technology, European countries should be affected in a similar way, however even if we consider routinization as the main driver for common trends in occupational change across countries, this leads only to a partial explanation of the causes of cross-country variation. A broader focus on institutions and a comparative research design approach which looks at how welfare regimes affect employment structures is needed and this is the gap this paper has tried to address by focusing on the contribution of three main labour market institutions - employment protection legislation, union density and minimum wages – in their interaction with routinization.

The main specifications contained in the empirical section reveal how the coefficient for our measure of routinization has the expected negative sign,

however when we interact it with the employment protection legislation variable we can see that its coefficient turns positive which seems to suggest that EPL does reduce the extent of routinization in a particular country, thus mitigating the hollowing out in the middle of the employment structure. This may be due to the fact that when we are in a regime with a high strictness of employment protection, the regulation on jobs which are affected by automation prevents an easy dismissal. Moreover, the constraints on the use of temporary contracts limit the potential of job polarization to occur by constraining job growth at the low end of the distribution where the use of more flexible forms of work, such as zero-hours contract or similar, is more frequent. With employers more unable to resort to such types of contracts, we may see a subdued hollowing out behaviour in the middle of the employment structure.

The paper has also analysed the interaction of routinization with union density testing the hypothesis that trade unions would resist technology-induced occupational changes, but this has not revealed a significant pattern. It may be that trade unions resist change at the level of the individual companies by dampening the effect of firing and maintaining employment levels, however we cannot exclude that entire firms are made redundant because of the introduction of a new technology which makes the operations of a particular firm redundant. Therefore when if we have entire firms going bankrupt

because of automation the interaction effect between routinization and trade unions becomes not significant.

In my last hypothesis I conjecture that minimum wages constrain the growth of low skilled jobs. The evidence I provide uses three different measures of minimum wages and they all show that no significant effect is exerted on job polarization patterns when minimum wages are interacted with routinization.

My results therefore show that both the labour market institution of trade unions and minimum wages have only a limited capacity to influence job polarization patterns, whereas employment protection legislation could effectively mitigate the effects of routinization.

PAPER II

The Routinization of Labour Market Reforms

Abstract

Does job polarization have a feedback effect on labour market institutions and policies, so that different degrees of polarization lead to different articulations of institutions at the domestic level, thus reinforcing or altering differences in national models across the European space? This paper is aimed at establishing whether there is a relationship between the extent of polarization exhibited by each European country and their specific labour market reform processes. The analysis finds that the job polarization experienced by a particular country in the 5 years before the reform instance is consistently among the strongest predictors of reform activity, as significant as other drivers such as GDP growth and government net debt. Moreover a higher degree of polarization tends to be associated with more deregulation and a decrease in the generosity of the policy measure. Finally, the empirical framework is tested against more conventional taxonomies of welfare capitalism (Esping-Andersen and VoC) revealing how both the continental and liberal regimes have been profoundly affected by job polarization.

1. Introduction

The main aim of my previous paper was to investigate the evolution of employment patterns in the European labour markets over the period 1993-2011 and attempt to show that, although the routinization hypothesis remains the most plausible cause of job polarization, it is the peculiar type of institutional framework that ultimately shapes the distinctive patterns that can be observed. Based on the analysis of the European Labour Force Survey(EULFS) data, it extended the empirical framework in Goos, Manning and Salomons(2014) by testing the joint effect of technology and labour market institutions on occupational structures. The evidence provided suggests that the claim of a pervasive technology-induced polarization must be revised in order to comprise a role for the institutional component.

However, technological, social and labour market change are often viewed as interdependent: labour market institutions affect occupational structures, but at the same time the push from technical change is seen as outpacing the capability of labour market institutions to respond. This paper therefore sets to explore the other direction of causality with the aim to establish whether there is a relationship between the extent of polarization exhibited by each European country and their specific labour market reform process and choice of labour market institutions. In particular, this paper will try to provide an answer to the following questions: Does job polarization have a feedback effect on labour market institutions and policies, so that different degrees of polarization lead to

different articulations of institutions at the domestic level, thus reinforcing or altering differences in national models across the European space? The paper introduces a fairly innovative empirical approach which consists in mapping the lagged indices of polarization calculated on an annual basis from the EU-LFS dataset with the institutional component provided by LABREF, the database of EU labour market reforms over the period 2000-2013 managed by the EU Commission in cooperation with the Employment Committee(EMCO) and the Social Reforms database created by the FRDB and IZA, which collects information about social reforms in the EU15 countries over the period 1980-2007.

The main hypothesis is that many European countries faced with the risk of losing their competitive edge economically became more prone to reform their labour markets and put in place a set of institutions that would more flexibly accommodate the changes brought by technology in the occupational and social structures. Therefore the test that will be performed is whether those countries exhibiting higher indices of polarization and that saw the highest drop in manufacturing as employment share in the total economy were also marked, although with a lag, by significant changes in the path of labour market reforms.

Evidence suggests that European governments have in several instances participated effectively in addressing the changes emerging as society moves from being a production-and-material based to an information-services based

system and that technological change has played an important role in shaping the path of social and labour market reforms, although a uniform picture cannot be drawn. The political economy channel at the core of the analysis sees a decreased bargaining power of trade unions due to the hollowing out of their power base (particularly relevant for manufacturing) translated into a weakened intermediating effect in the labour market reform process. The decrease in concerted power thus reflects into an increased reform activity, a move towards deregulation and a decrease in the generosity of the policy measures.

2. Literature Review on the Determinants of Labour Market Reforms

Having established that the structure of the labour market institutions must evolve alongside technological progress and the ever changing structure of markets, the elevated complexity of the subject renders a single universal solution ineffective. Nonetheless, in their work, Nickell and Layard (1999) focus on outlining the factors which are shared by most successful reforms. In particular, the authors argue that successful reform of labour market institutions must address both the macro and the micro issues. As noted by Adascalitei and Morano (2015), although the literature on the macroeconomic factors affecting labour market reforms is quite recent and generally focused on

developed economies, there is some consensus around such determinants. As noted by Bernal-Verdugo et al. (2012), these comprise a range of macroeconomic (initial labour market and output growth conditions, size of the economy in question, degree of trade openness, exchange rate regime, fiscal conditions) and political variables (ideology of the executive, extent to which the political power is more or less decentralised, political stability, and election cycles). The literature discussed below uses, by and large, a combination of these explanatory variables.

A number of studies, including Turrini et al. (2015), Duval and Elmeskov (2006), and Bernal-Verdugo et al. (2012) looked at the extent to which governments were more likely to implement labour market reforms during economic crises.

Using the same data source that this paper relies upon, Turrini et al. (2015) assessed the determinants of labour market reforms in the European Union over the period 2000-2011. An exploratory analysis conducted by the authors using unemployment rate in conjunction with the number of labour market reforms revealed that: i) there was some positive correlation between unemployment and the number of reforms implemented; and ii) the timing of the policy response differed across countries, whereby in some cases an increase in reform action occurred after the increase in unemployment, compared to instances where reforms anticipated periods of unemployment. In addition to unemployment rate, the authors also found a number of additional

correlations using measures such as income per capita, GDP growth, debt and fiscal stance; in particular, the authors found that: i) “unsatisfactory” labour market outcomes were correlated with more intense reform activity; ii) reforms were more frequent in countries with segmented labour markets; iii) reforms appeared to be less frequent where there was a higher growth rate; and iv) countries with both a high government debt and deficit seemed, on average, more prone to implement reforms. Finally – and most importantly from an empirical perspective – the authors focused on three specific policy domains (i.e., labour taxation, unemployment benefits, and employment protection legislation) to account for the heterogeneity of reforms, and performed a regression analysis to measure the effect of selected labour market outcomes, macroeconomic conditions, and existing policy settings on both total reforms across all the domains, and separately on a measure of reforms specific to each policy stance. The authors found that reform activism was stronger in countries with lower GDP per capita and long-standing EU membership, under critical economic and labour market conditions, and where political costs were low. The direction of reforms was affected by economic and labour market conditions, available fiscal space, and by initial policy settings.

Looking at 21 countries over the period 1985-2003, Duval and Elmeskov (2006) found similar results to Turrini et al. (2015). In particular, their analysis shows that structural reforms were strengthened by a number of factors, such as high levels of unemployment, periods of crisis, healthy public finances, reforms in

other policy fields, and small country size. Furthermore, the authors found that countries pursuing fixed exchange-rate regimes or participating in monetary unions – which, by definition, had little or no monetary autonomy – appeared to undertake less reforms. Such findings appear to go in the same direction as those presented by Duval (2008), who found that sound public finances and fiscal expansion stimulated reforms.

Using a sample of 97 countries over the period 1980–2008, Bernal-Verdugo et al. (2012) found that: i) pre-existing level of the labour market institutions played a key role in determining whether or not there was a change in labour market institutions. In particular, the authors found that the higher the quality of the existing labour market institutions, the less likely a country is to implement a reform; and ii) as one would expect, a favourable economic situation lowers the probability of a change in policy. Conversely, the authors found that the effect of other macroeconomic and demographic factors, including delayed unemployment rates, was not statistically significant. In terms of political variables, the authors found that an increase in the degree of decentralization (i.e., presidential system vs. one where the president is elected by the assembly) played the most important role in increasing the probability of changes in labour market institutions. As the authors themselves pointed out, although this finding is consistent with Dabrowski and Gortat (2002), it contrasts with Alesina et al., (2006), who concluded that strong governments (i.e., presidential systems and unified governments with a large majority of the party in office),

alongside the beginning of term of office of a new government, periods of crisis, and instances when the executive faced less constraints, were more likely to impact on the implementation of fiscal and inflation stabilization programs. Finally, the authors found that the length of time during which the chief executive's party had been in power had a negative effect on changes in labour market institutions.

When looking at the labour and product markets of OECD countries, the question of what factors may influence and bring about institutional and policy reform arises. Høj J. et al. (2006) considered the main political economy drivers of structural policy changes in OECD countries' labour and product markets over the periods 1985-2003 and 1973-2003. First, the authors distinguish between two macro categories of political economy drivers: those which are extraneous to the political process and thus are not controlled by governments, and those on which governments may exercise some influence. The study highlights how those factors which are exogenous to the political realm, such as foreign competition, duration in office of governments, and cycles of economic crises, play an important role when it comes to implementing structural reform. Differently, key players which may be subject to governmental leverage, including policy spillovers from the product market to the labour market and the status of the public budget, could both spark reform and support it. The authors thus noted that, while some of the drivers are not in the governments' control, others fall within the governments' remit. Their analysis suggests that

the former set of factors (i.e., economic crises, exposure to foreign competition, and government's duration in office) had an important influence on the implementation of structural reforms. Nonetheless, the latter set of factors – which included budgetary conditions and spillovers across policy areas – were also important to both implement and sustain reforms. Interestingly, the authors noted that the influence of new technologies – measured by the authors as the investment made in information and communication technology – was, in principle, seen as a factor capable of influencing the implementation of structural reforms; however, their empirical work revealed that this variable was not statistically significant.

More recently, Adascalitei and Morano (2015) looked at the determinants (and effects) of reforms of EPL using both developed and developing economies between 2008 and 2014. As the authors themselves noted, previous studies tended to concentrate on developed economies, for which data availability was not an issue. As a result, limited evidence had been gathered on the determinants of labour market reforms (or better, labour market regulation) in developing economies (see Campos and Nugent (2012) and Bernal-Verdugo et al. (2014)). Using a measure of reform intensity, which differed from the dependent variable used in the abovementioned literature on developing economies, the authors found that: i) in developed economies, reforms were mostly meant to relax labour regulation and were driven by high unemployment rates and low levels of GDP growth; ii) in contrast, in

developing economies reforms tended to increase workers' protection, and were more likely to occur in countries experiencing high levels of GDP growth – while not being sensitive to unemployment rates.

Aimed at addressing the issue of increased unemployment across Europe, the 1994 OECD Jobs Strategy paved the way for subsequent labour market reform. However, in introducing changes to the labour market on both an institutional and a policy level, not every country was equally successful. In their work, Bassanini and Duval (2006) set out to analyse the effects that new policies and institutions had on the aggregate level of employment. Differently from previous works, this analysis is grounded in up-to-date information on OECD policies and institutions and takes into account previously ignored issues such as how policies and institutions interact with each other, how is economic resistance to macroeconomic alterations affected by policies and institutions, and what impact does product market regulation have. Finding that nearly two-thirds of unemployment that is not linked to alterations of the economic cycle can be explained by policy and institutional reform, the authors support the thesis that indeed, regulations and institutions play a key role in shaping the labour market. At the same time, however, the state of the economy also has an impact on employment and certain combinations of policies create a stronger, more beneficial effect when implemented contemporarily.

Belot and Van Ours (2004) argue that during the 1990s the majority of OECD countries battled against persistently increasing unemployment rates. In order

to contrast such raising rates of unemployment many countries adopted institutional reforms, some more successful than others. A thorough analysis of the existing relationship between unemployment rates and labour market institutions (LMI) reveals that specific combinations of LMIs are responsible for lowering the aggregate rate of unemployment. In fact, OECD countries which resulted more successful in lowering unemployment rates had adopted a number of institutional reforms tackling different labour market institutions such as employment protection, labour taxes, bargaining power of labour unions, and unemployment benefits.

Chor and Freeman (2005) exploit the 2004 Global Labour Survey (GLS), an internet-based survey which sought to collect data and analyze the state of the labour market in several countries. More specifically, unlike other studies, the survey focuses on concrete labour practices rather than labour regulations. The findings show that in countries characterized by higher income equality and higher level of income per capita practices favorable to workers are more likely to occur.

A widespread view among economists, is that the structure of labour market institutions is the result of a rent seeking process whereby incumbent employees leverage on their political influence in order to impose increasingly rigid labour markets, benefitting themselves at the detriment of outsiders.

A number of authors has taken this perspective in trying to identify the key determinants of labour market institutions. For instance, Saint-Paul (2014)

conducted an empirical investigation whose results were consistent with this view. He found that high exposition to unemployment risk among the employed leads to more flexible labour markets, as insiders anticipate the possibility of becoming outsiders in the short run. Likewise, lower unemployment benefits were associated with increased reactivity of employment levels to wage variations. Finally, he showed that both high levels of unemployment and the presence of right-wing governments (which tend to be less susceptible to trade union demands) explain reductions in minimum wage growth.

A similar perspective was taken by Rueda (2007), who focused instead on the determinants of active labour markets policies. Perhaps counterintuitively, he showed that left wing parties tend to shun policies aimed at bringing more people into the labour market, as these may undermine higher wages for core workers, that tend to constitute their electoral basis. However, a paper by Bonoli (2010) that considered the significant heterogeneity in Active Labour Market Policies thus showed a more nuanced picture.

Taking into account the more recent trends of the European labour market reforms, in particular those measures which were implemented between 2000 and 2011, Bonfiglioli and Gancia (2011) offer new insights as to the relation between macroeconomic cycles and institutional and regulatory changes to the labour market. Specifically, the authors note that the economic crisis of 2008 prompted a number of changes on a policy-level that focused primarily on

restructuring sectors of the labour market with a widespread effect. Employment protection legislation, setting of wages, and regulation of unemployment benefits are some examples of the macro areas on which post-2008 labour reforms focused. Furthermore, the authors noted a positive correlation between adoption of labour market reform in a certain country and the existence, in that country, of a high fiscal pressure on labour accompanied by unsatisfactory outcomes of the labour market. Such correlation was supported by econometric evidence which shows that following fiscal and labour benefit reforms the unemployment rate tends to decrease.

Some authors such as Agell (2002) questioned the dominant perspective on the determinants of labour market reforms labelling it as incomplete. In his article Agell, argued that unions, job protection and egalitarian pay structures may not solely be the result the result of rent seeking, but rather be a form of social insurance of otherwise uninsurable risks. By reviewing historical and empirical evidence, Agell identifies the absence of markets for insurance against labour income risk as the market failure motivating the emergence of rigid labour markets, thus operating a significant change of perspective on the nature of European labour market institutions.

Finally looking at technological innovation as a key determinant Gries et al. (2017) ask to what extent does technological innovation affect economic development and, in particular, could technological advancement lead to economic growth and in turn increase social welfare? In order to answer this fundamental question three basic

queries must be first addressed. Firstly, what factors lead to technological development and what potential benefits may said development bring? Secondly, what impact could the aforementioned benefits have? Thirdly, is participation in the gains which derive from innovation symmetric or asymmetric and what factors influence this result? According to the results of the studies there is a key difference between developed countries (DCs) and less developed countries (LDCs). In fact, while the former countries rely on technological development in order to advance economically, the latter partake in the benefits through the transfer of new technologies. Not only does the participation in gains differ greatly between DCs and LDCs, but it also presents asymmetric distribution among various groups. Factors such as supply of labour, power structures in global value chains, outsourcing, and the malfunctioning of government and institutions all play a role in determining the distribution of economic gains brought about by technological advancements.

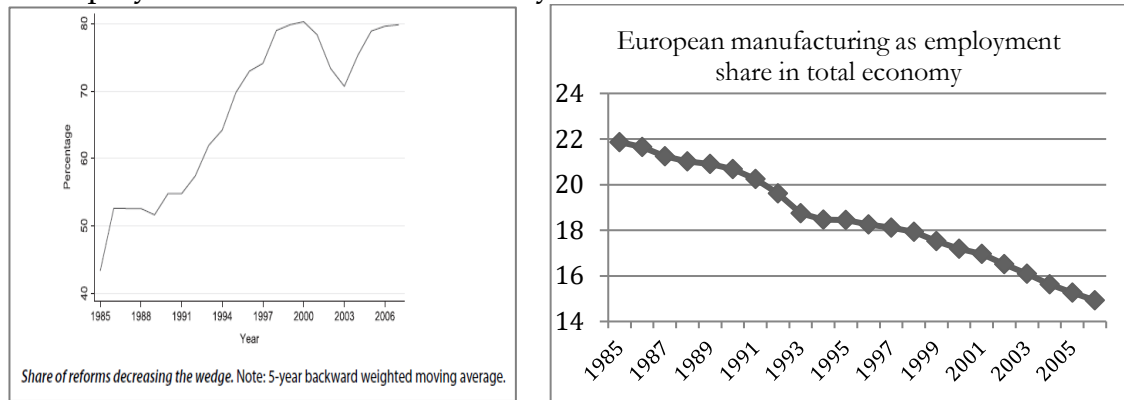
Gallie (2017) argues that with innovation playing such an important role in the economic growth of advanced economies, the question of how the labour market will evolve over time in said societies must also be addressed. To this regard, over the past thirty years three different points of view have been proposed. The optimistic scenario, which is grounded in the assumption that competition-driven technological innovation will require an increasingly skilled workforce, sees the expansion of employment and an increment in the level of the quality of work overall. On the contrary, a more pessimistic view details the probable negative effects new technologies may bring to the quality of work. In detail, according to this theory, new technologies will complement tasks requiring a high level of skill while alienating more repetitive, less-skilled tasks. In the long run this will lead to a polarization of skills and,

contemporarily, to the displacement of jobs pertaining to the middle and low skilled category of work. The third, more recent, point of view dismisses the assumptions outlined in the previous two points and insists instead that an increase in competition in the labour market brought about by technological advancements will not affect the structure or the quality of employment. A historical study of labour market structures will on the other hand reveal that institutional intervention will serve as a mitigating mechanism to alter the effects new production techniques will have on the labour market structure.

3. Theory and Hypotheses

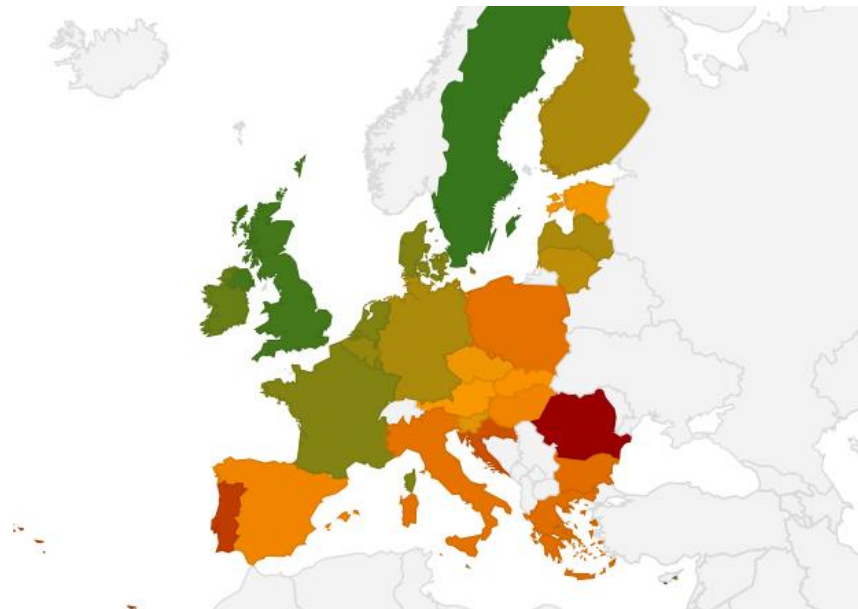
Let's start with some very suggestive evidence linking labour market reforms to the hollowing out in the European labour markets. In the graph on the left below you can observe the share of reforms targeted at reducing the wedge between the marginal productivity of labour and its opportunity cost in the period 1985 to 2006. As you can see this share is increasing over time and it is mostly due to competitive pressures of different nature (e.g. product market competition). However it is helpful to compare this with the graph on the right which is derived from the OECD STAN indicators and suggests that in the same period, manufacturing as employment share in the total economy has been drastically decreasing.

Figure 12: Share of reforms decreasing the wedge and european manufacturing as employment share in total economy



The second piece of evidence comes instead from the application by to Europe which analyses how susceptible jobs are to computerisation. As we can observe from the figure below, the northern countries feature low computerisation risk levels while this risk increases as we move south. Can this finding be reconciled with labour market reforms which favoured technological change?

Figure 13: Bruegel elaboration of the Frey and Osborne (2013) data on computerisation



Core political economy channel

In the Appendix I provide a detailed description of how the bargaining framework is altered by technological innovation. However, routinization has major reverberations which extend beyond the employer-trade union relationship. The core political economy channel through which job polarization thus becomes a fundamental determinant in the process of labour market reform can be represented by a reduced-form stages model which analyses the relationship between the lagged polarization level and the reform pace. The underlying mechanism is that increasing polarization tilts the balance of power away from trade unions (since their constituency is the one most affected by routinization) allowing an acceleration in reforms that were previously blocked.

Technological innovation leads to a fall in manufacturing as a share of employment in the total economy which in turn reflects into an erosion of trade union power and their privileged interest representation. Trade unions thus face a decreased bargaining power not only at the firm level but also their intermediating role is severely weakened. This in turn reflects in the political and legislative bodies where it is likely that we will see an increased reform activity, a higher degree of deregulation and decreased generosity of policy measures. The next diagrammatic visualization provides a summary of this mechanism and the hypotheses that follow from it:

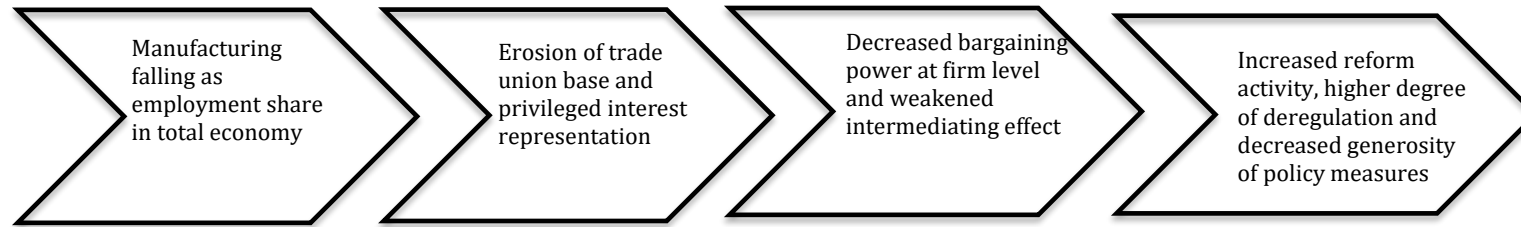


Figure 14: Reduced-form stages model for job polarization as a driver of labour market reform

Hypothesis 1: *The erosion of privileged interest representation and a weakened power of intermediation translate into a heightened intensity of labour market reforms*

Hypothesis 2: *The erosion of privileged interest representation and a weakened power of intermediation translate into a higher degree of deregulation and decreased generosity of policy measures*

Hypothesis 3: *LMEs are polarization consistent leading to a lower pressure to reform*

Hypothesis 4: *CMEs are polarization incompatible leading to an increased reform activity*

4. Data

Construction of the Polarization Indices

The polarization indices rely on the EU-LFS data from the previous paper, however for this paper I exploit the full extent of the information from the ILO October Enquiries on earnings. Indices are calculated by ranking occupations according to the average wage which varies by country rather than using only the UK wage ranking as done in Goos et al.(2009). Once all occupations have been ranked according to average wage Goos et al.(2007) run a quadratic regression of employment growth rates by wage percentile and the curvature of the U will be a measure of the magnitude of polarization since it only depends on the parameter of the squared term thus demonstrating robustness with regards to the data and definitions. However, as explained by Dauth(2014) in his analysis of job polarization on German local labour markets, a close alternative which accounts for how well the U fits to the data, is the **t-ratio** of the quadratic term, which will represent my first polarization measure called *de*

$$t_{rank^2} = \beta_{rank^2} / (\sigma / [SST_{rank^2}(1-p(rank; rank^2)^2)]^{1/2}) = (\beta_{rank^2} / \sigma)c$$

Where β_{rank^2} is the estimated coefficient of the quadratic term, SST_{rank^2} its total sum of squares, $p(rank; rank^2)$ its correlation coefficient with the level term, and σ the standard error of the regression. The denominator of the last fraction is a constant c . The t-ratio will therefore depend only on the

curvature of the regression curve (β_{rank^2}) and its fit to the data (σ). As highlighted by Dauth(2014) the main advantage of this straightforward measure is that it allows for a statistical test of polarization.

