Job Market Polarization and Employment Protection in Europe

Polarizace trhu práce a ochrana zaměstnanosti v Evropě

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Abstract

There is increasing evidence about polarization of national labor markets with employment and wage growth occurring in low- and high-skill occupations, but not in middle-skill occupations. As polarization has been documented mainly for Anglo-Saxon countries, there is little evidence and discussion on cross-country differences in this process. I fill this gap by analyzing job polarization in 12 European countries using an occupational skill-intensity measure. Findings suggest large cross-country differences in the extent of polarization, which correspond to variation in educational attainment growth, industrial structure, and dissimilarities in employment protection legislation. The latter is particular important, as employment protection limits the possibility to adjust workforce in response to technological change and thus dampens the polarization effect. This finding indirectly confirms existing theories explaining polarization: routinization and off-shoring. Finally, it provides prediction for policy makers about future development of social and labor market inequalities, if policies toward more flexible labor market regulation are implemented.

Keywords

polarization, employment protection, skill requirements, occupational structure

Abstrakt

Existující empirická evidence stále více poukazuje na polarizaci národních trhů práce, která se projevuje zvyšující se zaměstnaností a mzdami u neodborných a vysoce odborných zaměstnání, ale ne u středně odborných zaměstnání. Polarizace je zdokumentovaná v řadě anglosaských zemí, nicméně srovnání trendů mezi zeměmi není zatím analyzováno. V tomto výzkumu zaplňuji tuto mezeru a analyzuji polarizaci v 12 zemích EU pomocí míry náročnosti zaměstnání na dovednosti. Moje zjištění ukazují velké rozdíly mezi zeměmi v rozsahu polarizace, což koresponduje s rozdíly v míře vzdělanosti, v průmyslové struktuře a s mírou ochrany zaměstnanosti. Poslední faktor je zejména důležitý, protože míra ochrany zaměstnanosti limituje možnosti přizpůsobit pracovní sílu technologickým změnám a tím tlumí efekt polarizace. Tato zjištění nepřímo potvrzují existující teorie vysvětlující fenomén polarizace: rutinizace a tzv. off-shoring. Moje zjištění jsou také důležitá pro tvůrce hospodářské politiky, jelikož predikují budoucí vývoj nerovností na trhu práce, pokud se budou implementovat flexibilnější regulace trhu práce.

Klíčová slova

polarizace, ochrana zaměstnanosti, nároky na odbornosti, struktura zaměstnání

Introduction

Polarization of labor market, defined as employment and wages growth in low- and high-skill occupations at the cost of middle-skill occupations, was first documented by Goos and Manning(2007) in the UK.[1] Further analyses of the British and American labor markets confirm this trend and suggest some explanations of its causes. Autor et al. (2006) propose that the labor market polarization observed since the 1990's can be accounted for by the so called routinization, i.e., the substitution of routine job tasks by modern technologies.[2] Firpo et al. (2009) suggest that offshoring certain job tasks to low-wage countries can also be partially responsible for polarization in the US. Finally, Acemoglu and Autor (2010) note that the allocation of workers to occupational tasks might be influenced by labor market imperfections and institutions, thus challenging the polarization pattern in some countries.

This has raised the question of whether labor market polarization is unique within the Anglo-Saxon countries, among which the US is known as the pioneer in technological progress and the largest outsourcer of manufacturing and remote consumer service jobs. In answer to this question, recent research suggests that polarization can be observed across the majority of developed economies. For example, studies by Spitz-Oener (2006) and Dustmann, Ludsteck and Schonberg (2009) show that polarization is present in another leading economy, Germany. Most importantly, Goos, Manning and Salomons (2009) provide evidence of this phenomenon across 16 European countries.[3]

Nevertheless, the international analysis of labor market polarization is not complete. First, the European evidence is based on a rough measure of the skill requirements of occupations -- the average wage. As argued in Pertold-Gebicka (2010), this approach implicitly assumes that within occupations differently skilled workers are perfect substitutes, which is likely not to be the case. Second, cross-country differences in the shape of employment change distribution (which is used to picture polarization), while documented, have not been given much attention. These differences might be driven by cross-country heterogeneity in the supply of skills, variation in economic cycles, different industrial structure, or distinct labor market legislations. As Acemoglu and Autor (2010) point out, labor market institutions have strong potential to influence employment adjustments and thus they should not be ignored in the polarization literature. Finally, while in the US polarization has been measured in employment changes as well as in earnings changes, the existing international analysis is focusing only on employment changes, i.e., it documents the

1 *Goos and Manning first used the term polarization to describe employment growth in low- and high-skill occupations at the cost of middle-skill occupations in the 2003 Working Paper version of this publication.*

2 *The term routinization was introduced by Autor et al. (2003).*

3 *These countries are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden and the UK.*

so-called job polarization as opposed to wage polarization.[4] Studying wage polarization would give additional insight into the structure of the European labor market.