The first extension of this measure of polarization is the creation of a moving window for *de* of 3, 5, 7 and 10 years before each reform instance. This will allow me to have a measure of polarization which will thus vary across countries and across time. For the further details on how this panel has been constructed in the Paper II Appendix I provide part of the panel for *de3* (i.e. *de* with a 3 year window) and a diagrammatic visualization for the whole sample and for individual countries of this polarization measure.

However I have refined the *de* measure by constructing two further indices, *ind* and *pol* (also in the Appendix) which will provide a more informed picture of the type of polarization we are experiencing at a particular point in time in the individual countries. Firstly, the index *ind* takes into account not only the t-stat of $rank^2$ but also that of *rank*. This provides a better understanding of the true curvature of our U and allows me to differentiate between four types of polarization: PP-Positive polarization (classic U-shaped job polarization), NP-Negative polarization (when we have an inverted U), UP-Upgrading (when the occupational growth is tilted toward higher income occupations) and finally DG-Downgrading (which accounts for the increase in left-tail of the distribution).

The last measure of polarization *pol* is a further refinement of the original measure and builds on *ind* to isolate through the significance of the coefficients only the cases of proper job polarization.

LABREF database

The LABREF database is managed by the European Commission in cooperation with the Employment Committee (EMCO). The aim of the project, started in December 2005, is to support the work carried out in the framework of the Europe 2020 Strategy and to improve the understanding of labour market institutions as part of the general economic policy surveillance of Member States.

The measures reported in LABREF refer to enacted legislation, as well as other public acts of general scope, including measures entailing changes in the implementation framework of a previously adopted measure. In addition, they also encompass relevant collective agreements and tripartite agreements. The database does not record information on planned reforms or draft bills.

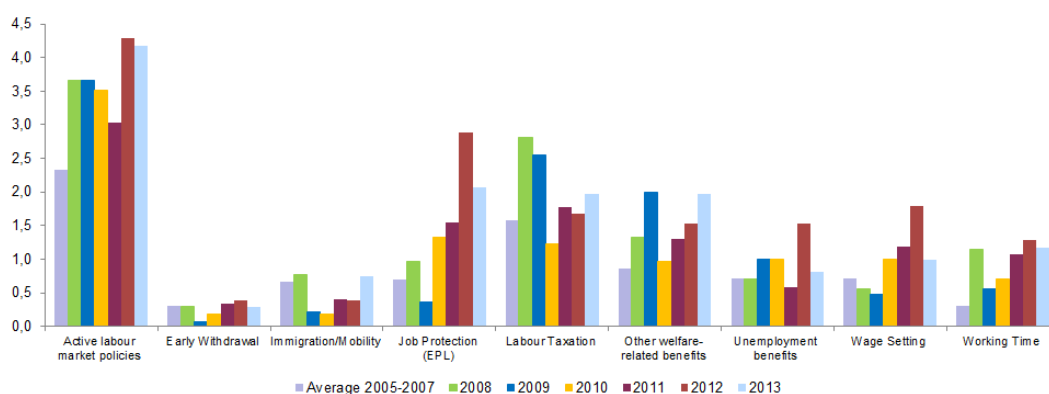
The LABREF database is organised around nine broad policy areas:

- labour taxation,
- unemployment benefits,
- other welfare-related benefits,

- active labour market policies,
- job protection legislation,
- disability and early retirement schemes,
- wage bargaining,
- working time organisation,
- immigration and mobility.

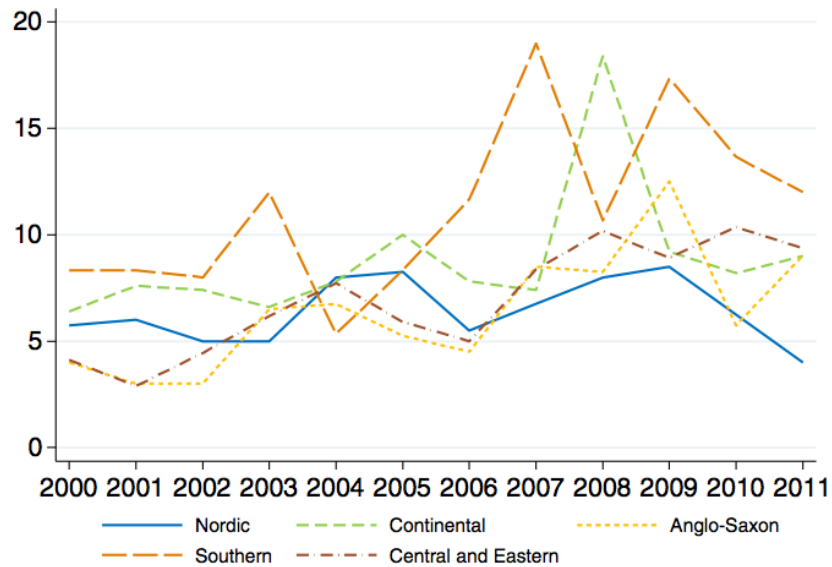
The database allows for cross-country analysis on the pace and type of measures enacted in a particular year, as well as for tracking measures over time, thus providing a consistent and policy-relevant picture of different reform strategies being pursued by Member States and of the existing interactions between various labour market institutions. LABREF covers the 28 EU Member States (we will use only 15) and the years 2000-2013 (we are going to use the data up to 2011).

Figure 15: Average number of labour market measures by policy domain, EU28



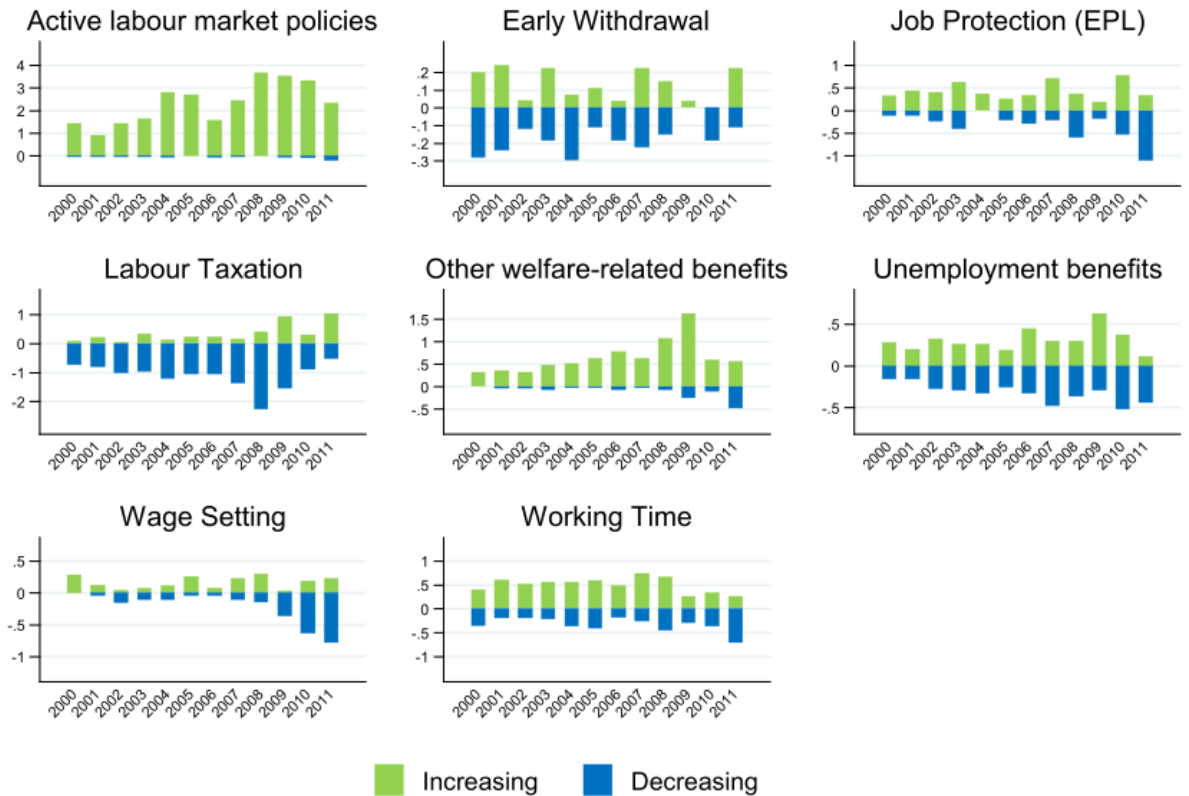
Source: Turrini (2015)

Figure 16: Average number of reforms adopted by EU countries, by year and country group



Source: Turrini (2015)

Figure 17: Direction of reforms by domain and year (average number of reforms adopted across the EU)



Source: Turrini (2015)

5. Empirical Model and Estimation Method

The empirical strategy consists in mapping the lagged indices of polarization calculated on an annual basis from the EU-LFS to the instances of reform reported by the LABREF.

The lagged measures represent the value of the indicators from the EU LFS dataset 10, 7, 5 and 3 years before the reform under consideration takes place.

The mapping will therefore associate the particular type of reform (details below) with the extent of polarization. As can be inferred, this will vary from country to country due to the high heterogeneity in the sample considered, however this exercise will be guided by the framework below.

Table 3: Application to the Labour Market Institutions of the Social Europe(s) framework proposed by Esping Andersen(1990) as in Boeri(2011)

Table 1 European clusters of institutions.

	Employment protection	Unemployment benefits	Active labor market policies	Taxes on low wages	Collective bargaining	Average ranking
	<i>Most restrictive</i>	<i>Most generous</i>	<i>Highest</i>	<i>Highest</i>	<i>Most centralized</i>	
Belgium ^c	9	5	2	1	4	4.2
Sweden ^b	7	6	3	2	7	5
Denmark ^b	12	2	1	6	8	5.8
Netherlands ^b	10	1	4	9	6	6
France ^c	3	3	5	7	14	6.4
Finland ^b	11	8	6	5	3	6.6
Austria ^c	8	10	9	8	2	7.4
Spain ^d	4	7	7	11	9	7.6
Portugal ^d	1	4	11	12	11	7.8
Italy ^d	5	9	12	3	10	7.8
Germany ^c	6	12	8	4	12	8.4
Greece ^d	2	14	14	10	5	9
Ireland ^d	14	11	10	15	1	10.2
United Kingdom ^a	15	15	13	14	13	14
United States	16	13	16	13	16	14.8
Japan	13	16	15	16	15	15
	<i>Less restrictive</i>	<i>Less generous</i>	<i>Lowest</i>	<i>Lowest</i>	<i>Less centralized</i>	

Average ranking is the average of the previous columns.

^a Anglo-Saxon cluster.

^b Scandinavian cluster.

^c Continental European cluster.

^d Southern European cluster.

Source: Boeri(2011)

This is an attempt to characterize the huge heterogeneity in the European landscape. It uses Esping-Andersen (1999) taxonomy and applies it in particular to labour market institutions. The first cluster to be considered is the Anglo-Saxon one which features weak unions and decentralised bargaining. This is followed by the Scandinavian one with active policy instruments and reliance on unemployment benefits. This is diametrically opposed to the Mediterranean cluster where we have countries with strict employment protection and relatively low unemployment benefits. The Continental European model instead relies on high levels of both EPL and UB.

Back to the empirical strategy, after matching manually the occupations in EU LFS (isco3d) to the ILO wages I built several types of polarization indices with 10,7,5,3 year-lag for each country (details in the Appendix). This step was followed by the creation of a country-year reform dataset using LABREF, counting the instances of reform and their direction.

The econometric framework I adopt is the following:

$$Reforms_{it} = \beta_0 + \beta_1 * GDP_growth_{it} + \gamma * GDP_capita_{it} + \delta * Debt_{it} + \varphi * Unemp_rate_{it} + \pi * Inflation_{it} + \eta * Trade_{it} + \lambda_t + \mu_i + \varepsilon_{it}$$

where $Reforms_{it}$ represents the total number of reforms passed at time t in country i (in some of the specifications the dependant variable will be the direction of the policy measure, i.e. increasing/decreasing); β_0 represents the

constant in the model; GDP_growth_{it} is the growth rate of GDP; GDP_capita_{it} is the natural logarithm of the GDP per capita; $Debt_{it}$ represents general government net debt as a share of national GDP; $Unemp_rate_{it}$ is the total unemployment rate; $Inflation_{it}$ are the consumer prices calculated as growth on the same period of the previous year; $Trade_{it}$ is the sum of exports and imports of goods and services as share of GDP; λ_t and μ_i are respectively time and country dummies whereas ε_{it} is the error term.

The estimation method applied is to understand whether (lagged) polarization affects the probability of reforms is `xtpoisson` which fits conditional fixed-effects to Poisson models. This model will be used with the number of reforms (# of reforms) adding also year fixed effects, whereas country fixed effects are already taken into account by the command `fe`. When instead we use the other dependant variable of interest, direction of policy measure, increasing net of decreasing or `increase_` (ratio of increasing net of decreasing over the total number of reforms), because of the underlying sample and the presence of negative values we will have to adopt `xtreg`, in which case we will also add country and year fixed effects (`i.coid` and `i.year`).

Details on `xtpoisson` (the case below is for `re` source: `Stata(c)`):

By default or when `re` is specified, `xtpoisson` fits via maximum likelihood the random effects model

$$\Pr(Y_{it} = y_{it} | x_{it}) = F(y_{it}, x_{it}\beta + v_i)$$

for $i = 1, \dots, n$ panels, where $t = 1, \dots, n_i$, and $F(x, z) = \Pr(X = x)$, where X is Poisson distributed with mean $\exp(z)$. In the standard random-effects model, v_i is assumed to be i.i.d. such that $\exp(v_i)$ is gamma with mean one and variance α , which is estimated from the data. If *normal* is specified, v_i is assumed to be i.i.d. $N(0, \sigma_v^2)$

Potential endogeneity issue

A potential source of endogeneity may be highlighted between the first and second paper of this thesis with job polarisation arising from the variation in the initial level of institutions. However, the main point is that whereas in my first work I show that institutions affect polarisation, in this subsequent analysis I examine how polarisation affects the likelihood of reforms. Reforms change institutions, but not always in the same direction and in this paper I look at changes in institutions (reforms) rather than levels of institutions, which creates less concerns for endogeneity. In a further robustness check I also run a model where the initial level of institutions is included as an additional control variable, to show that the effect of polarisation on reforms is independent from the direct effect that institutions may have on (polarisation and) reforms.

5. Results

In Table A I have reported the baseline specification which allows me to understand which are the main drivers of affecting the likelihood of labour market reform. The results show that the effect of the growth rate of GDP is

negative and statistically significant, meaning that countries reform less when undergoing periods of higher GDP growth. The same applies for per capita GDP for which higher levels decrease the likelihood of reform. The other significant effect, positive although limited in magnitude is net government debt which suggests countries are more likely to turn to labour market reforms when they have limited fiscal space. The unemployment rate is marginally non-significant and has the expected sign, whereas inflation and trade openness do not result statistically significant

Table A - Baseline

	(1) # of reforms
gdp growth	-0.0404** (0.0183)
log of per capita gdp	-7.73e-05** (3.25e-05)
government net debt	0.00590* (0.00320)
unemployment rate	0.0172 (0.0181)
inflation	0.00911 (0.0334)
trade openness	0.00471 (0.00572)
Observations	167
Year & Country Dummies	YES

Standard errors in
parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table B1 and B2 add our driver of interest to the model specification, the polarization index, *de* and *pol* respectively, for different windows. For *de* one can observe that the significant lags are the 5y and 7y ones. Whereas for *pol* we have that the 5y window is the most relevant. This means that the number of reforms is likely to be affected by the polarization pattern observed in the 5 years before, which underscores the persistence of such structural employment changes. In other words an increased hollowing out of the labour market produces an increase in the number of reforms with a 5y window.

Table B1 - <i>de</i>	(dependent variable: # of reforms)			
	(1) 3y	(2) 5y	(3) 7y	(4) 10y
gdp growth	-0.0410** (0.0186)	-0.0472** (0.0190)	-0.0499*** (0.0193)	-0.0447* (0.0233)
log of per capita gdp	-7.73e-05** (3.29e-05)	-7.54e-05** (3.42e-05)	-8.93e-05** (3.62e-05)	-7.06e-05 (5.15e-05)
government net debt	0.00664** (0.00323)	0.00662** (0.00329)	0.00702** (0.00332)	-0.000407 (0.00424)
unemployment rate	0.0114 (0.0186)	0.00573 (0.0192)	-0.00249 (0.0204)	0.0101 (0.0226)
inflation	0.0198 (0.0341)	0.0192 (0.0347)	0.0221 (0.0348)	0.0102 (0.0429)
trade openness	0.00760 (0.00588)	0.00823 (0.00590)	0.0101* (0.00600)	0.0113* (0.00685)
polarization index (<i>de</i>)	0.0304 (0.0326)	0.0706** (0.0332)	0.0736** (0.0369)	0.0305 (0.0515)
Observations	162	156	148	116

Year & Country Dummies	YES	YES	YES	YES
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Table B2 - pol	(dependent variable: # of reforms)			
	(1) 3y	(2) 5y	(3) 7y	(4) 10y
gdp growth	-0.0356* (0.0187)	-0.0435** (0.0189)	-0.0506*** (0.0194)	-0.0436* (0.0243)
log of per capita gdp	-8.00e-05** (3.28e-05)	-7.64e-05** (3.44e-05)	-8.60e-05** (3.63e-05)	-9.06e-05* (5.36e-05)
government net debt	0.00628* (0.00323)	0.00611* (0.00329)	0.00722** (0.00330)	9.13e-05 (0.00433)
unemployment rate	0.0131 (0.0184)	0.00709 (0.0192)	-0.00216 (0.0205)	0.0112 (0.0236)
inflation	0.0170 (0.0336)	0.0145 (0.0343)	0.0167 (0.0348)	0.0198 (0.0452)
trade openness	0.00594 (0.00592)	0.00563 (0.00597)	0.00870 (0.00603)	0.0125* (0.00695)
polarization index (pol)	0.0515 (0.0417)	0.208** (0.0895)	0.0706 (0.0435)	-0.0652 (0.108)
Observations	162	156	148	107
Year & Country Dummies	YES	YES	YES	YES
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Trying to quantify the effect of polarization on the number of labour market reforms we can see from Table B1 that a one standard deviation increase in polarization de 5y window leads to a 7,06% increase in the likelihood of having more reforms, a magnitude which is comparable to the one of GDP growth (-4,72%) which has an opposite sign. This positive and significant result is confirmed by looking at our alternative measure of polarization, pol where with a 5y window in Table B2, we notice that a standard deviation

increase in polarization actually results in an even larger increase in the likelihood of reform.

In Table B3 we keep the polarization index *de* and add a one year lag to all our covariates, including the polarization variable. The significance of the GDP growth rate and government net coefficients increases whereas GDP per capita becomes insignificant. The same happens to our polarization variable, but differently from before the two relevant lags now are 3 and 5 years.

Table B3 - lagged_de

	(1)	(2)	(3)	(4)
Lagged (L1) variables	L1_3y	L1_5y	L1_7y	L1_10y
L1.gdp growth	-0.0543*** (0.0206)	-0.0612*** (0.0211)	-0.0613*** (0.0214)	-0.0540** (0.0247)
L1.log of per capita gdp	-9.83e-06 (3.64e-05)	-8.46e-06 (3.86e-05)	3.30e-06 (4.20e-05)	-3.54e-05 (5.93e-05)
L1.government net debt	0.0213*** (0.00473)	0.0205*** (0.00487)	0.0234*** (0.00515)	0.0144** (0.00650)
L1.unemployment rate	0.0220 (0.0211)	0.0237 (0.0215)	0.0123 (0.0228)	0.0162 (0.0250)
L1.inflation	0.0373 (0.0375)	0.0181 (0.0387)	0.00857 (0.0396)	-0.00206 (0.0465)
L1.trade openness	-0.00774 (0.00626)	-0.00796 (0.00632)	-0.00710 (0.00644)	-0.0102 (0.00754)
L1.polarization index (<i>de</i>)	0.0937*** (0.0361)	0.0675* (0.0375)	0.00392 (0.0445)	0.0498 (0.0622)

Observations	147	141	133	102
Year & Country Dummies	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In Table C1 and C2 we are instead interested in the direction of policy measure (an increasing in this variable reflects an increase in the generosity of a policy measure, a decrease is associated with more deregulation). The results go in the expected direction. Polarization de with a 3 year lag is associated with less generosity or more deregulation in the policy measure observed. The same applies to ind.

Table C1 – Direction of policy measure

increase_	3y
gdp growth	0.0589** (0.0257)
log of per capita gdp	1.91e-05 (4.06e-05)
government net debt	0.00285 (0.00454)
unemployment rate	-0.0164 (0.0267)
inflation	-0.0543 (0.0461)
trade openness	-0.0147* (0.00766)
polarization index (de3)	-0.0731* (0.0432)
Constant	0.575 (1.684)
Observations	162
Year & Country Dummies	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table C2 – Direction of policy measure

increasingnetofdecreasing	3y
gdp growth	0.598*** (0.219)
log of per capita gdp	9.45e-05 (0.000343)
government net debt	0.0412 (0.0384)
unemployment rate	-0.173 (0.223)
inflation	-0.714* (0.394)
trade openness	-0.0510 (0.0653)
Positive Polarization (ind)	-1.721** (0.816)
Upgrading (ind)	-3.147** (1.559)
Constant	0.839 (14.38)
Observations	162
Year & Country Dummies	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table D1 and D2 are meant to replicate what has been shown above, but for different types of polarization using the index “ind”.

Table D1 - Types of polarization (ind variable)

	(1)	(2)	(3)	(4)
	3y	5y	7y	10y
gdp growth	-0.0321* (0.0189)	-0.0392** (0.0197)	-0.0468** (0.0193)	-0.0383 (0.0241)
log of per capita gdp	-7.66e-05** (3.33e-05)	-8.38e-05** (3.46e-05)	-9.12e-05** (3.74e-05)	-0.000101* (5.39e-05)
government net debt	0.00671** (0.00328)	0.00612* (0.00333)	0.00792** (0.00340)	0.000818 (0.00438)
unemployment rate	0.0174 (0.0186)	0.0112 (0.0194)	0.00345 (0.0201)	0.00976 (0.0236)
inflation	0.00105 (0.0345)	0.00988 (0.0351)	0.0311 (0.0364)	0.0275 (0.0446)
trade openness	0.00653 (0.00598)	0.00739 (0.00599)	0.0111* (0.00611)	0.0121* (0.00717)
Negative Polarization		0.389 (0.401)	-0.0199 (0.509)	0.247* (0.142)
Positive Polarization	-0.0473 (0.0743)	0.373 (0.395)	0.123 (0.512)	0.176 (0.198)
Upgrading	-0.569*** (0.171)	0.291 (0.404)	0.0148 (0.518)	
Observations	162	156	148	107
Year & Country Dummies	YES	YES	YES	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In Table D1 Upgrading has a negative and significant effect in the 3y_lag on the number of reforms. When we look at the direction of the policy measure instead, both the proper polarization and upgrading have a negative effect on the value of the value of our dependent variable in the 3 year lag. It is slightly different for the standardised version, as can be seen from the table on the right below.

Table D2 - Types of polarization (ind variable) +

Direction of policy measure

	(1)		(1)	(2)
increasingnetofdecreasing	3y	increase_	3y	5y
gdp growth	0.598*** (0.219)	gdp growth	0.0621** (0.0261)	0.0740*** (0.0263)
log of per capita gdp	9.45e-05 (0.000343)	log of per capita gdp	1.51e-05 (4.08e-05)	1.08e-06 (4.17e-05)
government net debt	0.0412 (0.0384)	government net debt	0.00181 (0.00457)	0.000532 (0.00454)
unemployment rate	-0.173 (0.223)	unemployment rate	-0.0178 (0.0265)	-0.00658 (0.0275)
inflation	-0.714* (0.394)	inflation	-0.0585 (0.0469)	-0.0408 (0.0467)
trade openness	-0.0510 (0.0653)	trade openness	-0.0160** (0.00777)	-0.0142* (0.00774)
Positive Polarization	-1.721** (0.816)	Negative Polarization		1.024*** (0.370)
Upgrading	-3.147** (1.559)	Positive Polarization	-0.172* (0.0971)	0.847** (0.366)
Constant	0.839 (14.38)	Upgrading	-0.0381 (0.185)	1.195*** (0.384)
Observations	162	Constant	0.955 (1.711)	0.281 (1.740)
Year & Country Dummies	YES	Observations	162	156
Standard errors in parentheses		Year & Country Dummies	YES	YES
*** p<0.01, ** p<0.05, * p<0.1		Standard errors in parentheses		
		*** p<0.01, ** p<0.05, * p<0.1		

I have also run a number of robustness checks. Instead of using poisson for my specifications I have resorted to negative binomial regressions. The results are broadly consistent with has been presented above. Moreover I run the regressions above with and without including polarization to see whether the coefficient of other variables change and also the opposite, keeping only polarization and including other variables progressively as controls. Again the results are not altered. Placebo tests with forward lags of

3, 5, 7 and 10 years for the three alternative measures of polarization were also run and they all lead to an effect equal to zero thus making the results above more robust.

Finally it is interesting to investigate how polarization interacts with more traditional taxonomies of welfare capitalism, therefore analysing the effect of job polarization on labour market reforms in terms of the Varieties of Capitalism (VoC) classification and Esping-Andersen's three worlds of welfare capitalism.

Varieties of Capitalism and Job Polarization

When we apply the Varieties of Capitalism (VoC) classification we can see a number of very interesting results. The polarization index has a negative and significant magnitude, in other words increased polarization is indeed associated with less propensity to reform in LME countries. On the other hand for CMEs the sign of this variable is positive and significant: higher polarization leads to an increased number of reforms. I think this is an extremely interesting result because it proves the hypotheses that Liberal Market Economies are polarization consistent. These countries, by relying on flexibility, they harness market dynamics, thus accommodating changes brought by technological change. Whereas Coordinated Market Economies which are against big changes, especially in the middle of the occupational distribution, are confirmed to be polarization incompatible therefore job polarization destabilizes the system leading to an increased need for reforms.

Job polarization leads to an erosion of welfare models through the weakening of the wage setting institutions which are meant to stabilize the system. I don't look at the direction of reform since as extensively explained in the VoC literature it depends on the path dependency of these economies, but it is interesting to highlight how job polarization seems also to lead to a possible convergence of Command Market Economies towards Liberal Market Economies, re-opening the age-old debate between convergence and divergence (Kerr, Dunlop, Fredeirck, Myers, 1960; Goldthorpe, 1984; Streeck & Thelen, 2005) and the more recent conceptualizations with the "dual convergence" thesis (Hay, 2004; Schekle, 2008).

Table VarCap - pol5

	(1)	(2)
	LME	CME
gdp growth	0.128 (0.0999)	-0.0124 (0.0547)
log of per capita gdp	0.00102** (0.000431)	-0.000184 (0.000123)
government net debt	0.251** (0.114)	-0.00944 (0.00939)
unemployment rate	-0.856** (0.428)	0.0624 (0.0793)
inflation	-0.439** (0.197)	-0.137 (0.0843)
trade openness	0.0645* (0.0358)	0.00563 (0.0162)
polarization index (pol5)	-1.525** (0.626)	0.415** (0.204)
Constant	-51.62** (21.88)	8.985* (5.305)
Observations	23	73

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In the Appendix you can also find a Robustness check which uses an alternative index of polarization (de5 instead of pol5) and confirms the pattern suggested above.

Esping-Andersen Three Worlds of Welfare Capitalism and Job

Polarization

As for the VoC categorization, we now move to test the effect of job polarization on labour market reforms according to the Esping-Andersen classification in the Three Worlds of Welfare Capitalism. We choose the pol and de index for the 5 year window, which resulted the most robust across specifications.

Table Esping - pol5

	(1) Social Dem	(2) Continental	(3) Liberal
gdp growth	0.0168 (0.0745)	-0.148*** (0.0301)	0.128 (0.0999)
log of per capita gdp	-0.000253 (0.000165)	-1.74e-05 (4.85e-05)	0.00102** (0.000431)
government net debt	0.0140 (0.0168)	0.0171*** (0.00565)	0.251** (0.114)
unemployment rate	0.261** (0.123)	-0.0435* (0.0226)	-0.856** (0.428)
inflation	0.00391 (0.144)	-0.125 (0.0763)	-0.439** (0.197)
trade openness	-0.0145 (0.0271)	0.0357*** (0.0125)	0.0645* (0.0358)
polarization index (pol5)	0.330 (0.276)	0.467*** (0.126)	-1.525** (0.626)
Constant	10.46 (8.014)	-1.425 (2.044)	-51.62** (21.88)
Observations	44	89	23

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table Esping - de5

	(1) Social Dem	(2) Continental	(3) Liberal
gdp growth	-0.0332 (0.0642)	-0.157*** (0.0307)	0.106 (0.0992)
log of per capita gdp	-6.37e-05 (0.000161)	-1.48e-05 (4.80e-05)	0.00127*** (0.000486)
government net debt	0.0339* (0.0189)	0.0187*** (0.00564)	0.305** (0.136)
unemployment rate	0.453*** (0.141)	-0.0505** (0.0227)	-0.990** (0.478)
inflation	0.0554 (0.143)	-0.163** (0.0764)	-0.646** (0.272)
trade openness	-0.00112 (0.0277)	0.0406*** (0.0124)	0.0393 (0.0418)
polarization index (de5)	-0.153 (0.116)	0.159*** (0.0447)	-0.955** (0.433)
Constant	0.179 (8.375)	-1.579 (2.030)	-58.98** (23.40)
Observations	44	89	23

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

What one can observe from the specifications is that the index of polarization matters for the Continental and Liberal regimes, whereas they are never significant for the countries in the Social Democratic category. In the Liberal regime as it had already occurred in the VoC classification, the sign of the coefficient is negative, meaning that higher polarization is actually associated with a lower likelihood of reform. On the other hand for Continental countries the coefficient turns positive which leads to the same considerations made above: job polarization destabilizes Continental countries which are forced to increase their reform activity. In the case of Social Democratic countries our coefficient is not significant, this is probably

due to the fact that upgrading is the most relevant employment structure and instead of an hollowing out of the middle we have actually witnessed a shift of the entire skill occupational distribution towards higher income occupations.

6. Conclusions

In this paper I ask whether job polarization has a feedback effect on labour market institutions and policies, so that different degrees of polarization lead to different articulations of institutions at the domestic level, thus reinforcing or altering differences in national models across the European space. The political economy channel at the core of the analysis sees a decreased bargaining power of trade unions due to the hollowing out of their power base (particularly relevant for manufacturing) translated into a weakened intermediating effect in the labour market reform process. The decrease in concerted power thus reflects into an increased reform activity, a move towards deregulation and a decrease in the generosity of the policy measures. The hypotheses set out by the paper seem to be confirmed. The erosion of privileged interest representation and a weakened power of intermediation translate into a heightened intensity of labour market reforms and into a higher degree of deregulation and decreased generosity of policy measures.

When I look at the welfare capitalism taxonomy I find that LMEs are polarization consistent, thus leading to a lower pressure to reform, whereas CMEs are polarization incompatible leading to an increased reform activity.

The analysis finds that the job polarization experienced by a particular country in the 5 years before the reform instance is consistently among the strongest predictors of reform activity, as significant as other drivers such as GDP growth and government net debt. Moreover a higher degree of polarization tends to be associated with more deregulation and a decrease in the generosity of the policy measure. Finally, as anticipated above the empirical framework is tested against more conventional taxonomies of welfare capitalism (Esping-Andersen and VoC) revealing how both the continental and liberal regimes have been profoundly affected by job polarization.

PAPER III

Falling Behind: the Decoupling of Job and Wage Polarization in Europe

Abstract

The “Great Decoupling” is the term used to describe the divergence between labour productivity and employment/wages that occurred in the US in the 1980s and that has become quite pronounced over the past thirty years: while productivity was increasing, median family income started to trail and job growth in the middle began to decline. The hollowing out of the middle in the US labour market produced both job and wage polarization patterns which persisted throughout the period 1985-2005. However, while wage inequality has been on the rise also in Europe, has the U-shaped impact on the wage distribution predicted by the literature materialized? The findings in this paper show that job polarization increased upper-tail inequality (90/50) and decreased lower-tail (50/10) inequality but that employment protection legislation restrained these wage effects.

1. Introduction

In October 2013 the UK Department for Business Innovation & Skills was writing:

If only demand-side factors such as task-biased technological change are behind changes in the labour market, we would expect wages and employment to move together, producing similar changes in the job distribution and wage distribution. The fact that we do not observe this, with growth in jobs but not in wages at the lower end of the labour market, suggests supply-side factors could also be important there, with increased supply potentially coming from displaced intermediate workers, former benefit recipients pushed into work by eligibility changes, or immigration⁵

Unlike the evidence for the US, in Europe job polarization does not seem to have been followed by a corresponding pattern of wage polarization. In this paper I build on my two previous contributions for what concerns the role of institutions and job polarization to understand how wage patterns have evolved over the last three decades and establish what are the implications for wage inequality.

Boehm (2013) investigates the US wage distribution since the end of the 1980s and claims that routinisation has not only replaced middle-skill workers' jobs but also strongly decreased their relative wages: both the analysis of the National Longitudinal Survey of Youth (NLSY) and the Current Population Survey (CPS) highlight that there was a substantial decrease since the mid-1980s in the number of well-paid middle-skill jobs in

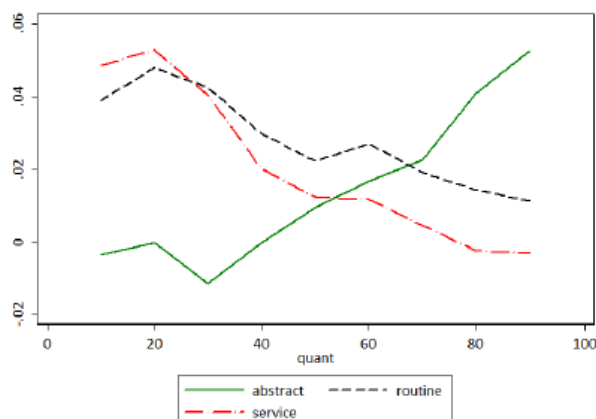
⁵ BIS Research Paper Number 134 (October 2013) – Hollowing out and the future of the labour market

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/250206/bis-13-1213-hollowing-out-and-future-of-the-labour-market.pdf

manufacturing and clerical occupations and there was a significant drop in the relative earnings for workers around the median of the wage distribution with no meaningful real wage gains over the last three decades.

Naticchioni et al. (2014) instead who explore the unconditional and conditional wage polarization in Europe using industry and individual level data for the period 1995-2007 find scant signs of polarization in Europe. Moreover, they provide evidence for technological change to be affecting the lower and upper part of the distribution differently because of services tasks being crucial for the lower quantiles and abstract tasks in the case of higher ones. This I think is the most relevant finding, which I will exploit also in this paper. Let's look at their work in more detail in order to understand how my contribution fits within the broader debate on wage polarization. The authors providing evidence from a restricted sample (AT, ES, GR, IE, IT, PT, UK) which is represented in the figure below showing gross current hourly wage and the decomposition of technology into three occupational tasks (abstract, routine, service). As one can observe, the abstract component has a steep increasing impact along the wage distribution, thus exerting a positive impact on the increase of both the 90/50 and the 50/10 inequality ratios.

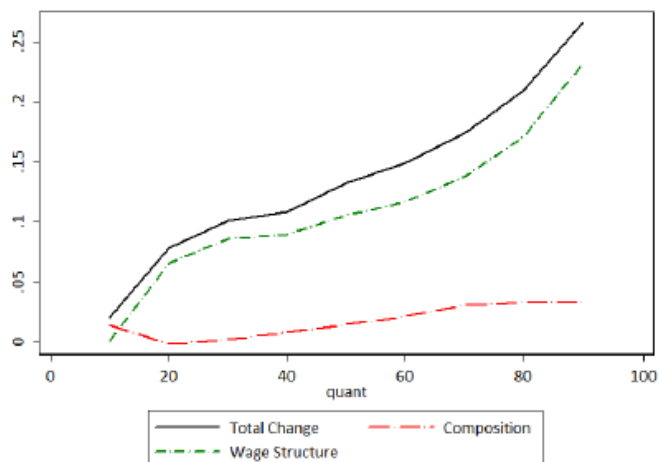
Figure 18: Gross current hourly wage: detailed composition effect. Sample of countries for which hourly wages are available



Source: Naticchioni et al. (2014)

On the other hand the pattern for the service task intensity seems to be decreasing along the wage distribution. This means that we should actually see an increase in wages in the lower part of the wage distribution, with a polarization effect on the lower tail of the distribution that reduces the 50/10 ratio. However according to the authors these are the patterns that have materialized in gross hourly wage in the period 1995-2007 for the selected sample:

Figure 19: Gross current hourly wage: overall change, aggregate composition and wage structure Source: Naticchioni et al. (2014)



It seems that rather than a wage polarization pattern, the effects of job polarization on wages have led to an increase concentrated above all in the upper quantiles.

My work will try to extend the evidence to a larger sample of countries and time period and provide an analysis across sectors. Also by exploiting the same set of data it will compare the EU patterns to the US ones. Finally, it will investigate the differential effects of job polarization on upper and lower tail inequality and look at the wage dispersion patterns according to the Varieties of Capitalism taxonomy.

2. Literature Review

In an article for *Foreign Policy* in 1994 Krugman offers an explanation of why modern advanced economies face serious economic trouble which is reflected particularly by two factors: jobs and wages. Specifically, while in the mid-1900s unemployment didn't seem to be a problem in the United States, (which, at the time, had a near perfect employment record with unemployment systematically approaching the ideal 5.5% level), an increasing number of American workers received wages that forced them to live at what is widely considered to be poverty-level. On the other hand, Europe faced a constantly increasing level of unemployment. Paradoxically, while both the United States and Europe struggled with labour market

issues, the world experienced a time of great technological advancement which, according to many, should have been accompanied by higher wages and increased rate of employment. Krugman explains this dichotomy between theory and reality by hypothesizing that technological advancements will lead to a higher increase in wage polarization. As a result, in the United States, where workers remain highly not unionized, wage distribution has undergone extreme polarization. At the same time, in Europe, where workers' unions and collective bargaining have mitigated the phenomenon of income inequality, the same technological advancement has resulted in an increase of the overall unemployment rate.

The economic literature has identified a variety of factors as determinants of income inequality. Authors such as Topel (1997) have stressed the influence of supply side factors. He identified changes in the supply of skills as a key driver of wage inequality, while the evidence relating woman's increased labour force participation and immigration with reductions in the wages of low-skilled male workers was deemed inconclusive. Human capital investment was identified as a key tool in reversing the trend of rising income inequality, even though according to Topel its ability to raise the wages of low skilled workers appears far more dubious than its ability to limit the emergence of wage inequality among the highly skilled.

Other authors built on these perspectives and shifted the debate on the causes of wage inequality towards a dichotomy: skill-biased technical change

(SBTC) and international trade (IT) liberalization. In a 2013 empirical study, Afonso et al. tried to assess both perspectives analysing the impact of these two factors across 18 EU countries. The trade explanation draws from the Stolper-Samuelson theorem, postulating that a fall in the relative price of imported goods must reduce the return on the factor that is used intensively in their production. Specialization in goods requiring high-skilled workers implies higher demand for such skills and therefore higher relative wages. The SBTC explanation is rooted in the technological knowledge bias in favour of skilled labour; this leads to a relative increase in productivity of skilled labour and, in equilibrium, of relative wages. The results of the study suggested SBTC as the main explanation for within country wage inequality, followed by education expenditure levels. IT proved to be a relevant explanation only in countries at the frontier of technological innovation, where immigration seemed, interestingly, to have a negative effect on wage inequality. Nevertheless, other studies have supported the trade hypothesis. In particular, Milanovic & Squire (2005) found evidence that trade tariffs reductions lead to increased wage inequality; however, the empirical results were admittedly not very strong, with the evidence for between industry inequality being more certain than that for within industry inequality.

Some scholars have taken a different perspective, and looked at the way institutions influence income inequality. Rueda and Pontusson (2000) looked at how the presence of different varieties of capitalism in different countries

affected the emergence of differentiated levels of income inequality. The authors argued that in liberal market economies factors such as increases in female labour force participation are able to affect wage inequality, while in social market economies they do not. Works such as Blau & Khan (1996), by analysing the differences between the U.S. and other OECD countries, complement these theories by offering an account of how in liberal market economies labour market institutions, namely decentralized wage-setting mechanisms, are able to explain higher compression at the bottom of the wage distribution.

Also, it is worth noting that some scholars (e.g. Card & DiNardo, 2002) characterize rising income inequality in the US over the past 35 years as an episodic event, driven by non-market factors: namely a fall in the real value of minimum wages. According to this line of thought, this was then compounded by a physiological change in labour force composition (growing education and experience). Without getting into too much detail, we will just note that the proposed arguments are not valid if taken outside of the US context, and therefore are unable to explain rising wage inequality in other developed economies.

Acemoglu, Aghion and Violante (2001) present very interesting framework looking at deunionization, technical change and inequality for the US and UK by splitting the workers in low skill and high skill, not looking at specific occupations/tasks. The authors argue that SBTC causes deunionization

because it increases the outside option of skilled workers, undermining the coalition among skilled and unskilled worker in support of unions. Their main conclusion is that although deunionization is not the underlying cause of the increase in inequality, it amplifies the direct effect of SBTC since the role of wage compressors by unions is removed.

The work by Antonczyk, DeLeire, Fitzenberger (2010) compares the US and German wage inequality patterns and looks at the role of SBTC in determining the increase in wage inequality in Germany. There is an increase in wage inequalities in both countries but the patterns between US and Germany are differentiated along age cohorts and low/high skilled workers. The authors argue that SBTC is not sufficient to explain the wage patterns in Germany, and that German institutions might play a major role.

Applying a quantile decomposition analysis, Naticchioni, Ricci, and Rustichelli (2008) investigate empirically the relation between wage inequality, employment structure, and skill biased change in Italy. Their main finding is that changes in wage inequality are mainly driven by a decrease in educational premia over time, whereas the employment structure plays only a minor role. Skill-biased change is thus replaced by increasing educational attainment as an explanation for changes in wage inequality.

For Acemoglu and Autor (2011) the so-called *canonical model* has been extensively used to explain skill biased demand shifts and wage inequality,

nevertheless said model does not take into consideration a number of more recent factors which may help shed light on increasing inequalities in wage distribution in the United States and other advanced economies. According to authors, a new, more accurate model for the analysis of wage inequality should take into account the decline in wages of low-skill workers, job polarization, technological advancements which allow for the substitution, in certain tasks, of labour, offshoring – *i.e.* the substitution of domestic labour with foreign workers, and changes in wages which are not evenly distributed across the earnings scale – *i.e.* higher changes in wages in lower or higher earning jobs.

According to Lemieux (2008) since the 1980s wage inequality in the United States began rapidly increasing and by the 1990s the general consensus attributed such sharp growth in inequality to an increase in the demand for skilled labour. While the general trend of wage distribution remained the same throughout the 1990s, Lamieux argues that a closer analysis will reveal a fundamental difference between the wage inequality which characterized the 1980s and that which occurred in the last 15 years. In fact, the author notes that the recent increment in wage inequality has affected the higher end of the wage distribution scale in a more significant manner. In other words, higher wages have suffered a more dramatic increase in inequality. When looking at the underlying reasons which may explain such trend, Lamieux identifies three key factors: changes in demand for specific tasks

carried out by high-earning workers, de-unionization, and a more widespread use of the 'pay-for-performance' model.

3. Theory and Hypotheses

Lemieux (2008, p 23) argues that if advanced economies are subject to the same technological change and technological change is the main explanation for growing wage inequality it is difficult to fully explain such divergent inequality patterns across countries. Freeman and Katz (1995) try to address this puzzle by suggesting that supply and demand, as evidenced by Skilled Biased Technical Change (SBTC), can contribute only in part to changes in inequality and that wage-setting institutions need to be taken into account. The authors put forward a more encompassing model of Supply, Demand, Institutions (SDI) in which common demand shocks are mitigated by institutional factors.

The hypotheses in this paper therefore will build on the theoretical framework by Lemieux(2008) and will try to argue that where wage-setting institutions are weak, a negative technological change depresses the wage growth in the sector where automation is stronger, instead where they are strong, wages in the medium sector remain stable despite the same negative demand change. To make the hypotheses testable they will thus be formulated in terms of upper-tail (90/50) inequality and lower-tail inequality

(50/10) and will build on the results from the two previous papers, as follows:

- *Hypothesis H1: EPL reduces upper-tail inequality (90/50) while maintaining or increasing lower-tail (50/10) inequality*
- *Hypothesis H2: Job polarization increases upper-tail inequality (90/50) while reducing lower-tail (50/10) inequality*

4. Operationalisation and Data

The main aim of this paper remains to investigate the effects on wage inequality of both secular trends of technological change, as evidenced by job polarization, as well as institution-based explanations. For this reason I will perform a series of empirical analyses.

Firstly, I will start by looking at wage dynamics and evolutions across sectors for the EU and US in the last three decades in order to find evidence of wage polarization. Secondly, my analysis will include fixed effects regressions of wage inequality ratios (upper 90/50 and lower tail 50/10) on wage determinants common in the literature and separately on an institutional factor (employment protection legislation) and on job polarization. Finally, I will try to unveil wage dynamics over time according to the Varieties of Capitalism taxonomy.

The main source of data on which I rely is the Occupational Wages around the World (OWW) Database⁶ compiled by Richard B. Freeman and Remco H. Oostendorp. This database contains wage data covering 171 countries from 1983 to 2008 derived from the ILO October Inquiry database. The 2013 version expands the earlier databases by including not only the most recent ILO data but also data for earlier years which were previously available only in hardcopy format. Another novelty is that wages are standardized on both an hourly and monthly basis unlike the two previous standardizations which were on a monthly basis only.

The normalized wages I am going to use are *hw3w1us* (hourly wages in US\$ with uniform calibration) and *mw3w1us* (monthly wage in US\$ with uniform calibration), both measures are considered by the authors the most reliable and consistent following the standardization procedure involving a lexicographic ordering and assignment of hours of work in the period 1983-2008 and an estimation of data type correction factors. I am also using only data for the same 16 EU countries of my first investigation plus the USA.

The other key variable from this dataset is *y3: industry code*, to which I apply a modified version of the Eurostat industry aggregation⁷ based on NACE

⁶ http://siteresources.worldbank.org/EXTNWDR2013/Resources/8258024-1320950747192/8260293-1320956712276/8261091-1348683883703/WDR2013_bp_Occupational_Wages.pdf

⁷ http://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf

Rev. 2 at 2-digit level for compiling three main aggregates for my analysis (details can be found in the Appendix):

- Sector 1: Less Knowledge-intensive services (LKIS)
- Sector 2: Manufacturing industries
- Sector 3: Knowledge-intensive services (KIS)

This aggregation is consistent throughout my time period and is meant to match the task-based framework in Autor and Dorn (2009, 2013) for analysing the allocation of skills to tasks and for studying the effect of new technologies on the labour market and their impact on the distribution of earnings.

Table 4: Sectoral Classification

Less Knowledge-intensive services (LKIS)	Wholesale trade (grocery) Retail trade (grocery) Restaurants and hotels Railway transport Passenger transport by road Freight transport by road Sanitary services Repair of motor vehicles
	Coalmining Crude petroleum and natural gas production Other mining and quarrying Slaughtering, preparing and preserving meat Manufacture of dairy products Grain mill products Manufacture of bakery products Spinning, weaving and finishing textiles

<p>Manufacturing industries</p>	<p>Manufacture of wearing apparel (except footwear) Manufacture of leather and leather products (except footwear) Manufacture of footwear Sawmills, planing and other wood mills Manufacture of wooden furniture and fixtures Manufacture of pulp, paper and paperboard Printing, publishing and allied industries Manufacture of industrial chemicals Manufacture of other chemical products Petroleum refineries Iron and steel basic industries Manufacture of metal products (except machinery and equipment) Manufacture of machinery (except electrical) Manufacture of electronic equipment, machinery and supplies Construction Shipbuilding and repairing Electric light and power</p>
<p>Knowledge-intensive services (KIS)</p>	<p>Communication Banks Insurance Air transport Supporting services to air transport Maritime transport Supporting services to maritime transport Engineering and architectural services Public administration Education services Medical and dental services</p>

5. Empirical Analysis and Results

In the first part of the empirical analysis I will start by looking at wage dynamics and evolutions across sectors for the EU (16 countries) and the US in the last three decades in order to find evidence for wage polarization.