This paper addresses the first two issues. I use the European Union Labor Force Survey (EULFS) to report differences in the extent of job polarization across European countries, adopting the measure of skill requirements of occupations inspired by Pertold-Gebicka (2010). This measure is more flexible than the average wage, as it puts less strict assumptions on occupation-specific production functions. Additionally, occupational skill requirements are derived with the use of U.S. data, so this measure is independent of labor market conditions in European countries. This assures cross-country comparability. With the use of the skill requirements measure, I provide extensive evidence on cross-country differences in the extent of polarization. Specifically, one can observe that polarization is the strongest in Denmark, Finland, and Ireland, while it is the weakest in the Netherlands, Norway and Sweden. As a potential explanation of this observation, I suggest differences in countries' industrial structure, economic growth, and educational attainment of their populations. The remaining cross-country variation in the extent of polarization is shown to be partially driven by dissimilarities in labor market institutions.

The major contribution of this study is to pin down the relationship between labor market institutions and employment adjustments to the prevailing economic conditions. The results presented in this paper suggest that strong employment protection might impede or slow down the market mechanisms observed in non-regulated countries, such as substitution of certain job tasks by computers Acemoglu and Autor (2010), which flatters the polarization patterns.

The rest of the paper is organized as follows: Section 2 describes the skill-intensity measure used to order occupations according to their skill requirements and analyze polarization patterns. Section 3 pictures the incidence of labor market polarization in Europe using the skill-intensity measure and compares it to the results obtained using alternative measures of occupational skill requirements. The next section documents cross-country differences in the extent of polarization and discusses the role of country-specific economic conditions, with special attention given to employment protection legislation, in explaining these differences. Finally, conclusions are presented in Section 6.

1 The Measure of Skill Requirements of Occupations

The term job polarization is used in the literature to indicate growth of employment in high- and low-skilled occupations with a simultaneous decrease (or stagnation) of employment in middle-skilled occupations (Goos and Manning, 2007). Thus, the key ingredient of any analysis of labor market polarization is a measure of the skill requirements of occupations.

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4 Wage polarization is known as the pattern of earnings growth in the bottom and top percentiles of earnings distribution with a simultaneous decrease of earnings in the middle of the earnings distribution. Job polarization is known as growth of employment in high- and low-skilled occupations with simultaneous decrease (or stagnation) of employment in middle-skilled occupations. See Acemoglu et al. (2010) for a summary of the terminology used in the polarization literature.

Recent literature uses several alternative measures of the skill requirements of occupations. The most often encountered are the average educational achievement of workers employed within an occupation (Autor et al., 2006, for the US; Goos and Manning, 2007, for the UK) and the average occupational wage (Firpo, Fortin and Lemieux, 2009; Goos et al., 2009), although both approaches are based on implicit assumptions that are likely to be violated. For the educational structure of occupations to correctly reflect their skill requirements, we need to face zero within-occupation substitutability between workers of different skills (as proxied by education levels). On the other hand, wages are good predictors of occupational skill requirements when differently skilled workers are perfect substitutes. With imperfect substitutability between skill types, occupation-specific educational structures are driven not only by skill requirements (i.e. the demand for skills) but also by the supply of differently skilled workers. In this case wages are the equilibrium outcome of the interaction between these two forces. Thus, neither wages nor education structure alone can be used to identify occupational skill requirements.

To deal with this lack of identification, I use the measure of skill requirements of occupations (called the skill-intensity of occupations) inspired by Pertold-Gebicka (2010). This alternative measure corresponds to the relative productivity of more and less skilled workers employed within each occupation. Thus, it measures how crucial workers' skills are for the tasks performed within a specific occupation. I propose that each occupation uses a relatively general labor aggregating technology of the constant elasticity of substitution (CES):

$$Y_j = \left(\alpha_{Hj} L_{Hj}^{\gamma_j} + \alpha_{Lj} L_{Lj}^{\gamma_j}\right)^{1/\gamma_j},$$

where Y_j is the output of occupation j, L_{Hj} is the amount of high-skilled labor and L_{Lj} is the amount of low-skilled labor employed in occupation α_{Hj}, and α_{Lj} are productivities of these two labor types, and is a parameter describing substitutability between these two labor types (the elasticity of substitution is $\sigma_j = \frac{1}{1-\gamma_j}$). In this context, $\frac{\alpha_{Hj}}{\alpha_{Lj}}$ describes the occupation-specific relative productivity of differently skilled workers.

Under perfect competition, occupation-specific employment (L_{Hj} and L_{Lj}) and equilibrium wages (and) have to satisfy

$$\frac{\alpha_{Hj}}{\alpha_{Lj}} = \frac{w_{Hj}}{w_{Lj}} \left(\frac{L_{Hj}}{L_{Lj}}\right)^{1-\gamma_j} = \frac{w_{Hj}}{w_{Lj}} \left(\frac{L_{Hj}}{L_{Lj}}\right)^{-1/\sigma_j}.$$

Thus, in the setup where more and less skilled workers are imperfect substitutes (i.e. where $0 < \sigma_j < \infty$), it is necessary to combine the relative employment of differently skilled workers (the educational structure), relative wages, and the elasticity of substitution between more and less skilled workers to determine occupation-specific relative productivity. The skill requirements measure based on the relative productivity defined above is independent of the supply of skills (i.e. the supply of differently skilled workers) and purely reflects technologies employed by individual occupations. This property is not shared by the average wage measure. Average wage is high in occupations adopting modern technologies that increase workers' productivity. It is also high in occupations where the supply of workers is low, even if they are not technologically advanced. Independence of the skill

requirements measure of the supply of skills is crucial for documenting job polarization. To correctly measure polarization, one needs to distinguish between occupational skill requirements, which are used to identify low-, middle-, and high-skilled occupations, and the supply of workers, which influences changes in employment levels.