Table 5 : Wage dynamics across sectors US vs EU

Table: US					
Panel A: log hourly wages by sector					
Sector1					
	mean	p10	p50	p90	
1983	1.940974	1.133105	1.988746	2.404947	
2006	2.772428	2.204499	2.777644	3.30541	
% Difference	43%	95%	40%	37%	
Sector2					
	mean	p10	p50	p90	
1983	2.382332	2.076709	2.478533	2.591755	
2006	2.797983	2.446418	2.802103	3.223965	
% Difference	17%	18%	13%	24%	
Sector3					
	mean	p10	p50	p90	
1983	2.176659	1.873793	1.932674	2.723509	
2006	3.159329	2.488452	3.239369	3.679549	
% Difference	45%	33%	68%	35%	
EU					
Panel B: log hourly wages by sector					
Sector1					
	mean	p10	p50	p90	
1983	1.456265	1.02807	1.509077	1.894727	
2006	2.80048	2.389251	2.765274	3.293916	
% Difference	92%	132%	83%	74%	
Sector2					
	mean	p10	p50	p90	
1983	1.454285	1.001318	1.492709	1.8782	
2006	2.887259	2.334956	2.843965	3.477803	
% Difference	99%	133%	91%	85%	
Sector3					

EU				
Panel D: log monthly wages by sector				
Sector1				
	mean	p10	p50	p90
1983	6.599574	6.175875	6.630117	6.630117
2006	7.910147	7.493174	7.857867	8.405339
% Difference	20%	21%	19%	27%
Sector2				
	mean	p10	p50	p90
1983	6.588804	6.132565	6.620379	7.014369
2006	7.992548	7.490172	7.945318	7.490172
% Difference	21%	22%	20%	7%
Sector3				
	mean	p10	p50	p90
1983	7.00754	6.529374	6.985634	7.657275
2006	8.263417	7.703236	8.232835	8.890612

	mean	p10	p50	p90
1983	1.860466	1.37343	1.836663	2.520783
2006	3.1870	2.6564	3.1284	3.7521
% Difference	71%	93%	70%	49%

% Difference	18%	18%	18%	16%
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US Panel C: log monthly wages by sector					
Sector1					
	mean	p10	p50	p90	
1983	7.042696	6.239644	7.081564	7.511938	
2006	7.882998	8.269511	7.888076	8.41584	
% Difference	12%	33%	11%	12%	
Sector2					
	mean	p10	p50	p90	
1983	7.497581	7.1837	7.610299	7.698746	
2006	7.908526	7.55685	7.912534	8.334396	
% Difference	5%	5%	4%	8%	
Sector3					
	mean	p10	p50	p90	
1983	7.285032	6.982167	7.041047	7.831882	
2006	8.269511	7.598884	8.349108	8.790671	
% Difference	14%	9%	19%	12%	

A number of interesting patterns emerge from this preliminary evidence. As can be clearly seen from Panel A in the table above of log hourly wages the US in the period between 1983 and 2006 shows a clear U-shaped pattern in the wage growth of its sectors: with low-skilled services and high-skilled services growing considerably more than the middle sector. On the other hand in the EU the distinctive pattern of wage polarization that we observe in the US does not seem to materialize. The same result is obtained in Panel C by comparing the growth in log monthly wages below, again the US shows wage polarization while this is not the case for the European countries.

In the second part of the empirical analysis, I run a fixed effects model to understand what are the wage inequality determinants. The econometric framework I adopt will thus be the following:

$$\begin{aligned} \log(\text{lowineq}_{50_10})_{it} &= \beta_0 + \beta_1 * \text{productivity}_{it} + \gamma * \text{female_lfp}_{it} + \pi * \text{inflation}_{it} + \\ &\delta * \text{migration}_{it} + \varphi * \text{unemp_rate}_{it} + \chi * \text{EPL} + [\eta * \text{job_polarization}_{it}] + \lambda_t + \mu_i + \varepsilon_{it} \\ \log(\text{lowineq}_{90_50})_{it} &= \beta_0 + \beta_1 * \text{productivity}_{it} + \gamma * \text{female_lfp}_{it} + \pi * \text{inflation}_{it} + \\ &\delta * \text{migration}_{it} + \varphi * \text{unemp_rate}_{it} + \chi * \text{EPL} + [\eta * \text{job_polarization}_{it}] + \lambda_t + \mu_i + \varepsilon_{it} \end{aligned}$$

Note: I have included the *job_polarization* variable in squared brackets since it will be run separately from the specification containing EPL. This is because as shown in one of my previous paper EPL is among the determinants of job polarization in the sense that it mediates the effect of routinization. Having them together we would be looking at the effect

of job polarization net of EPL which would not be consistent since I show that EPL is a determinant of job polarization.

In the specification above $\log(\text{lowineq}_{50_10})_{it}$ and $\log(\text{lowineq}_{90_50})_{it}$ represent respectively the log of the ratio between p90 and p50 and p50 over p10 at time t in country i ; β_0 represents the constant in the model; productivity_{it} is the productivity rate defined as GDP per person employed; female_lfp is the female labour force participation; inflation_{it} are the consumer prices calculated as growth on the same period of the previous year; migration_{it} represents the total inflow of foreign population in a country i at time t ; unemp_rate_{it} is the total unemployment rate; EPL is the strictness of employment legislation in a country i at time t , whereas $\text{job_polarization}_{it}$ for the final specifications is proxied by the index de5 constructed in the previous paper and which represents a job polarization index for a moving window of the past 5 years; λ_t and μ_i are respectively time and country dummies whereas ε_{it} is the error term.

As highlighted in the previous paper a potential source of endogeneity may arise from job polarisation being affected by the initial level of institutions. For this reason in this paper I adopted different specifications which try to look at the effects on inequality separately.

Table 6: Effect of EPL on upper-tail inequality (90/50) and lower-tail inequality (50/10)

	(1) lower_inequality (50/10)	(2) upper_inequality (90/50)
inflation	-0.00223*** (0.000356)	0.0149*** (0.000578)
migration	4.42e-09*** (9.58e-10)	5.01e-08*** (1.56e-09)
productivity	-2.25e-06*** (3.38e-08)	-2.49e-06*** (5.49e-08)
female_lfp	-0.00183*** (2.90e-05)	-0.00299*** (4.71e-05)
unr	-0.00503*** (9.26e-05)	-0.00234*** (0.000151)
EPL	0.00980*** (0.000440)	-0.0127*** (0.000716)
Constant	1.435*** (0.00412)	1.576*** (0.00670)
Observations	9,145	9,145
R-squared	0.532	0.571
Number of years	16	16
R2_adj	0.531	0.570

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Looking first at lower-tail inequality (50/10) we observe that a standard deviation increase in inflation and female labour force participation both reduce inequality by a similar magnitude, the effect of the unemployment rate is also negative, however of a larger size. The coefficient for migration has a positive sign, but its effect is almost negligible, the same can be said about productivity which should reduce lower-tail inequality, but the magnitude is extremely small. Finally analysing our coefficient of interest in this specification we have that employment protection legislation increases lower tail inequality.

Looking at upper-tail inequality (90/50) the effect of inflation has now an opposite sign and a larger magnitude. Female labour force participation which still has a negative sign has also increased in size. Migration seems to increase upper-tail inequality, but its effect is still negligible. The contribution of productivity remains negative and still negligible. Unemployment reduces the 90/50 ratio as well as employment protection legislation which now has an opposite and larger effect than in column (1). The contributions of EPL thus goes in the expected direction but I will discuss this result in more detail below.

Table 7: Effect of job polarization (*de5*) on upper-tail inequality (90/50) and lower-tail inequality (50/10)

	(1) lower_inequality (50/10)	(2) upper_inequality (90/50)
inflation	0.0117*** (0.000621)	0.0325*** (0.000503)
migration	4.07e-09 (3.22e-09)	-6.56e-08*** (2.60e-09)
productivity	-1.82e-06*** (1.33e-07)	-1.24e-05*** (1.08e-07)
female_lfp	-0.000786*** (6.77e-05)	-0.00579*** (5.49e-05)
unr	-0.00353*** (0.000165)	0.00408*** (0.000133)
polarization (<i>de5</i>)	-0.00716*** (0.000330)	0.0105*** (0.000268)
Constant	1.326*** (0.0143)	2.486*** (0.0116)
Observations	3,715	3,715
R-squared	0.534	0.922
Number of years	9	9
R2_adj	0.532	0.922

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In the specification where I replace EPL with job polarization using the index *de5* from the previous paper a very interesting pattern of results emerges. Polarization in column (1) has a negative and significant magnitude, an increase of one standard deviation in our measure of polarization thus reduces lower-tail inequality (50/10). On the other hand, the effect of job polarization on upper-tail inequality (90/50) is opposite and of a slightly larger magnitude. Job polarization thus contributes to more inequality in the upper tail. It is important to highlight that the number of observations drops compared to before since this specification was run over a period of 9 years (2000-2008) rather than 16 years (1993-2008) as in the previous one. However, looking at the R^2 we note that in this specification it almost doubles between column (1) and (2), meaning that job polarization seems to explain much more the increase in upper-tail inequality than lower-tail inequality.

A number of robustness checks have been carried out. To understand whether there is a trend in inequality firstly I applied a forward lag to my measure of polarization the resulting effect being negligible. Secondly, I included linear and quadratic time trends and what I obtain is broadly similar to the specifications above.

Before discussing the results just obtained, let's summarise them with a diagrammatic visualization:

Table 8: Effect of EPL and Job Polarization on Lower and Upper-tail inequality

Contribution from	<i>Lower-tail inequality (50/10)</i>	<i>Upper-tail inequality (90/50)</i>
EPL	Positive	Negative
Job polarization (de5)	Negative	Positive

The first hypothesis *H1* laid out beforehand seems to be confirmed, EPL reduces upper-tail inequality (90/50) while maintaining or increasing lower-tail (50/10) inequality. EPL does reduce upper-tail inequality, this may be due to the fact that the higher strictness is associated with an increased difficulty for employers to fire workers in the middle of the employment distribution which reflects in their wage level being preserved. On the other hand lower-tail inequality is increased, although the effect is smaller in magnitude than for the upper-tail inequality. EPL thus contributes to maintaining the ratio p_{50}/p_{10} since wages of the middle workers are preserved by the strictness in firing and by diminishing the propensity to create temporary jobs at the lower end of the distribution which would likely translate into a decrease in p_{50} .

The second hypothesis *H2* of job polarization increasing upper-tail inequality (90/50) while reducing lower-tail (50/10) inequality is also proven to be correct. Job polarization is associated with a hollowing out of the middle and increases in employment growth at the low and high end of the distribution,

as expected this translates into a corresponding effect in the wage distribution which pushes down lower-tail inequality by reducing the ratio p_{50}/p_{10} and drives up upper-tail inequality by enlarging the ratio p_{90}/p_{50} . The middle thus loses out. For completeness the evolution of the inequality ratios by individual countries has been provided in the Appendix.

The final part of the empirical analysis revolves around the evolution of wage dispersion according to the Varieties of Capitalism (VoC) taxonomy. Splitting the sample for standardised hourly wages *hw3w1us* into the LMEs vs CMEs classification and looking at the evolution over time we can observe that wages in LMEs are much more dispersed than in CMEs. This is further evidence of LMEs harnessing market dynamics over the last three decades, while CMEs having institutional and political factors which constrain more the wage dynamics.

Table 9: Evolution of standardised hourly wages *hw3w1us* in LMEs

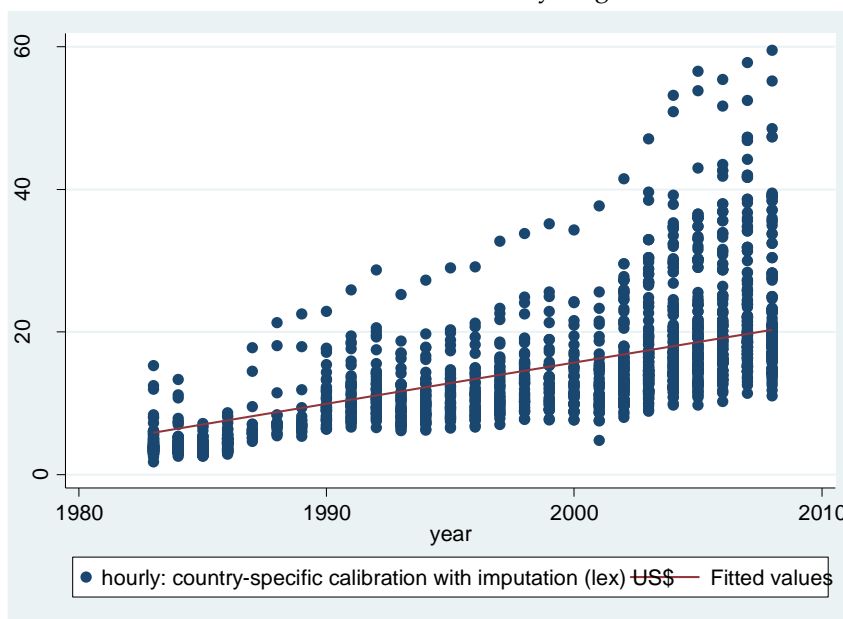
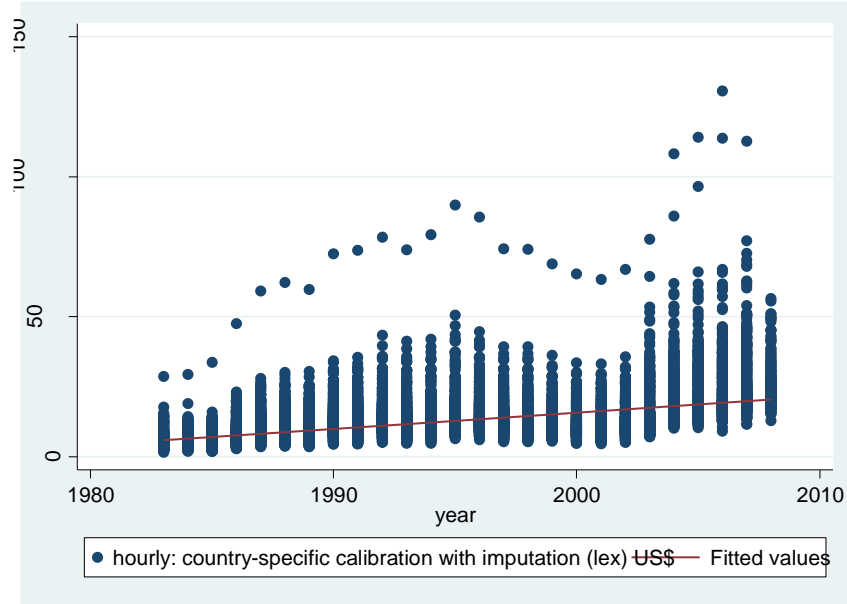


Table 10: Evolution of standardised hourly wages *hw3w1us* in CMEs



The aggregate picture is also reflected at the sectoral level as can be seen from the Tables below, with a dispersion that is present across all sectors.

Table 11: Evolution of standardised hourly wages *hw3w1us* in LMEs by sector

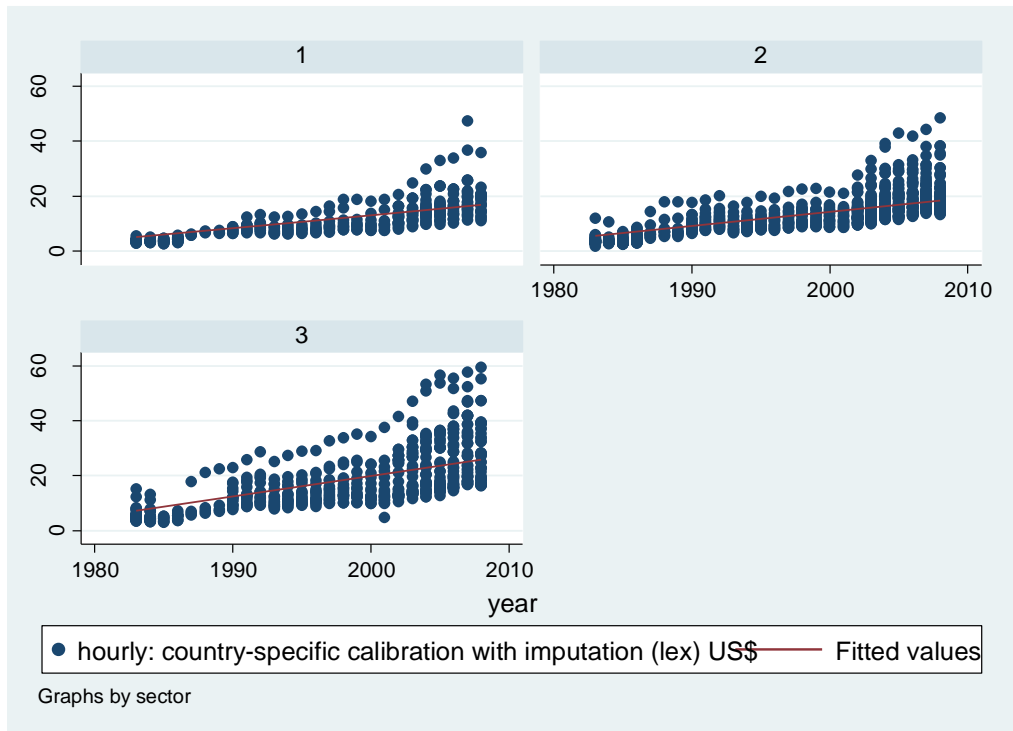
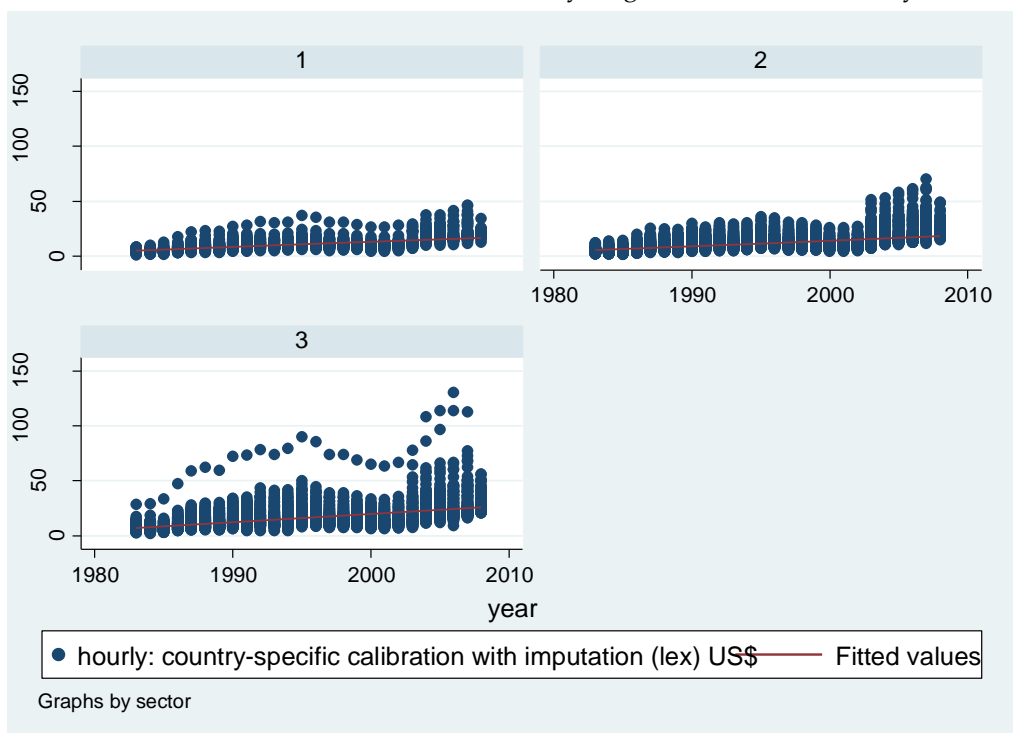


Table 12: Evolution of standardised hourly wages *hw3w1us* in CMEs by sector



In the Appendix a number of additional wage analyses have been provided to corroborate the evidence provided above, including inequality ratios across countries for upper Tail (90/50) and lower tail (50/10) inequality, wage

distributions USA vs EU, evolution of standardised hourly wages *hw3w1us* according to the Esping-Andersen taxonomy.

We can reflect on a number of explanations for the patterns observed so far. In the US the polarisation pattern could have arisen from a demand-led growth in cities as well as a major collapse in unionisation in the middle and a rise in demand for low service workers outweighing displaced routine workers. In the UK we could have experienced a similar pattern however supply side factors such as immigration and family policies increasing labour force participation could have held wages down. In rest of the EU we could have seen immigration and lower demand-led growth in cities relatively to the US, coupled with still higher levels of unionisation, although the evidence in the paper does not seem to give credit to this interpretation and in part upgrading of several middle-skill jobs. It would for instance be important to have a further breakdown in manufacturing to understand how the composition of this category has shifted during the downgrading and upgrading processes. Also, understanding how EPL is associated with retraining/upgrading within CMEs and compared to LMEs would also refine further the findings above. Finally, a further distinction between permanent and temporary jobs and the wage coordination aspect should also become an element of the analysis.

6. Conclusions

The main aim of this paper has been to investigate the effects on wage inequality of both secular trends of technological change, as evidenced by job polarization, as well as institution-based explanations. For this reason the operationalization has been threefold. Firstly it tried to unveil the wage dynamics and evolutions across sectors (defined as Less Knowledge Intensive Services, Manufacturing Industries and Knowledge Intensive Services) for the EU and the US over the last three decades. Looking at both hourly and monthly wages we can observe that the US exhibits a clear U-shaped pattern with low-skilled services and high-skilled services growing considerably more than the middle sector, whereas no sign of wage polarization can be found in the EU: the wage dynamics show that the middle sector has not been hollowed out in terms of wage growth as in the case of the US. Secondly the analysis moved to delve deeper into these aggregate findings through a number of fixed effects regressions of upper-tail (90/50) inequality and lower-tail (50/10) inequality. Based on the results from the previous papers, I first exploit employment protection legislation (EPL) and find that it reduce the 90/10 ratio while increasing the 50/10 ratio. This may be due to the fact that the higher strictness is associated with an increased difficulty for employers to fire workers in the middle of the employment distribution which reflects in their wage level being preserved.

EPL seems to increase the 50/10 ratio, although the effect is smaller in magnitude than for the upper-tail inequality where it has the opposite sign. Middle workers' wages are thus preserved by the strictness in firing and probably by the diminished propensity to create temporary jobs at the lower end of the distribution which would likely translate into a decrease in p50. Job polarization is then used in following regressions (EPL is omitted since we found in Paper 1 that it is one of the regressors of job polarization). The results of the empirical specifications show that job polarization increases upper-tail inequality (90/50) while reducing lower-tail (50/10) inequality. The effect of job polarization is thus the one predicted by the literature, with a wage distribution which sees a reduction in the p50/p10 ratio and an increase in the p90/p50 ratio, however the contribution from the institutional component found above seems to be stronger than in the US case and thus the final patterns are not U-shaped. Finally, the paper has tried to unveil wage dynamics over time according to the Varieties of Capitalism (VoC) taxonomy. After splitting the sample for standardised hourly wages into the LMEs vs CMEs we can observe that wages in LMEs are much more dispersed than in CMEs and this pattern is preserved when looking at the evolution over time. LMEs are thus confirmed to harness market dynamics over the last three decades, while CMEs with a stronger institutional and political component have constrained more wage dynamics. The findings in this paper therefore corroborate the framework by Lemieux(2008) and the

evidence he presented for the US by arguing that where wage-setting institutions are weak, a negative technological change depresses the wage growth in the sector where automation is stronger, instead where they are strong, wages in the middle remain stable despite the same negative demand change.

CONCLUSIONS

Robots are hurting middle class workers and education won't solve the problem
Lawrence Summers, *The Washington Post*, March 2015

This will be a major debate that I suspect will define a large part of the politics of the industrial world over the next decade. Little is certain. But we will do better going forward than backward. That means making America even greater, not great again. And it means embracing rather than rejecting technological progress.

Lawrence Summers – 'Robots are wealth creators and taxing them is illogical'
Financial Times, March 2017

The overarching objective of this thesis has been to investigate the political economy of job polarization developing it along three research fronts. The first paper extends the framework in Goos, Manning and Salomons(2014) by testing the joint effect of routinization and labour market institutions on employment structures in Europe. The evidence provided suggests that the claim of a pervasive technology-induced polarization should be revised in order to comprise a role for the institutional component. In particular, if job polarization operates through routinization, this effect is mitigated by employment protection legislation. On the other hand the interaction effect between routinization and trade unions and separately with minimum wages result not to be significant. My second research work finds that the job polarization experienced by a particular European country in the 5 years before a labour market reform instance is consistently among the strongest predictors of reform activity, as significant as other drivers such as GDP

growth and government net debt. Moreover, a higher degree of job polarization tends to be associated with an increase in deregulation and a decrease in the generosity of the policy measure. The empirical framework is also tested against more conventional taxonomies of welfare capitalism revealing that LMEs tend to harness job polarization dynamics whereas CMEs are incompatible with job polarization which destabilizes the system leading to an increased need for reforms. The final paper asks whether the U-shaped impact on the wage distribution predicted by the job polarization literature has actually materialized in Europe. The findings in this paper show that job polarization increased upper-tail inequality (90/50) and decreased lower-tail (50/10) inequality but that employment protection legislation restrained these wage effects. Through a sectoral comparison I show that wage polarization is therefore a distinct pattern only for the US. Finally, by analysing wage dynamics I find that LMEs exhibit a much wider wage dispersion than CMEs and this is consistent over time.

Main Results

Paper I – Structural Employment Changes and the Disappearing Middle Class

This first paper has investigated the evolution of employment patterns in the European labour markets over the period 1993-2011 and attempted to show that, although the routinization hypothesis remains the most plausible cause of job polarization, it is the peculiar type of institutional framework that

ultimately shapes the distinctive patterns that can be observed. It based its analysis on the European Labour Force Survey(EU LFS) and a number of other sources including the CEP-OECD Labour Market Institutions dataset and followed a methodology which resembles closely the one adopted by Goos, Manning and Salomons(2014). However, it further extended this framework by testing the joint effect of routinization and labour market institutions on employment structures. The results seem to go in the direction of labour market institutions, in particular employment protection legislation, constraining the effect of routinization and therefore delivering job polarization patterns which are heterogenous across countries, rather than a uniform phenomenon as evidenced by Goos et al. (2009, 2014).

The hypothesis *H1* of EPL insulating insiders which dampens down the routinization effect is confirmed by my results. Job polarization operates through routinization, but this effect is mitigated by employment protection legislation. A higher strictness of regulation on dismissals and on the use of temporary contracts thus constrains the job polarization patterns, and making the hollowing out of the labour market more subdued. Hypothesis *H2* of trade unions resisting technology-induced occupational changes is not verified. It may be that trade unions dampen the effect of firing within a firm, thus the slightly positive coefficient, however we could have entire firms going bankrupt because of automation therefore the interaction effect between routinization and trade unions becomes not significant. The last

hypothesis *H3* of minimum wages constraining the growth of low skilled jobs is not confirmed either. Minimum Wages do not exert a significant effect on job polarization patterns when interacted with routinization. When adding the three labour market interactions together, the only significant interaction keeps being the one of employment protection legislation with routinization.

Paper II – *The Routinization of Labour Market Reforms*

This second research work explored whether job polarization has a feedback effect on labour market institutions and policies, so that different degrees of polarization lead to different articulations of institutions at the domestic level, thus reinforcing or altering differences in national models across the European space. This paper thus tries to establish whether there is a relationship between the extent of polarization exhibited by each European country and their specific labour market reform processes. The analysis finds that the job polarization experienced by a particular country in the 5 years before the reform instance is consistently among the strongest predictors of reform activity, as significant as other drivers such as GDP growth and government net debt. This means that the number of reforms is likely to be affected by the polarization pattern observed in the 5 years before, which underscores the persistence of such structural

employment changes. In other words an increased hollowing out of the labour market produces an increase in the number of reforms with a 5y window. Moreover a higher degree of job polarization tends to be associated with more deregulation and a decrease in the generosity of the policy measure. Finally when we apply the Varieties of Capitalism (VoC) classification we can see that the polarization index has a negative and significant magnitude, in other words increased polarization is indeed associated with less propensity to reform in LME countries. On the other hand for CMEs the sign of this variable is positive and significant: higher polarization leads to an increased number of reforms. This corroborates the hypotheses that LMEs are polarization consistent. These countries, by relying on flexibility, they harness market dynamics, thus accommodating changes brought by technological change. Whereas CMEs which are against big changes, especially in the middle of the occupational distribution, are confirmed to be polarization incompatible therefore job polarization destabilizes the system leading to an increased need for reforms. Job polarization leads to an erosion of welfare models through the weakening of the wage setting institutions which are meant to stabilize the system. It is thus interesting to highlight how job polarization seems also to lead to a possible convergence of CMEs towards LMEs, re-opening the age-old debate between convergence and divergence (Kerr, Dunlop,

Fredeirck, Myers, 1960; Goldthorpe, 1984; Streeck & Thelen, 2005) and the more recent conceptualizations with the “dual convergence” thesis (Hay, 2004; Schekle, 2008).

Paper III – Falling Behind: the Decoupling of Job and Wage Polarization in Europe

Finally in my last paper I ask whether the coupling of job and wage polarization, which happened in the US throughout the period 1985-2005, has also occurred in Europe. However, while wage inequality has been on the rise also in Europe this U-shaped impact on the wage distribution predicted by the job polarization literature seems to have not materialized. The findings in this paper showed that job polarization increased upper-tail inequality (90/50) and decreased lower-tail (50/10) inequality but that employment protection legislation restrained these wage effects. This may be due to the fact that the higher strictness is associated with an increased difficulty for employers to fire workers in the middle of the employment distribution which reflects in their wage level being preserved. Job polarization is thus associated with a hollowing out of the middle and increases in employment growth at the low and high end of the distribution, as expected this translates into a corresponding effect in the wage distribution which pushes down lower-tail inequality by reducing the ratio

p50/p10 and drives up upper-tail inequality by enlarging the ratio p90/p50, however EPL has a complete opposite countereffect which prevents wage polarization from occurring. The final part of the empirical analysis revolves around the evolution of wage dispersion according to the Varieties of Capitalism (VoC) taxonomy. Splitting the sample for standardised hourly wages *hw3w1us* into the LMEs vs CMEs classification and looking at the evolution over time we can observe that wages in LMEs are much more dispersed than in CMEs. This is further evidence of LMEs harnessing market dynamics over the last three decades, while CMEs having institutional and political factors which constrain more the wage dynamics.

On the next page I summarise the key elements of this PhD thesis

		Paper One	Paper Two	Paper Three
Question	Research Puzzle	If there is technological convergence among the European labour markets, because of routinization, why then do we still have different levels of job polarization across these countries?	Does job polarization have a feedback effect on labour market institutions and policies, so that different degrees of polarization lead to different articulations of institutions at the domestic level, thus reinforcing or altering differences in national models across the European space?	Has the U-shaped impact on the wage distribution predicted by the job literature materialized in Europe?
	Governing Question	What is the role played by labour market institutions in explaining the diverging patterns of job polarization?	What is the impact of job polarization on the likelihood and direction of labour market reforms?	What are the effects on wage inequality of both secular trends of technological change, as evidenced by job polarization, as well as labour market institutions?
Setup	Data	EU LFS, UKLFS, EU-SILC, the Routing Task Intensity (RTI) index, the Princeton Data Improvement Initiative (PDII) dataset, and the CEP-OECD Institutions Dataset	EU Commission LABREF dataset, fRDB-IZA Social Policy Reforms Database, the construction of the Polarization Indices relies on employment growth measures from Paper One	Occupational Wages around the World (OWW) Database, EU Commission Sectoral Classifications, Polarization Indices from Paper Two
	Empirical Methodology	Regression analysis based on an extension of the model in Goos et al(2014)	Probit regression model	Analysis of wage dynamics and evolutions across sectors and over time, fixed effects regressions of wage inequality ratios
Results	Main findings	EPL is shown to mitigate the effect of routinization, while trade unions and minimum wages do not seem to be significant in resisting technology-induced occupational changes	The erosion of privileged interest representation and a weakened power of intermediation translate into a heightened intensity of labour market reforms and a higher degree of deregulation and decreased generosity of policy measures; LMEs are polarization consistent leading to a lower pressure to reform; CMEs are polarization incompatible leading to an increased reform activity	No evidence of wage polarization in Europe.; EPL reduces upper-tail inequality (90/50) while maintaining or increasing lower-tail (50/10) inequality; job polarization increases upper-tail inequality (90/50) while reducing lower-tail (50/10) inequality
Contribution	Scope/Type	The claim of the labour economics literature of a pervasive technology-induced polarization should be revised in order to comprise a role for the institutional component	Job polarization is consistently among the strongest determinants of reform activity. Findings shed further light on the debate on convergence among welfare regime types	Results show that labour market institutions can play a major role in determining wage inequality patterns

Limitations

A number of limitations have arisen while writing this thesis, here I will group them around three broad categories:

Data Availability

For a research work, which relies heavily on the occupational task framework, I think the most challenging aspect has been to find a satisfying match of the different occupational classifications. The breaks in the data and the several updates have made it difficult to match data not only across datasets (e.g. EULFS and ILO Earnings October Inquiries) but also within the same dataset (EULFS) across time. Additionally, reliance on existing crosswalk files has often resulted in mismeasurement errors and misclassifications, which protracted the data cleaning process. For Paper I, availability of employment data also before 1993 would certainly enrich my analysis given the different technological phases over the last three decades. For Paper II extending the construction of the polarization indices to the period before than 2000 would result in a major improvement and relevance of my findings. In Paper III, I wished offshoring could be used as an additional covariate in the determination of the wage inequality patterns.

Measurement

In Paper I, matching routinization and offshoring indices based on different occupational data has been a daunting task. Moreover, it would be important to explore further the role of full-time versus part-time work. In

Paper 2, the construction of the polarization indices can probably be improved to explore more in detail the different types and how they link to the categories of welfare capitalism. In Paper III because of the mismatch between the occupational wage dataset and my routinization measures, routinization could not be used directly as a measure and job polarization was used instead.

Empirical Methodology

Several improvements could be carried out also on the methodological front. In Paper I could split the countries in high vs low EPL and see whether results are robust within these two subsamples. The same can be performed with high vs low routinization occupations. In Paper II the sample can also be split to understand whether the effect is driven by countries with initially very rigid labour market institutions or you can always be more flexible. An additional robustness check can be done with extensive margins, dummy for any reform and then do linear probability model and probit. For Paper III further robustness checks could include splitting the sample in high vs low epl and high vs low job polarization.

Future Research Agenda and Tentative Policy Recommendations

Moving now to *possible future research avenues* there are a number of considerations to be made. Among the forces driving the future of work – globalisation, demographic and environmental change – technological

disruption is manifesting itself as the most pervasive and impacting. In the transition of industrial nations to intensive knowledge economies, digitalisation is affecting not only the type of jobs needed, but also how, where and by whom they are carried out. The organisation of work, especially more recently with the gig and platform economy, has undergone substantial restructuring or re-orientation. Historical patterns and the economic literature have shown that technological change is disruptive but also brings about opportunities: it creates jobs directly but even more indirectly, makes jobs safer and more interesting with routine and manual tasks absorbed by automation. Hence are we going to be the inadvertent casualties of a technological collateral damage or will digitalisation have a multiplier effect on future employment? My future research agenda builds on this thesis and aims to further understand how the European labour force is being transformed and redefined by technological progress. In particular it could have the following objectives:

- Track changes to the occupational structure, task distribution and forms of work by extending the analysis to the EU28
- Anticipate skill needs, identifying shortages and mismatch and follow the adaption of labour market institutions and policies to technological disruption through activation policies and apprenticeships

- Investigate how to promote quality jobs in a larger policy context which takes into account productivity growth, trade, spending and social policies

Also from a policy perspective, this study could try to move beyond the main responses to technological disruption given until now across the private and public spheres, such as:

- *educational upgrading*, however, when disruption affects also white collar jobs, this solution has severe limitations and can only be part of the answer;
- *redistributive policies*, proposals of taxation for winner-take-all technologies or the introduction of a universal basic income which face severe political obstacles;

and can try to explore a “third way to technological disruption”:

- *technological adoption and diffusion units*, governments to set up an ad-hoc infrastructure to embrace technological change and adopt policies to fully integrate the immigrants from the future (i.e. robots). Early signs of this are currently being put forward by Japan.

Risks being addressed

- How many jobs are really at risk going forward?
- Are labour market and social risks shifting to workers? And do they have the skills for the new and changing jobs?
- Are the current employment relations and social contracts adequate to the evolving forms of work?
- Are labour markets as well as tax and benefit systems pro-actively responding to the opportunities and challenges of digitalisation?
- To what extent is the redefinition of work affecting the sustainability of public and private welfare systems across countries and industries?

As highlighted by recent OECD studies most of the studies carried out in the field of technological disruption assume *all jobs within an occupation are the same and all occupations across countries are the same*. However it is more appropriate to analyse *the task content of each job and not the average tasks of each occupation*. The Survey of Adult Skills (PIAAC) offers this possibility and it is my intention to make full use of this in order to track changes to the occupational structure and forms of work in the EU28. Moreover, it has been pointed out that tasks and jobs can be automated only when there is technological adoption and diffusion. It is therefore crucial when discussing job destruction to *account for jobs that are created directly and indirectly*. Also *jobs themselves change*, hence some precautions have to be taken when interpreting results from previous studies. My research aims to look at these important patterns and investigate which are the possibilities to *compensate any lower demand for labour*.

The most innovative component of my future research agenda could be that through the combination of the datasets presented above it tries to address the question of technology being labour replacing or labour augmenting by overcoming the limitations of several studies in the economic literature which do not distinguish the new forms of independent work or do not take into account the evolution of the definition of work.

Additionally, this study could investigate and advance proposals to address the rising economic and social patterns that are emerging among workers in non-standard work arrangements:

- Less access to social protection and worker rights
- Less access to training
- Weaker career progression
- Limited access to credit and insurance coverage

As Manning (2011) observes “wage inequality and job polarization show that it is time to be pursuing redistribution from the highest-earners to those with middle and lower incomes”. Manning’s key observation is that, while in the last three decades the very richest have seen their incomes significantly pull away from those on low and middle incomes, this phenomenon has not been matched by an increase in the public’s desire to see incomes redistributed by the government. While the level of public distrust for government interventionism in this area is significant and meaningful, we need to think harder about solutions to income inequalities. My research has shown that trade unions in their current form and minimum wages have been slightly ineffective at addressing the transformational consequences of phenomena such as job polarization, but there is certainly a role for labour market institutions to be played. Rethinking wage setting systems and updating employment protection legislations could be the way forward in tackling the future occupational challenges.

Appendix

Paper I Appendix

TableA1: Bargaining coverage, wage inequality, and temporary employment in the 1990s–2000s

	Collective Bargaining: % of Workers Covered		Lower-tail Wage Inequality: Wage at Decile 5/wage at Decile 1			Temporary Employment as % of Total Dependent Employment		
	Early 1990s	Early 2000s	1990	2000	2005	1990	2000	2008
Britain	47	35	1.78	1.81	1.84	5	7	5
Denmark	73	76	1.38	1.47	1.53	11	10	9
Germany	70	60	1.44	1.54	1.63	11	13	15
Spain	70	80	1.95	1.64	1.67	30	32	29
Switzerland	50	50	1.51	1.49	1.47	...	12	13

Sources: Oesch (2013) - Collective bargaining: Visser (2007); wage inequality, temporary employment: OECD, various years

TableA2: Relative wages and job creation in the quintile 1

	Median Wage of Quintile 1 as % of Overall Median Wage		Absolute Job Growth in Quintile 1, 1990-2008 (in %)	Absolute Job Growth in Interpersonal Service Jobs, 1990-2008 (in %)
Britain	65	(1993)	15	47
Denmark	-		(9)	3
Germany	78	(1990)	(12)	0
Spain	68	(1989/90)	19	108
Switzerland	73	(1991)	(9)	9

Source: Oesch (2013) Note: Dataset for Denmark (EU-LFS) does not include earnings.

The following provides details for a measure which was not included in the main analyses but was used as an additional institutional variable:

co_oecd: This is an index of bargaining coordination with range {1,5} taken from OECD (2004), Table 3.5. It is increasing in the degree of coordination in the bargaining process on the employers' as well as the unions' side.

1 = Fragmented company/plant bargaining, little or no coordination by upper-level associates.

2 = Fragmented industry and company level bargaining, with little or no pattern-setting.

3 = Industry level bargaining with irregular pattern-setting and moderate coordination among major bargaining actors.

4 = a) Informal coordination of industry and firm-level bargaining by peak associations;

b) Coordinated bargaining by peak confederations, including government-sponsored negotiations or government imposition of wage schedules;

c) Regular pattern-setting coupled with high union concentration and/or bargaining coordination by large firms;

d) Government wage arbitration.

5 = a) Informal coordination of industry-level bargaining by an encompassing union confederation;

b) Coordinated bargaining by peak confederations or government imposition of a wage schedule/freeze, with a peace obligation.

Paper II Appendix

Bargaining framework at the firm level

A number of models have looked at how different labour market institutions – for instance employment protection versus flexicurity – affect technology adoption in unionised firms. Lommerud and Straume (2007) carry out an analysis cast in a setting of corporate globalisation, where domestic unionised labour face the double threat of labour-saving technological innovations and international outsourcing of domestic production. They look mainly at trade unions' incentives to oppose or endorse the adoption of new technology.

However, it is much less common to look at the other direction of causality: the impact of technological innovation on the balance of power between employers and trade unions, that is likely to affect also the type of labour market reform implemented in a particular country.

The relationship between large employers and trade unions cannot be assessed through a standard competition framework in which wages are determined just by looking at the interplay of supply and demand. Wages as well as other elements are determined instead through a bilateral negotiation process, where the final outcome of this process depends on both parties' inside and outside options. In particular, inside options are the alternatives that both parties have in case of a temporary breakdown in negotiations. One

outside option for employers in our bargaining framework can be the introduction and the ability to quickly implement a new technology, which effectively replaces the workers represented by a trade union. If the implementation of such a technology is more cost effective for the employer in question than the cost of training of his employees this will likely cause a change in the value of this outside option. The technological innovation under certain conditions may also represent an independent choice (labour augmenting), however in this framework it will more likely constitute 'the outside option' to which the employer will resort in order to obtain higher profits.

Elaborating on our simplified framework: initially neither the trade unions nor the employers appear to be price takers, in the sense that they must accept a price set by the other party. This means that neither of the two appears to be in a position to make "take it or leave it offers". Economic principles suggest that in a bilateral bargaining context the bargaining outcome (for example wages) depends on the alternatives (so called outside options) available to both negotiating parties. Typically an agreement is reached if both parties receive some financial benefit above and beyond their outside options. We refer to this financial benefit as a party's share of the bargaining surplus. Outside options are the best alternative profits the parties can earn in the event of a temporary or permanent breakdown in negotiations.

Given the dependence of the bargaining outcome on parties' outside options, all else equal, the less (more) attractive a employer's outside option, the higher (lower) will be the negotiated wage. A similar but reverse relationship holds for trade union –it will receive a higher (lower) wage the more (less) attractive its outside option.

A schematic visualisation of the bargaining framework can be provided by the following:

$$U_E = D_E + b_E (V - D_{TU} - D_E) \quad (1)$$

Equation 1 represents the profit U for the employer. D_E represents the outside option (in our case technology). b_E is the share of the net surplus whereas V is the gross surplus and D_{TU} is the profit of the next best alternative for the trade union.

We will rearrange equation 1 in order to allow an analysis of the impact of a change in the employer's outside option on the bargaining outcome "all else equal"

$$U_E = b_E (V - D_{TU}) + b_{TU} D_E \quad (2)$$

We then consider a change in the employer's outside option, denoted by ΔD_E with all the parameters unchanged. The resulting change in the employer's profit (denoted by ΔU_E) is given by:

$$\Delta U_E = b_{TU} (\Delta D_E) \quad (3)$$

Equation 3 shows that without knowledge of the parameter b_{TU} (that being the trade union's share of the net surplus) one cannot conclude whether an

all else equal change in the employer's outside option would have a large, small (or indeed any) effect on the bargaining outcome .

The simplified framework above aims at studying indirectly the diminishing bargaining power that trade unions may have when it comes to negotiating wages for workers whose tasks can be replaced by the introduction of a new technology. Although in a simplistic way, it looks at the shifting balance of power as a technological innovation becomes available.

Appendix B: Definition of reform direction

Reforms with an increasing direction are defined as follows (a symmetric definition applies to “decreasing” reforms):

- Labour taxation: measures increasing the tax burden on labour.
- Unemployment benefits: measures increasing the generosity of unemployment benefits (replacement rates, duration, coverage) or easing entitlement conditions.
- Other welfare-related benefits: measures increasing the generosity of benefits or easing entitlement conditions.
- Active labour market programmes: measures aiming at increasing the availability, generosity, or effectiveness of ALMPs.
- Job protection (EPL): measures increasing protection against job dismissals: strengthening procedural requirements, increasing notice and severance payments, strengthening the definition of fair dismissal, or restricting the conditions for the use of temporary contracts and temporary agency work. But also, measures increasing rights and working conditions of workers.
- Early withdrawal schemes: measures increasing the generosity of early withdrawal schemes (early retirement or disability benefits) or easing eligibility conditions.
- Wage setting: legislation or agreements tightening framework conditions for wage setting on the part of employers.
- Working time regulation: measures tightening regulatory requirements on working time, increasing rights and conditions of part-time workers, tightening availability of or access to childcare, increasing generosity or duration of parental/paternity/maternity leaves, or increasing access to sabbatical or educational leaves.
- Immigration and mobility: measures tightening regulatory restrictions on migration or reducing support to mobility.

Table VarCap - de5

	(1)	(2)
	LME	CME
gdp growth	0.106 (0.0992)	-0.0544 (0.0498)
log of per capita gdp	0.00127*** (0.000486)	-0.000105 (0.000115)
government net debt	0.305** (0.136)	-0.00824 (0.00937)
unemployment rate	-0.990** (0.478)	0.0902 (0.0782)
inflation	-0.646** (0.272)	-0.116 (0.0835)
trade openness	0.0393	0.00804

	(0.0418)	(0.0165)
polarization index (de5)	-0.955**	0.0490
	(0.433)	(0.0662)
Constant	-58.98**	6.034
	(23.40)	(5.133)
Observations	23	73

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The fRDB-IZA Social Policy Reforms Database

This database has been created as a joint initiative of Fondazione Rodolfo De Benedetti and IZA (Institute for the Study of Labour, Bonn) to collect an inventory on core labour market reforms. It collects information about social reforms in the EU15 countries (except Luxembourg) over the period 1980-2007.

The table that follows helps to have a better understanding of the categorization of the reforms in the database. Two dimensions are considered: size, which can be either discrete or incremental, and scope if it affects only part of the working population (two-tier) or if it is complete.

Share of Manufacturing

The figures for manufacturing as employment share in total economy instead are derived from the OECD-STAN Database which provides annual indicators related to production and employment structure, labour productivity and labour costs, investment, business research and development expenditures and international trade patterns. The data we will

use refers only to 15 EU countries and covers the time-period 1980-2007, although the time coverage may vary across countries and indicators.

Polarization Indices – Construction (*de*, *ind*, *pol*)

As can be observed from the visualizations below, the t-stat ratio of rank and rank² will provide the *de* index. Whereas *ind* will further categorise the type of polarization and *pol* will also consider the significance of this estimation.

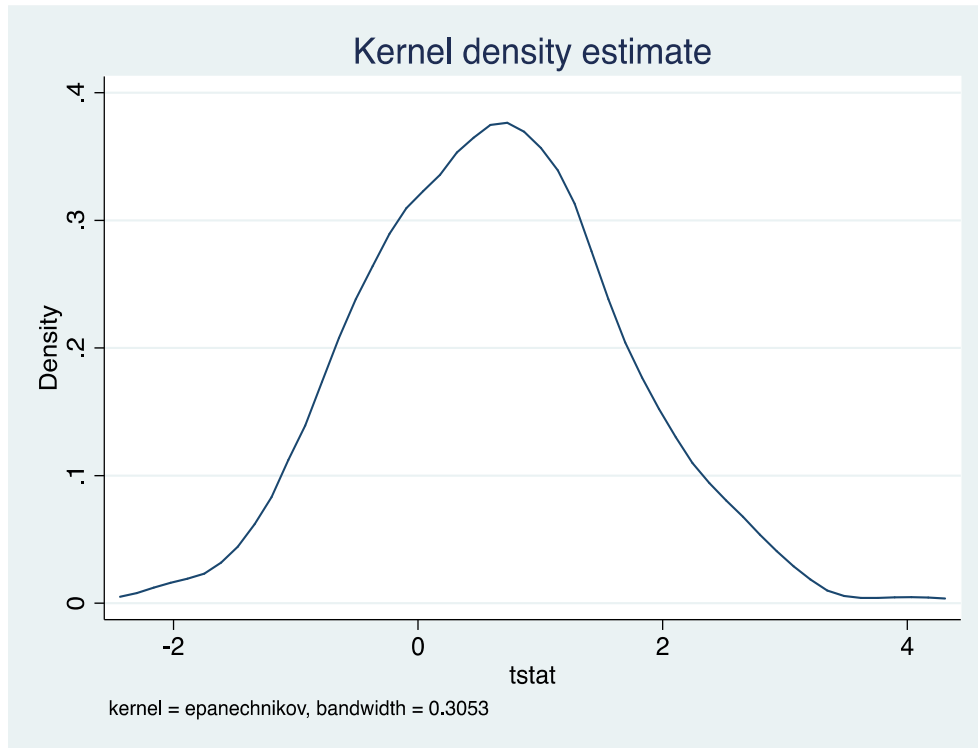
year	coid	parmseq	parm	label	estimate	stderr	dof	tstat (de 3 index)	pvalue	min95	max95	ind3	Significance	pol3
1996		2	1 rank		-0.00196	0.002163	75	-0.90636095	0.367501	-0.00627	0.002345	PP	no	HD
1996		2	2 rank2		3.14E-05	2.18E-05	79	1.4412567	0.153464	-1.2E-05	7.48E-05			
1996		2	3_cons	Constant	0.008704	0.046367	79	0.18771049	0.851585	-0.08359	0.100994			
1996		4	1 rank		-0.00415	0.001977	83	-2.100259	0.038742	-0.00808	-0.00022	PP	yes	PP
1996		4	2 rank2		4.6E-05	2.01E-05	83	2.2938675	0.024325	6.12E-05	8.59E-05			
1996		4	3_cons	Constant	0.090169	0.04145	83	2.1753958	0.032445	0.007728	0.172611			

tstat (de 3 index)	pvalue	min95	max95	ind3	Significance	pol3
-0.90636095	0.367501	-0.00627	0.002345	=IF(I2<0,IF(I3>0,"PP","DG"),IF(I3>0,"UG","NP"))		
1.4412567	0.153464	-1.2E-05	7.48E-05	IF(logical_test, [value_if_true], [value_if_false])		
0.18771049	0.851585	-0.08359	0.100994			

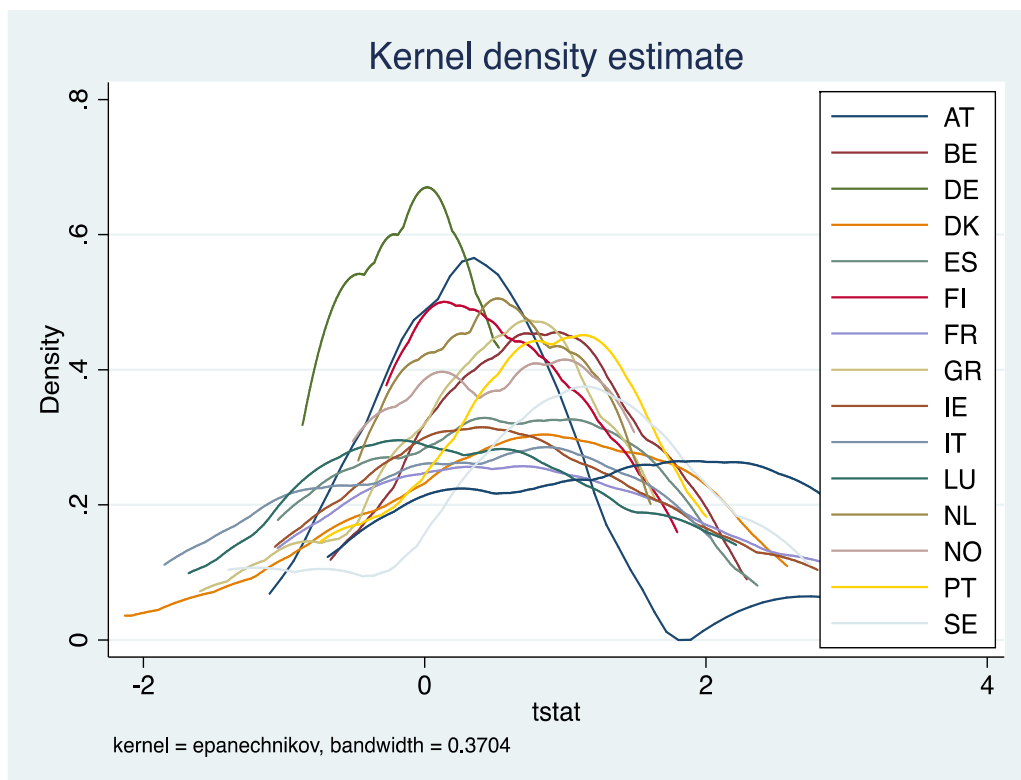
tstat (de 3 index)	pvalue	min95	max95	ind3	Significance	pol3
-0.90636095	0.367501	-0.00627	0.002345	PP	no	=IF(N2="yes",M2,"HD")
1.4412567	0.153464	-1.2E-05	7.48E-05			
0.18771049	0.851585	-0.08359	0.100994			

Polarization index - de – Kernel density estimates

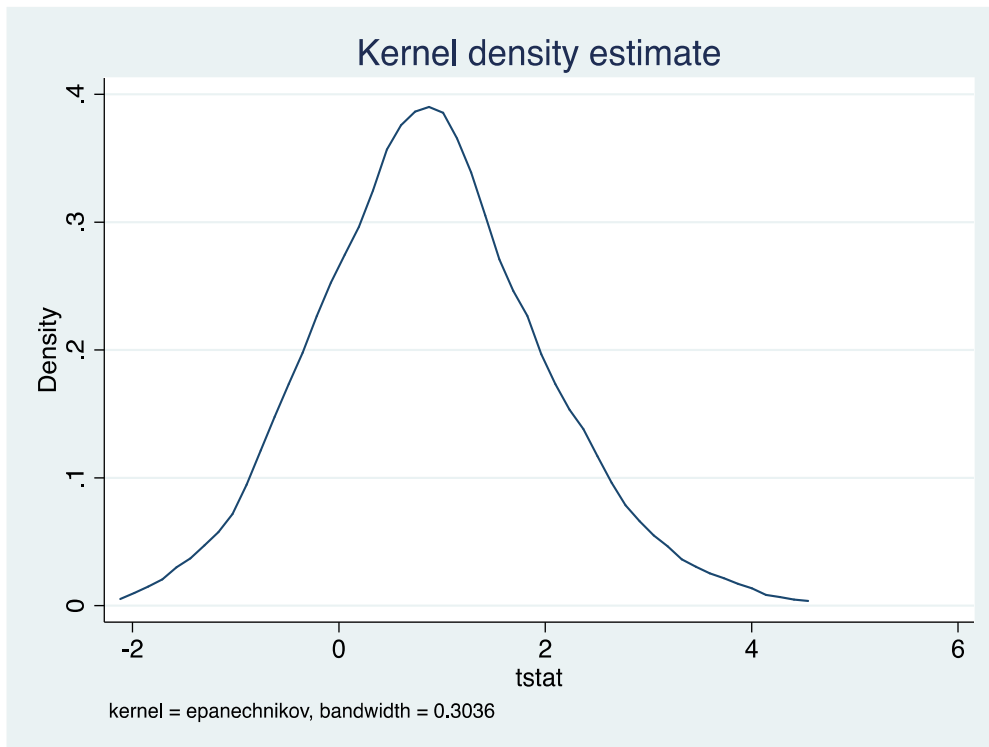
de3 Whole sample



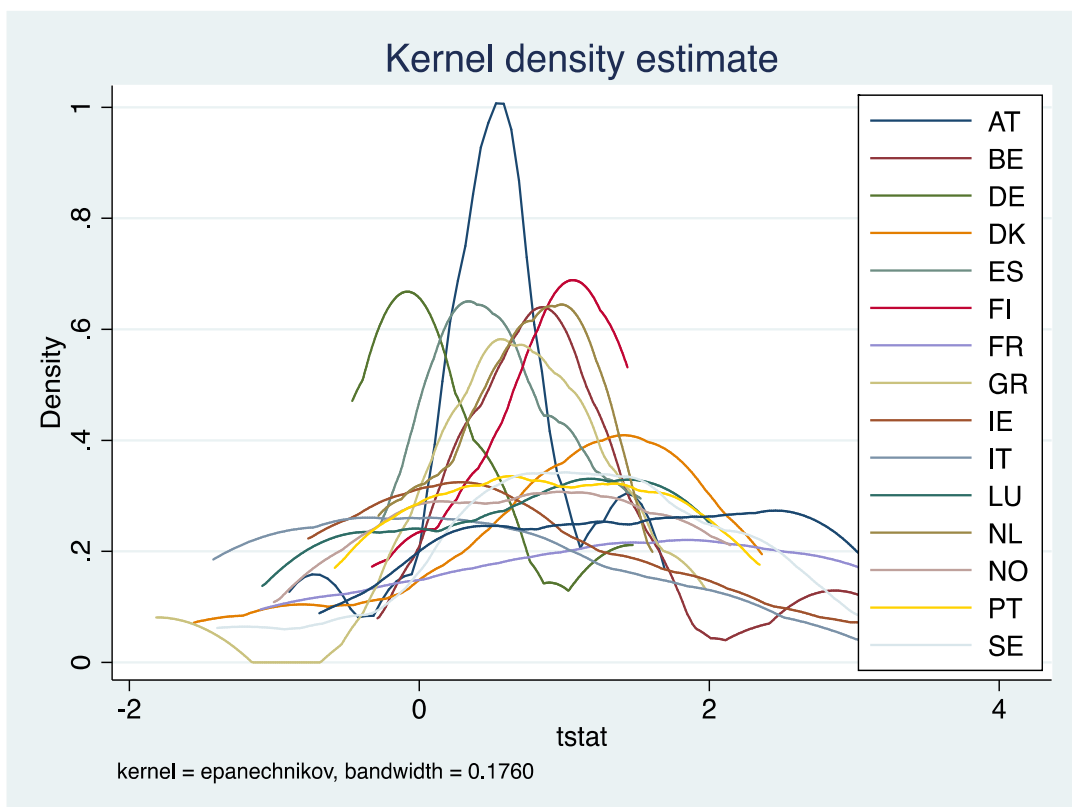
Individual countries



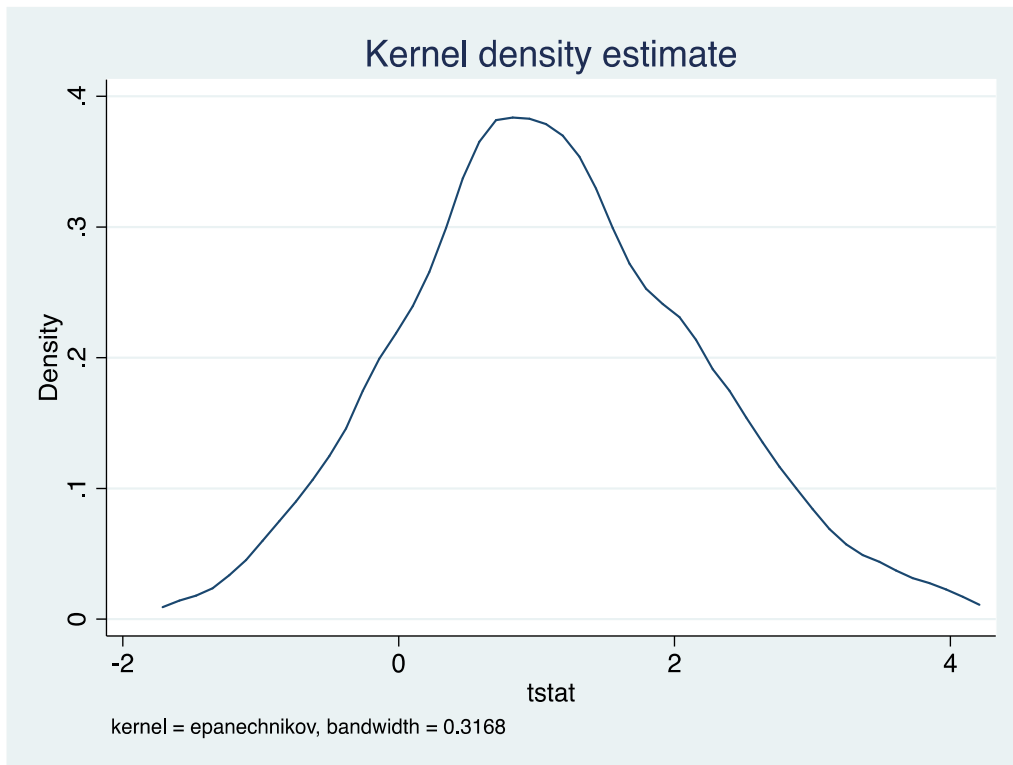
de5 Whole sample



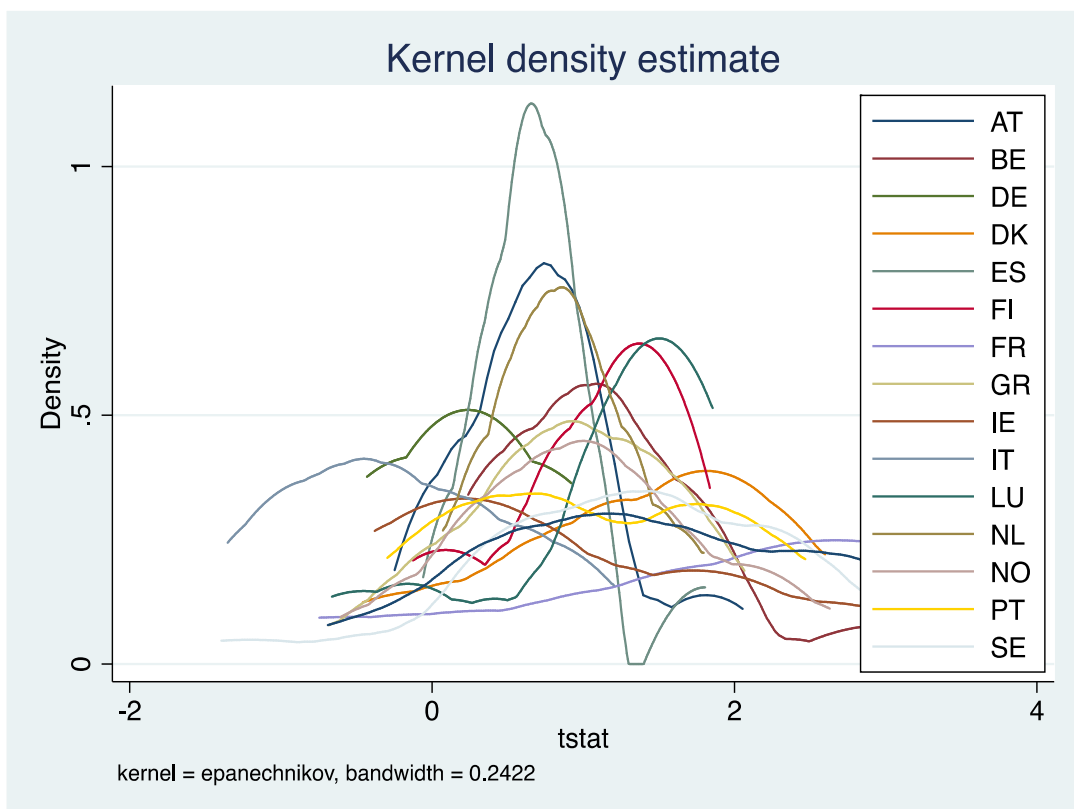
Individual countries



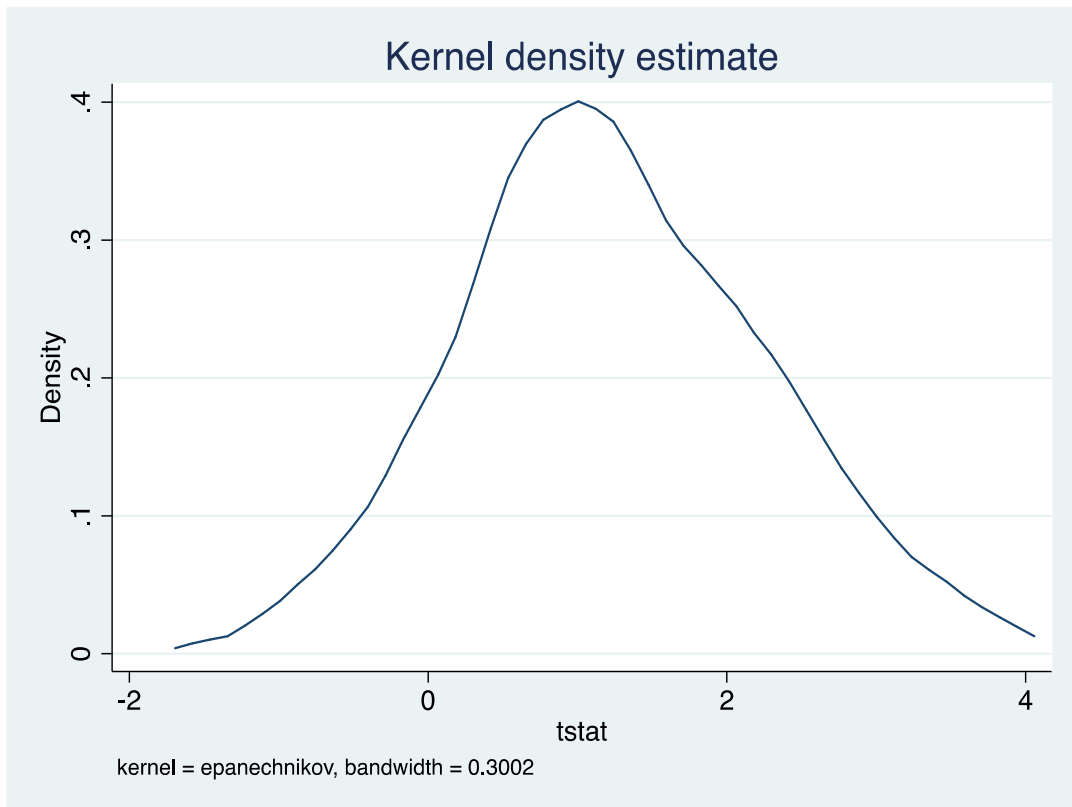
de7 Whole sample



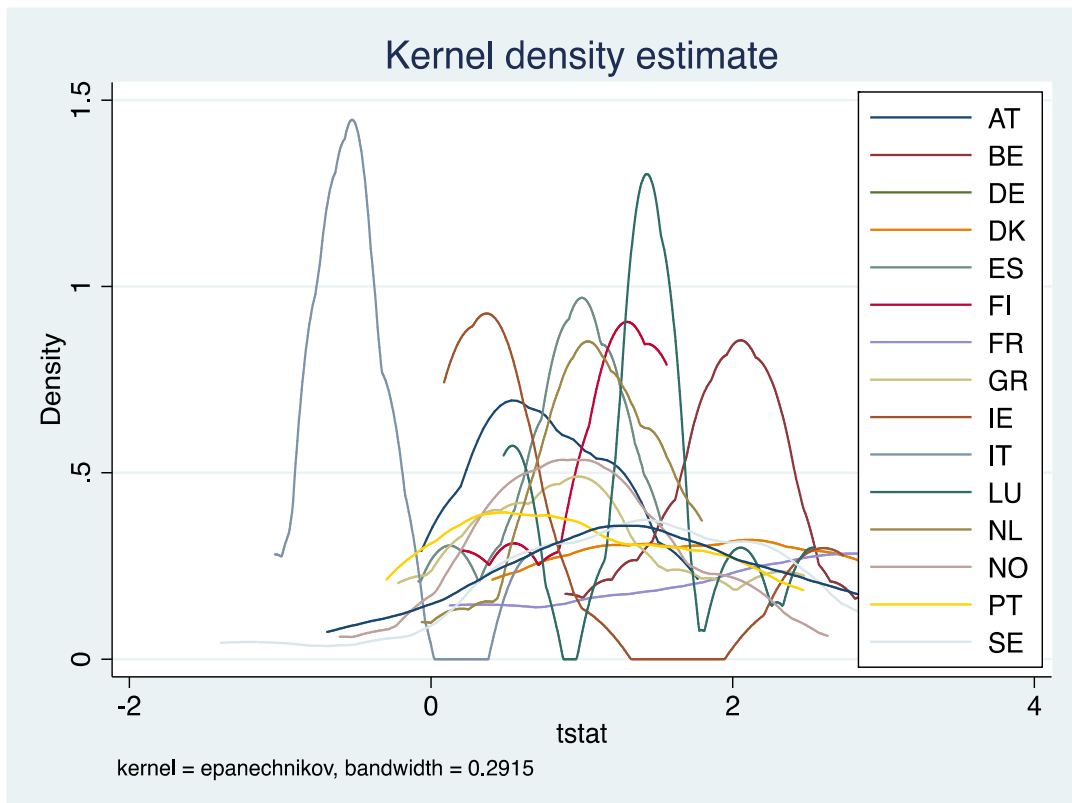
Individual countries



de10 Whole sample

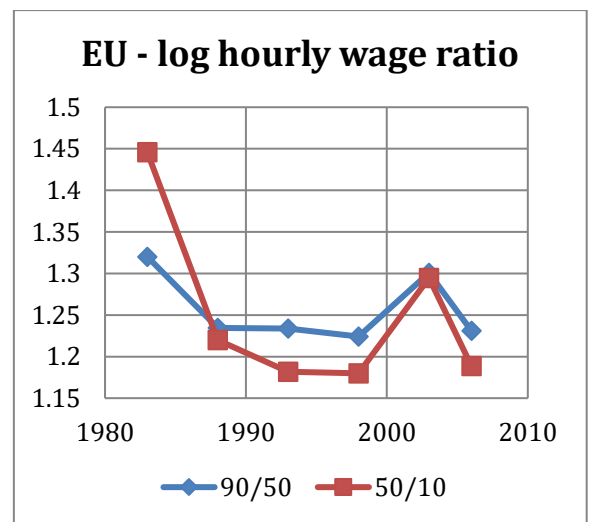
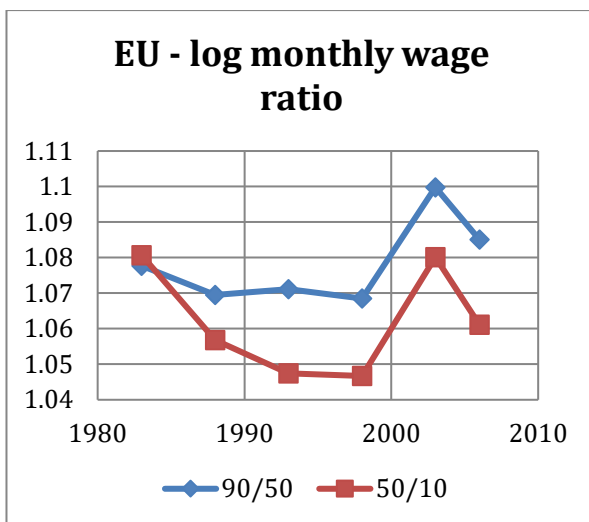
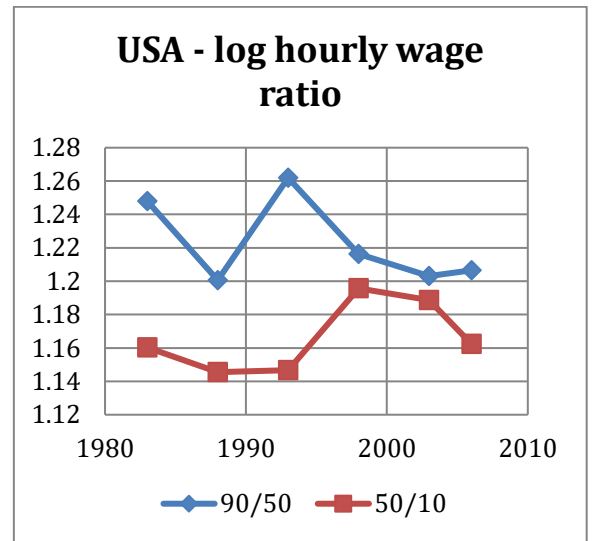
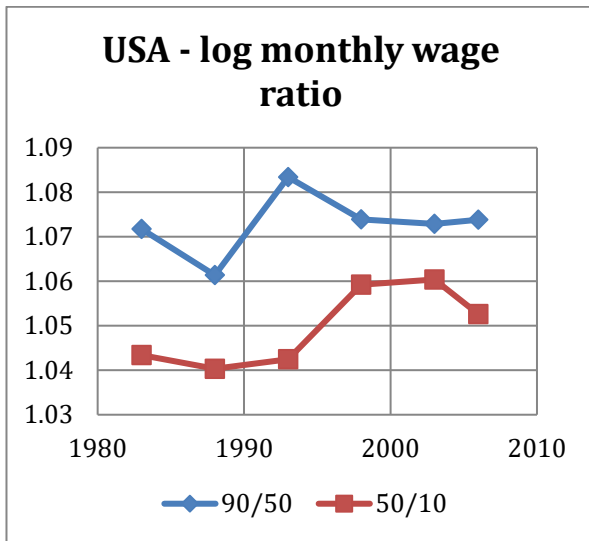


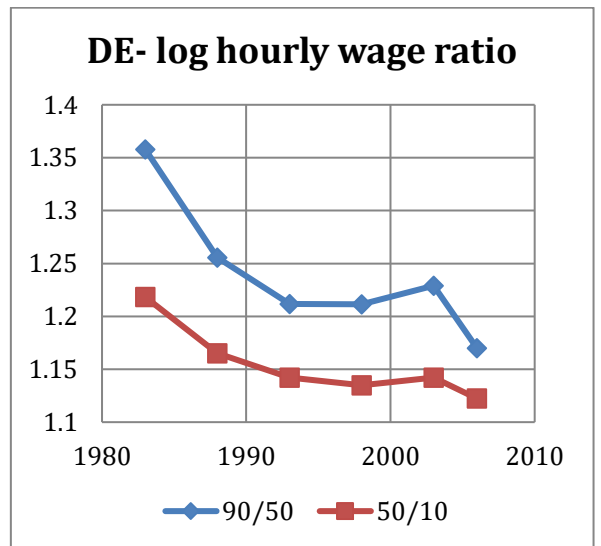
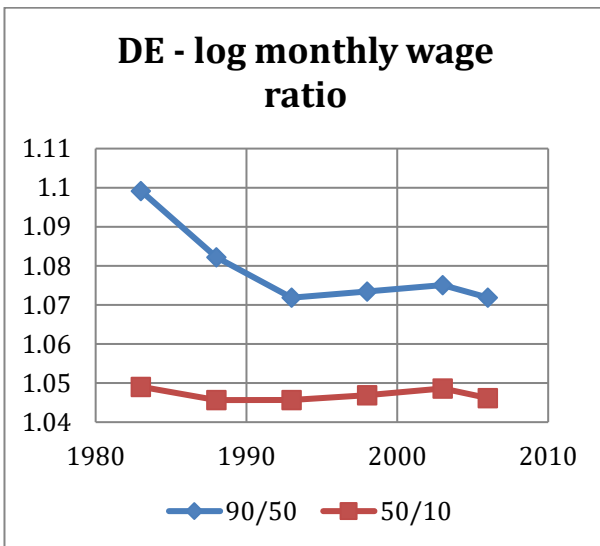
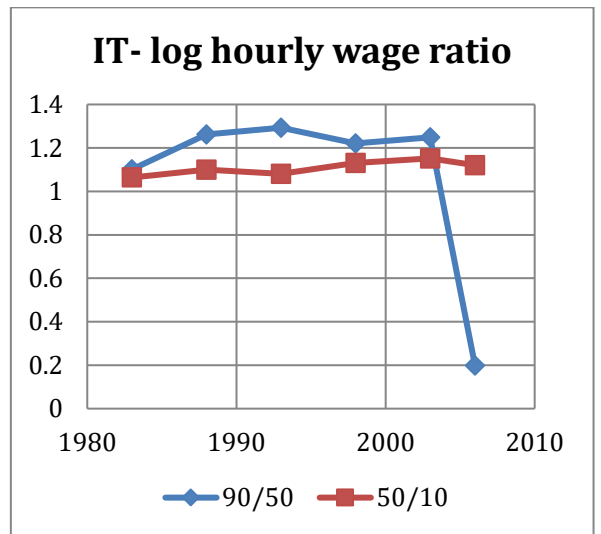
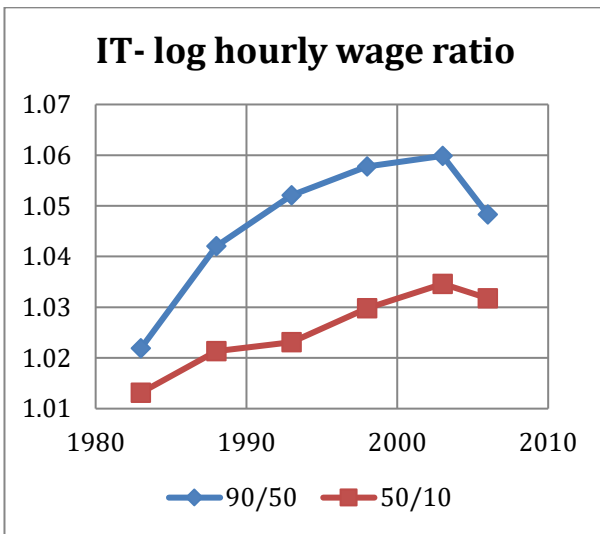
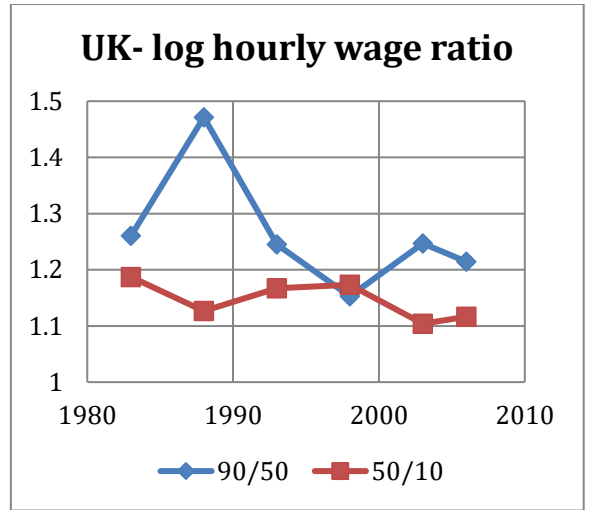
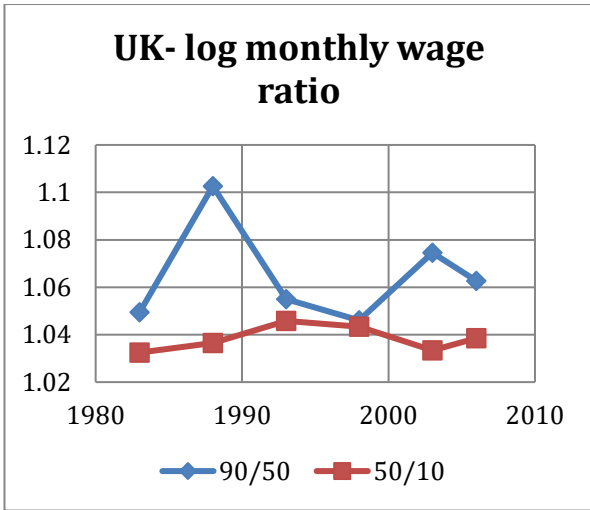
Individual countries



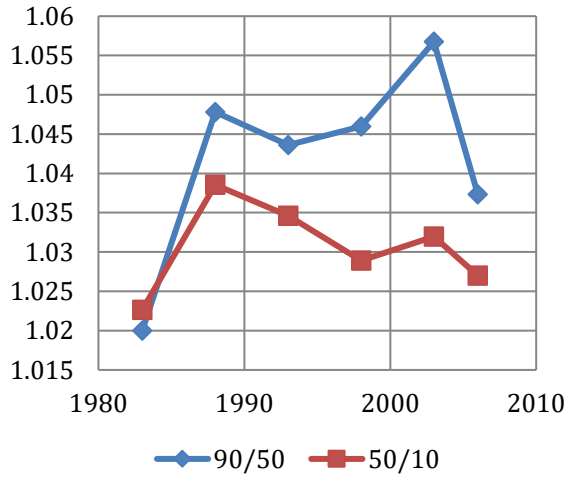
Paper III Appendix

Inequality ratios – Upper Tail (90/50) and Lower tail (50/10)

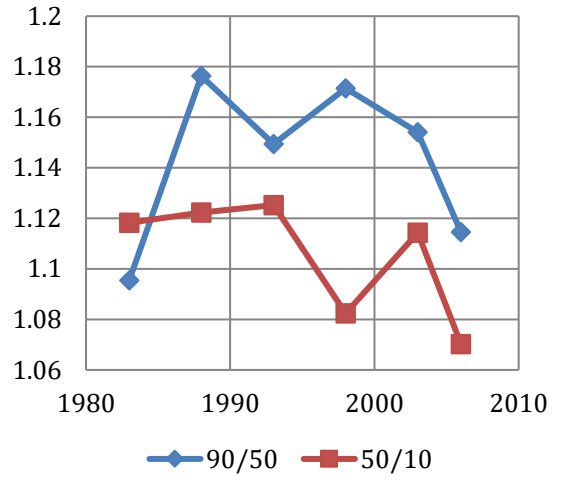




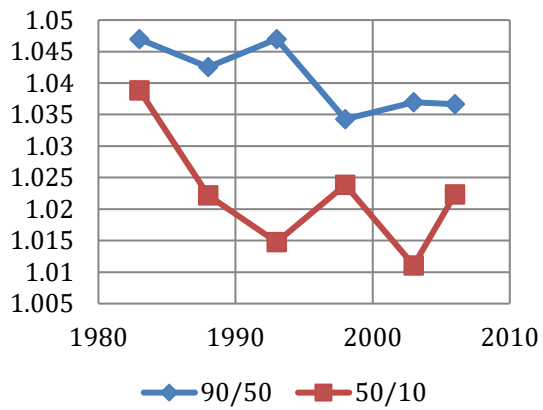
FI - log monthly wage ratio



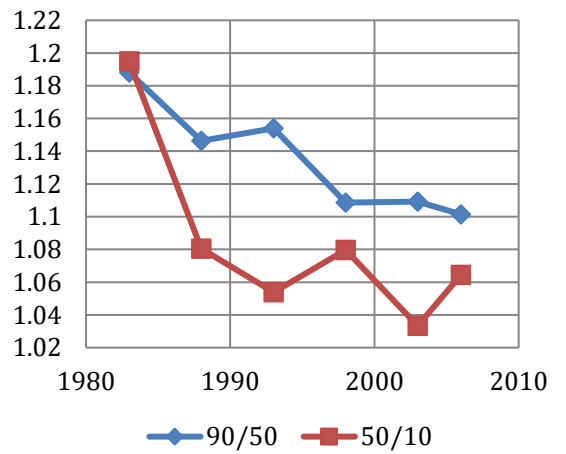
FI - log hourly wage ratio



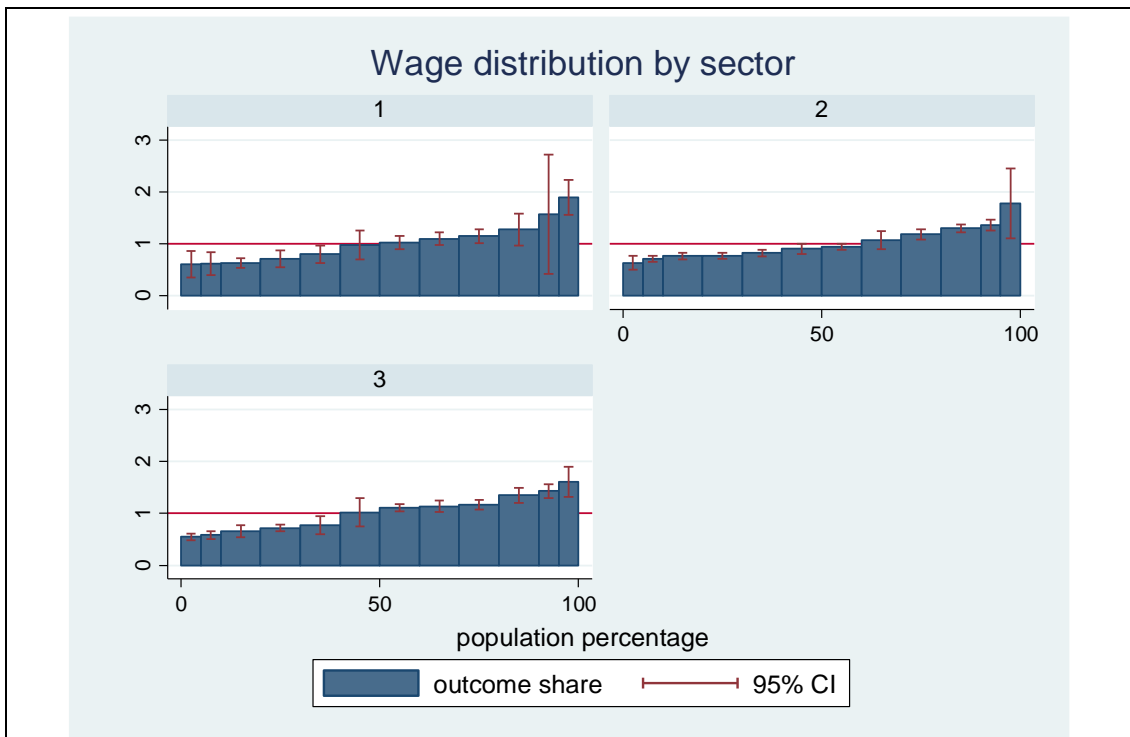
NO - log monthly wage ratio



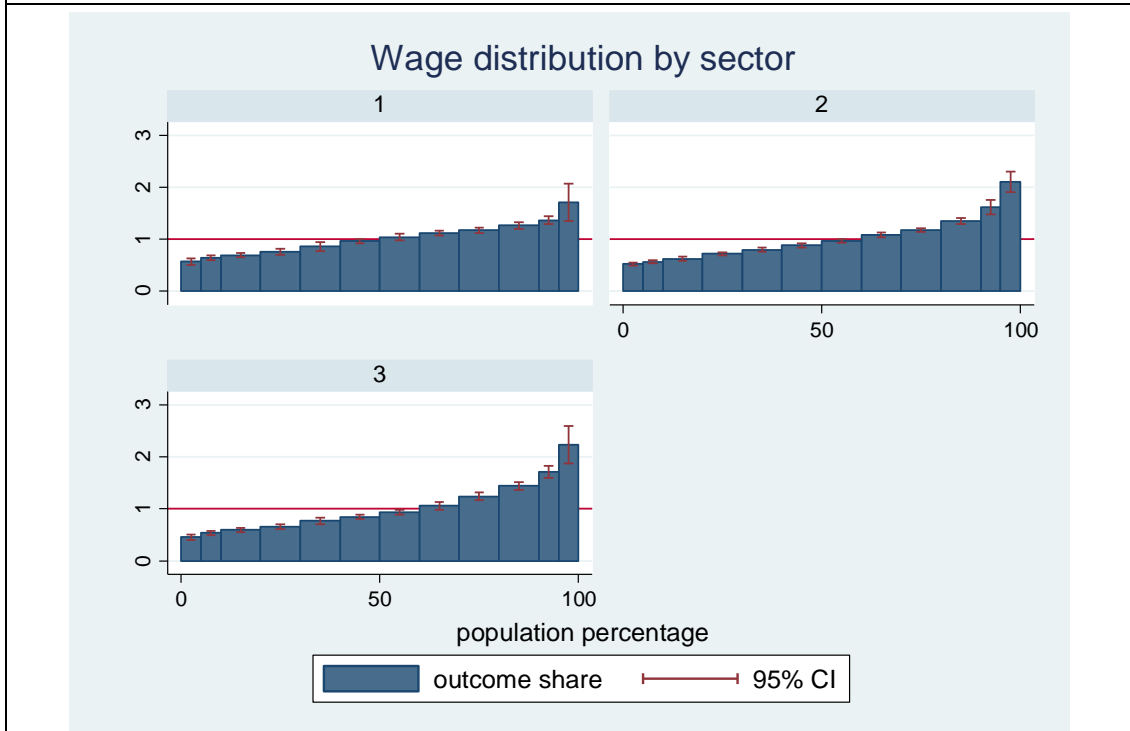
NO - log hourly wage ratio



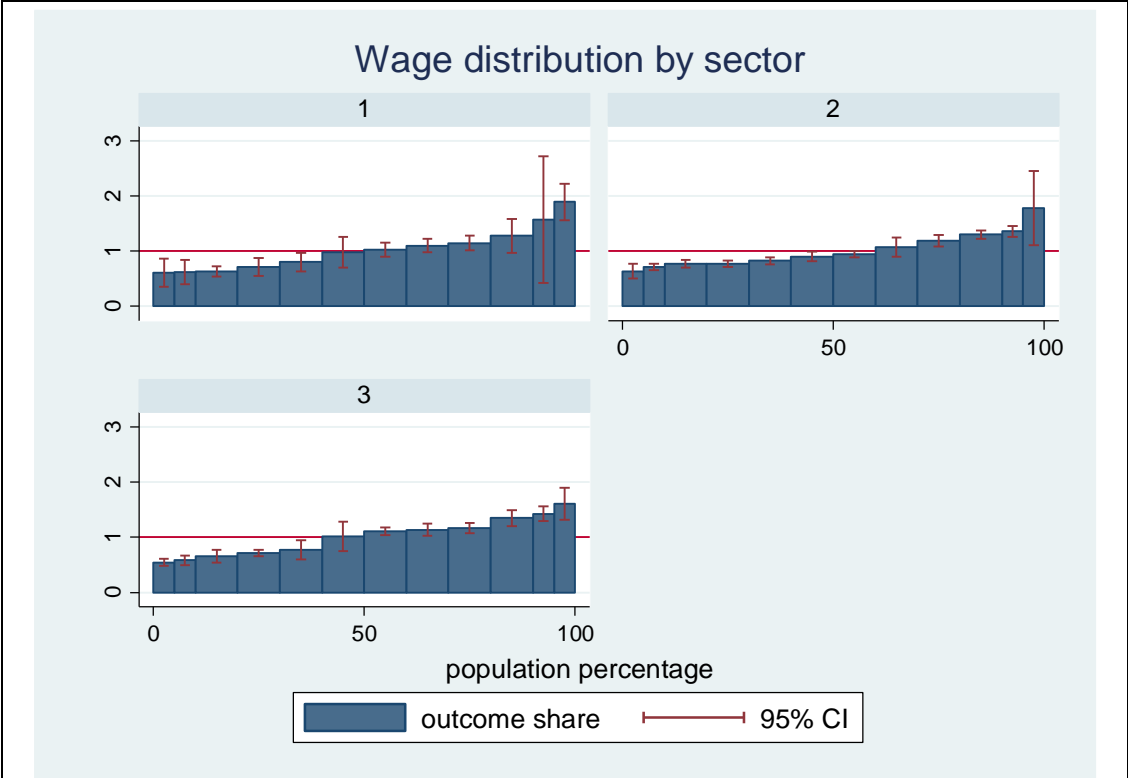
Wage distributions USA



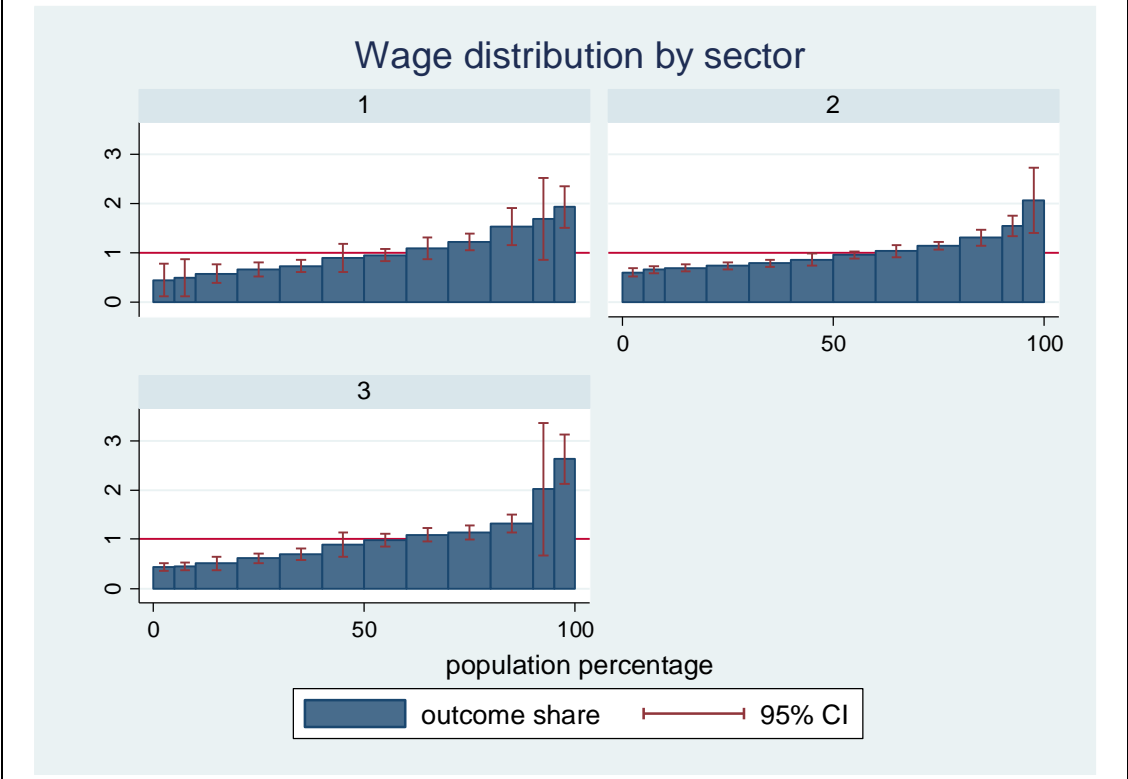
Monthly 1983



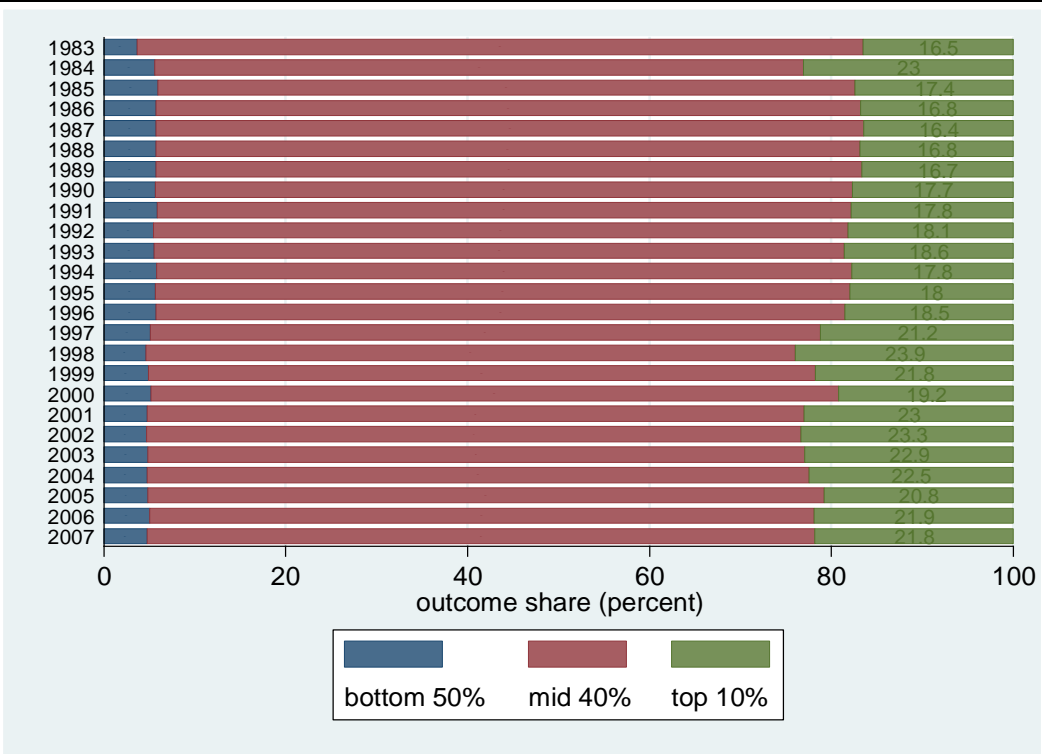
Monthly 2008



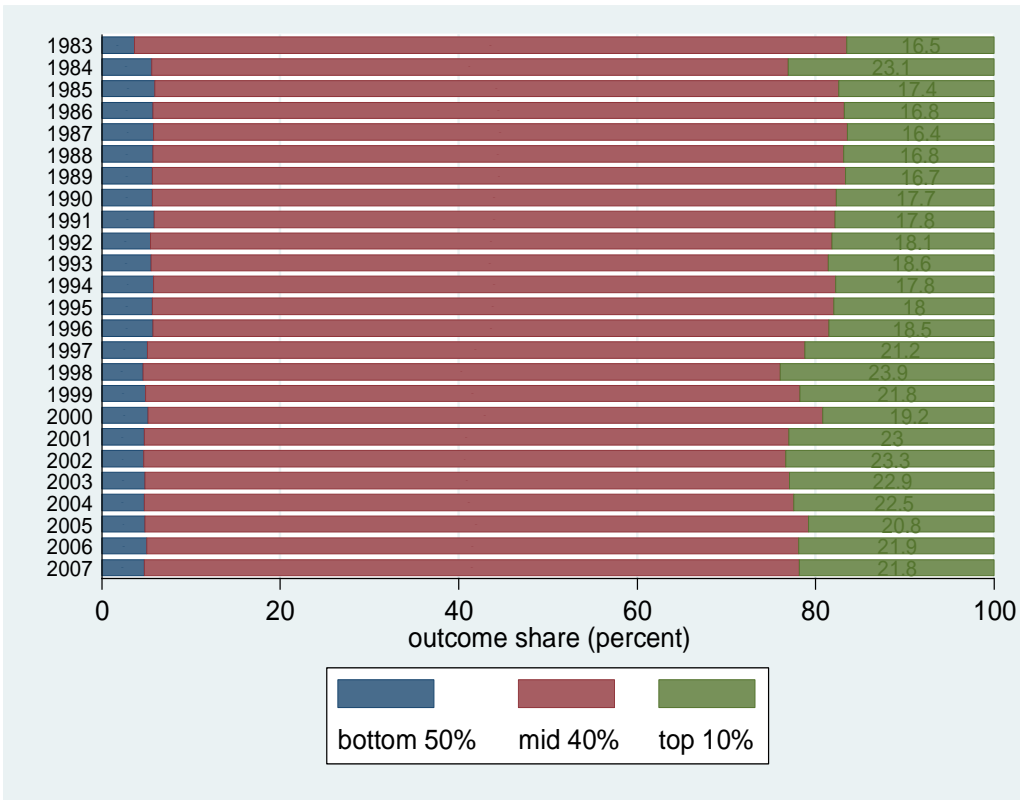
Hourly 1983



Hourly 2008

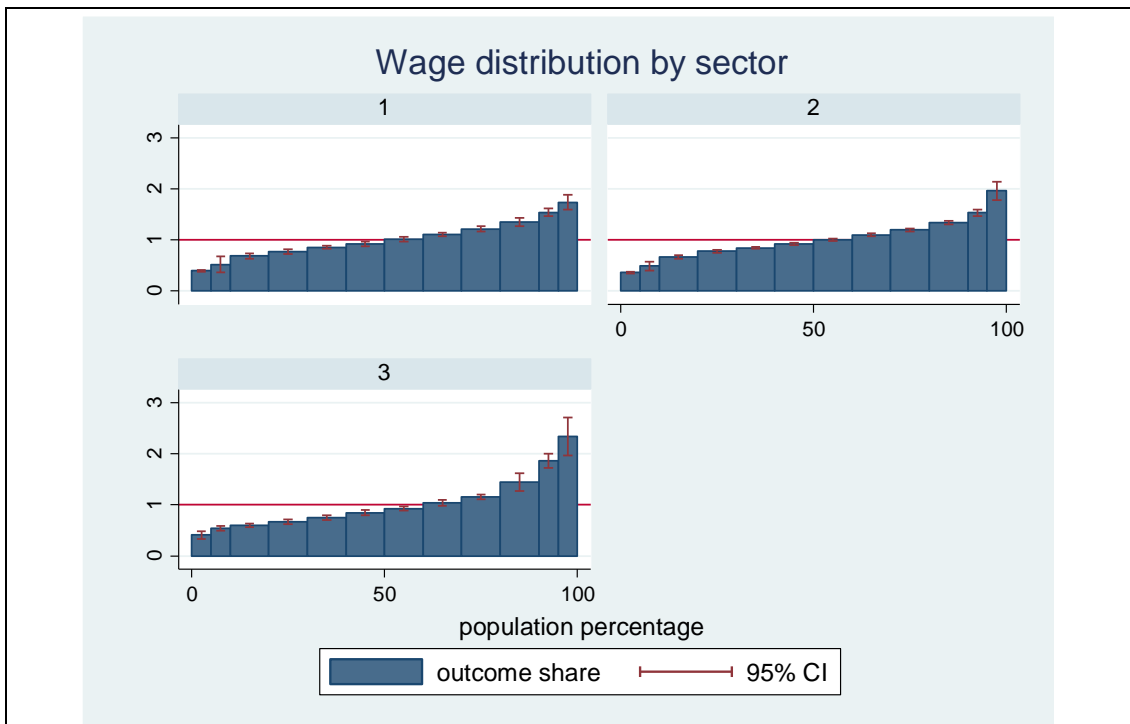


Monthly

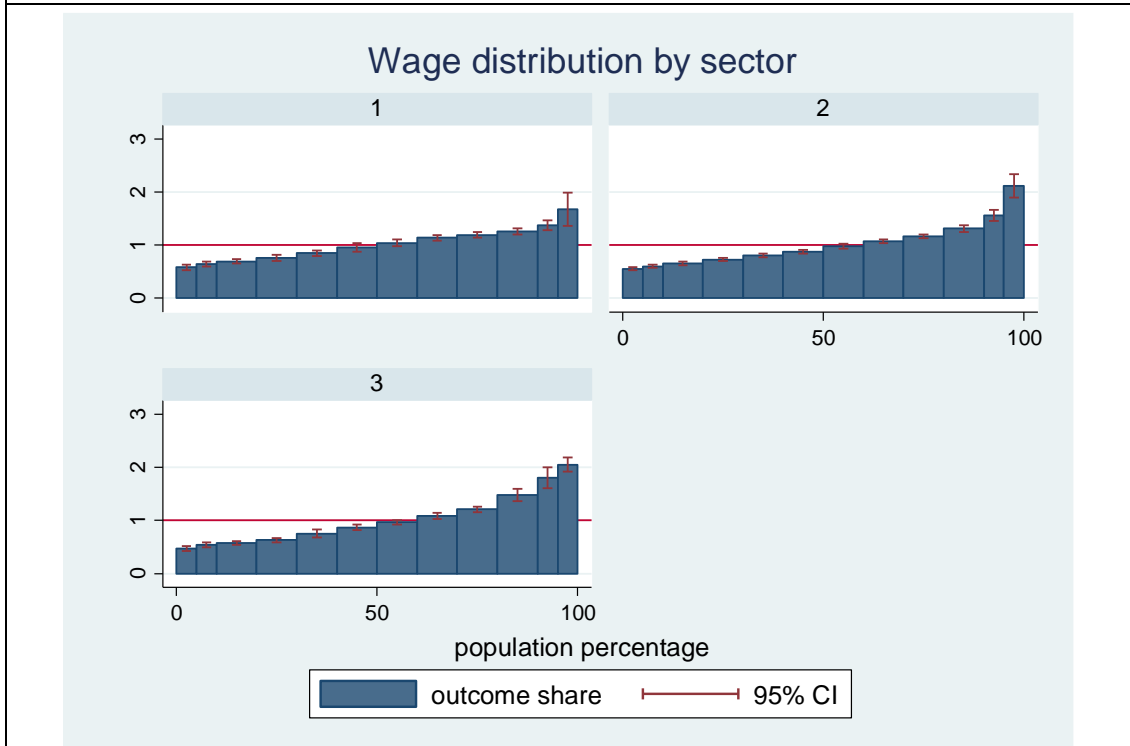


Hourly

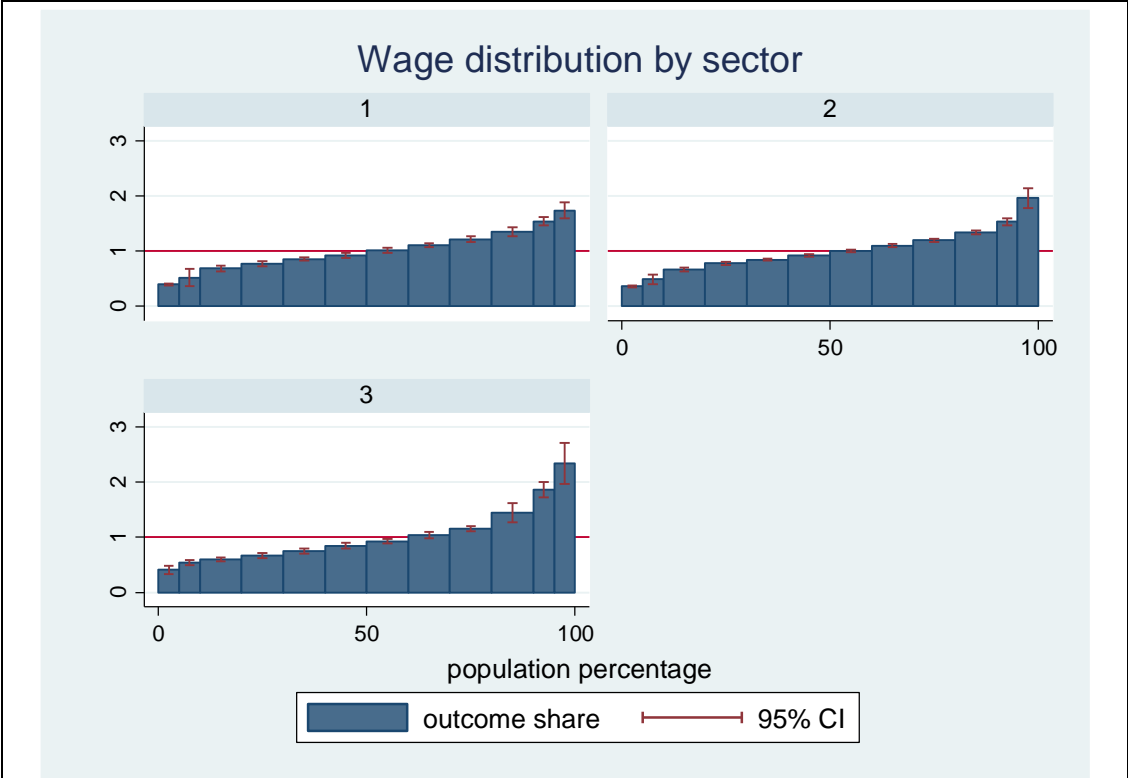
Wage distributions EU



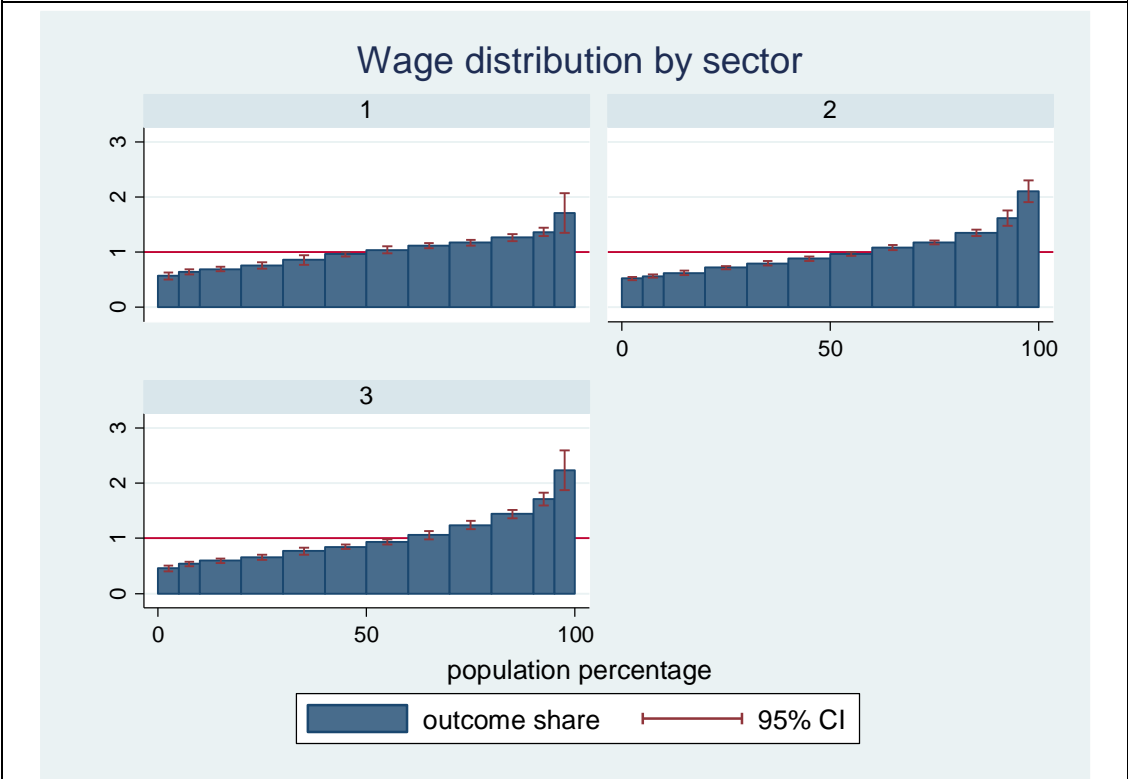
Monthly 1983



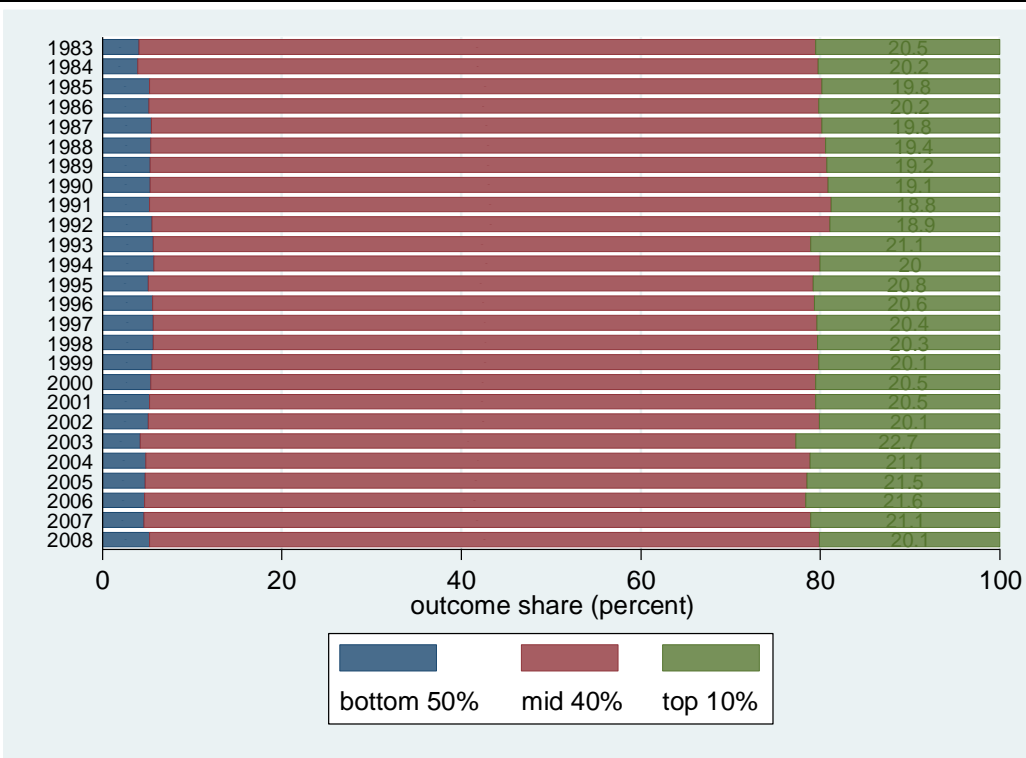
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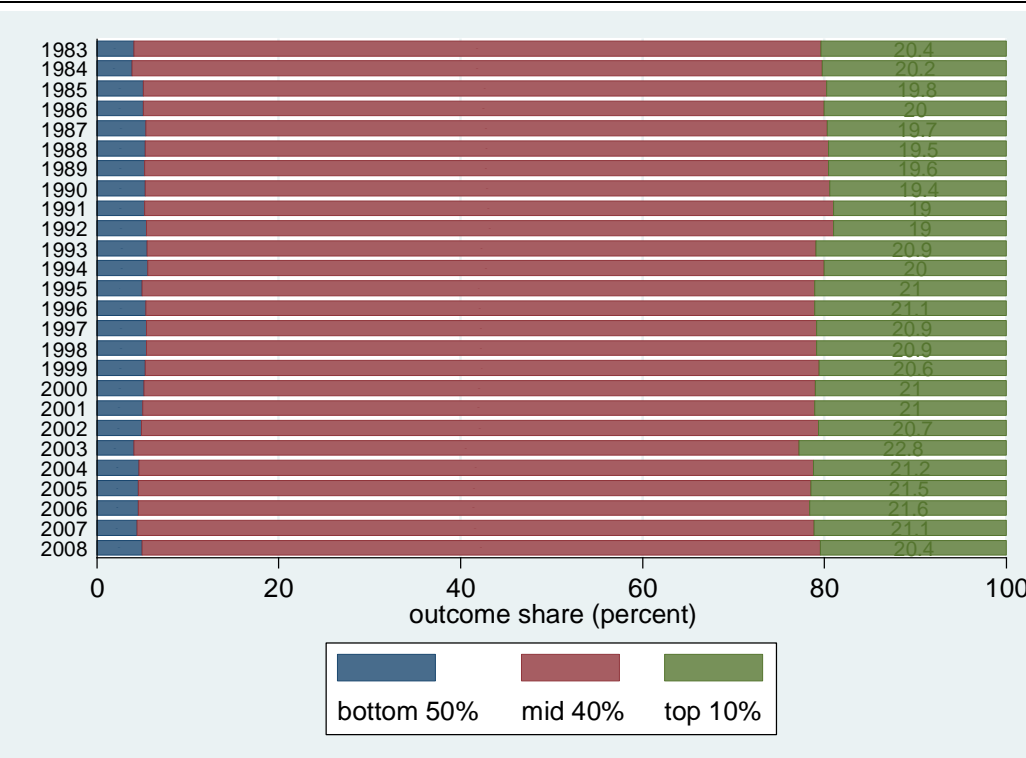
Monthly 1983



Monthly 2008

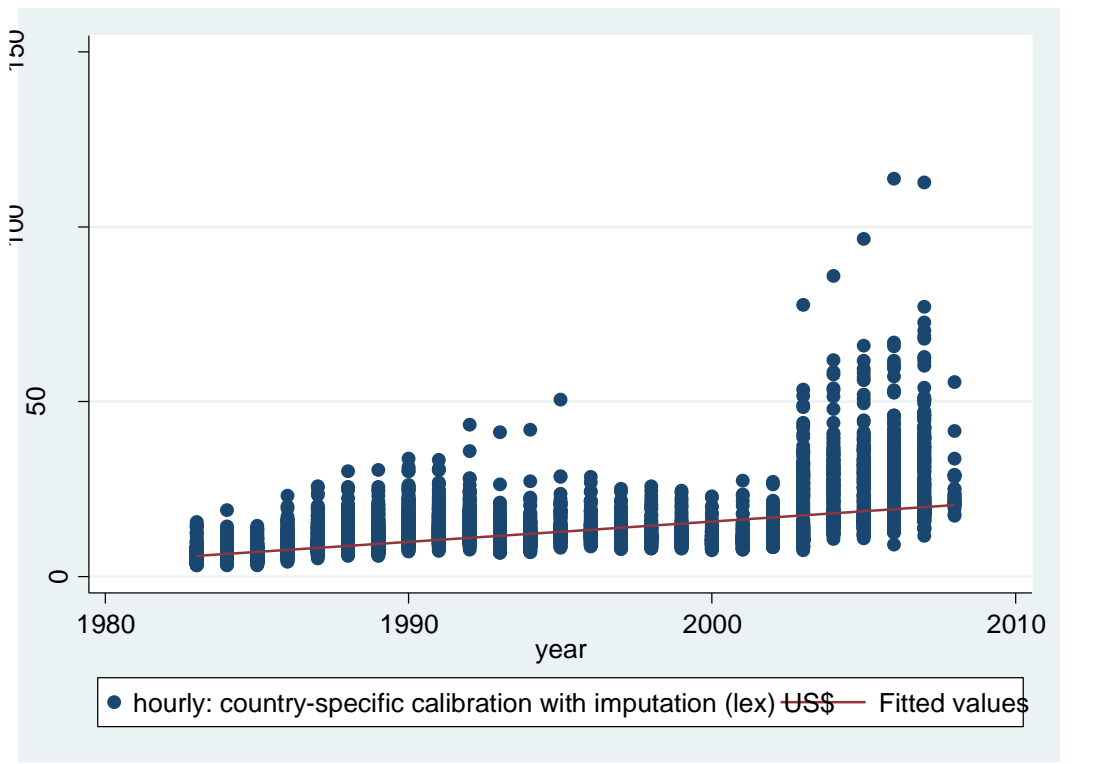


Monthly

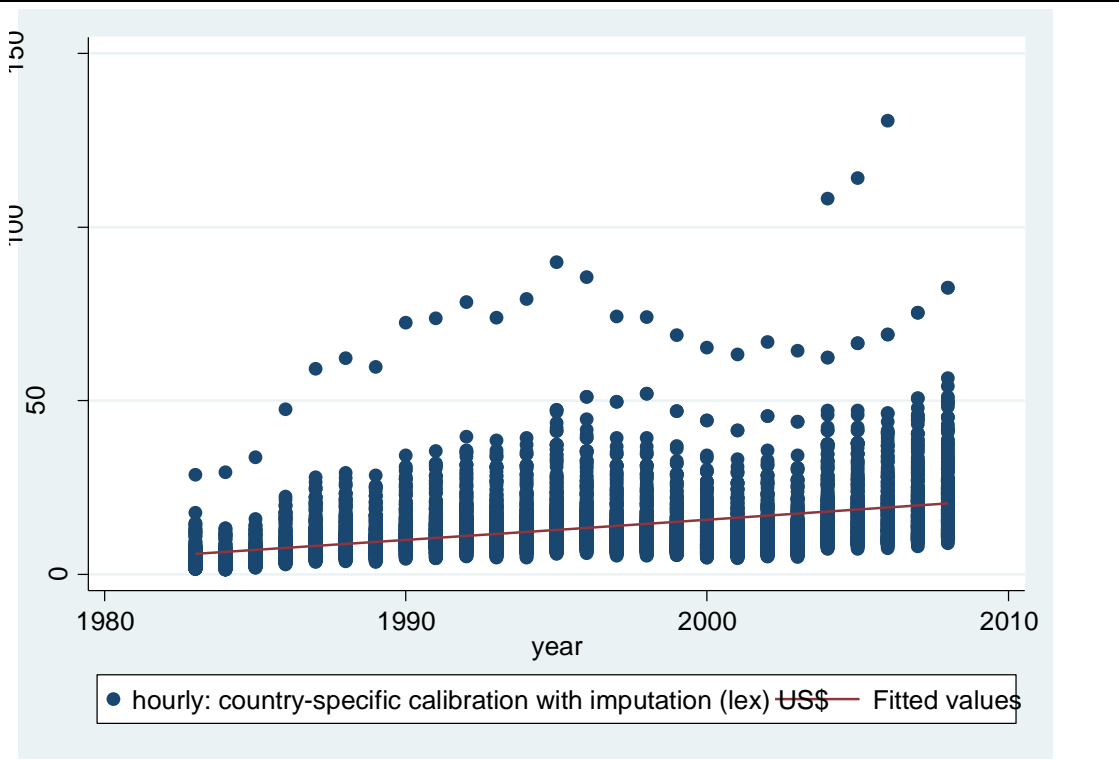


Hourly

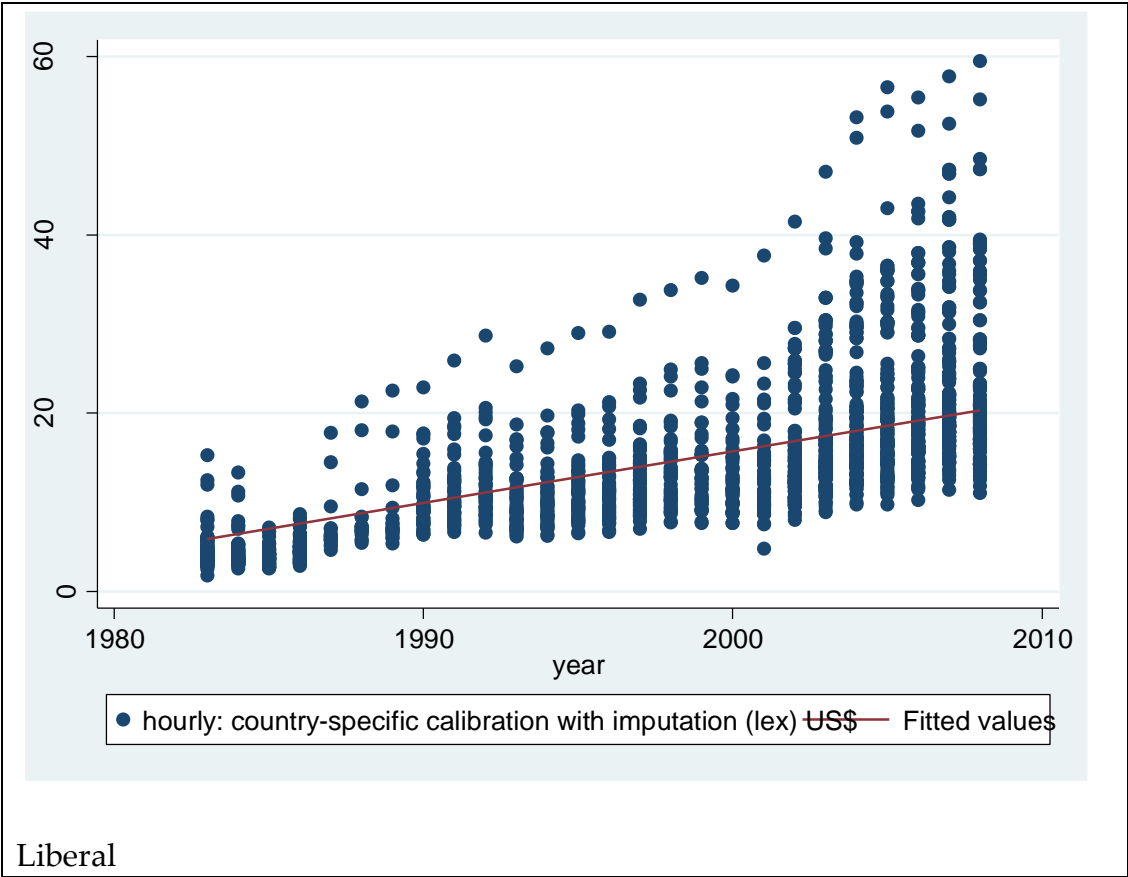
Evolution of standardised hourly wages *hw3w1us* according to the Esping-Andersen taxonomy



Social Democratic



Continental



Liberal

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