In order to calculate occupation-specific skill requirements, one needs to measure relative employment of differently skilled workers, relative wages, and the elasticity of substitution between more and less skilled workers for each analyzed occupation. While relative wages and employment can be easily retrieved from worker-level data, estimating occupation-specific substitution elasticities requires additional identifying assumptions (Pertold-Gebicka, 2010). This can be avoided when applying a uniform elasticity of substitution for all occupations. Its value can be inferred from numerous studies estimating the economy-wide substitutability between more and less skilled workers (Katz and Murphy, 1992; Krusell et al., 2000; Ciccone and Peri, 2005). As Ciccone and Peri (2005) summarize, the estimates for the U.S. vary from 1.34 to 1.66, which is a relatively small interval. I choose to apply the middle value, i.e., I assume that $\sigma_j = 1.5$ for all occupations.

It remains to be determined which labor market(s) should be used to measure occupational skill requirements. One could measure them in each European country separately. This might result in different categorization of occupations into low-, middle-, and high-skilled across countries. An occupation j might be classified as a middle-skilled occupation in Country A and as a high-skilled occupation in Country B because of different technologies used in these two economies. While Country A still uses old, labor-intensive technology relying on middle-skilled workers, Country B has adopted modern automated technology requiring highly-skilled workers to operate the machines. In this case differences in occupational skill requirements also capture differences in polarization patterns: in Country B middle-skilled workers have been substituted by machines and high-skilled workers.

To disentangle these two stories one needs to apply a uniform definition of occupational skill-requirements for all countries. This could be the average European skill requirements or skill requirements measured in another economy. In this paper I chose to measure skill requirements for the U.S. labor market. This approach guarantees that the classification of occupations is uniform across all analyzed countries and is not asymmetrically influenced by any of their economies (i.e., it assures exogeneity of the skill requirements measure). The choice of the U.S. is driven by two arguments. First, this country is believed to be a leader in technological development, what assures that the estimated skill requirements capture recent technologies. With today's extent of globalization and spillover of technologies one can assume that these technologies are (with possible delays) also adopted in Europe. Second, the the elasticity of substitution between more and less skilled workers, used to retrieve the skill-intensity measure, is based on U.S. estimates.

The data used to measure skill requirements of occupations come from the March Supplement to the Current Population Survey (March CPS). A detailed description of these data and procedures used to estimate skill requirements are outlined in the appendix.

2 Data and Measurement Issues

Throughout this paper I use the 1993-2001 waves of the EU LFS microdata for scientific purposes. This is a collection of harmonized labor force surveys conducted at national levels in all EU member states and the associated countries. The availability of this dataset for all European economies, its comparability across countries and over time, and its representativeness on 2-digit occupation level makes it the best applicable for this study.

The chosen time span corresponds to the time period when polarization has been documented (Goos and Manning, 2007) and to the availability of the skill-intensity measure. Due to the limited time consistency of the occupational coding in the US CPS data, I could only estimate occupation-specific elasticities of substitution between more and less educated labor for the 1983-2001 period.

Given limitations in data availability for some countries, this study investigates 12 Western European economies: Denmark, Finland, Greece, Ireland, Iceland, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden and the United Kingdom. The Central and Eastern European countries are not analyzed, because the assumption about the similarity of occupations' characteristics between these countries and the US is likely to fail. This study covers the whole working population of the above-mentioned 12 countries.

In the anonymized version of the EULFS occupations are coded using 2-digit ISCO codes, while the estimates of the substitution elasticities and thus the estimates of occupation-specific skill-intensities) are available at the 3-digit level of the US Census occupational classification. To merge the EULFS data with the US occupational characteristics, 3-digit occupations from both datasets are matched according to an algorithm based on Elliott and Gerova (2005)[5] and skill intensities are averaged at the 2-digit level. This procedure leaves me with 20 occupations listed in Table 1. Throughout the paper occupation-specific employment is measured as the usual weekly man-hours worked. For countries with shorter time spans,[6] man-hours worked in each of the 20 2-digit occupations were extrapolated on the basis of average annual growth rates in occupation-specific employment.

3 Job Polarization in Europe

Documenting job polarization consists of two steps. First, one needs to classify occupations into different levels of skill requirements (usually low-, middle-, and high-skilled occupations); second, for each group of occupations measure employment changes. In this study occupational skill requirements are measured as the relative productivity of more and less skilled workers in a setup with imperfect substitutability of skills, which is a novel approach. Employment changes are measured in relative terms as changes in the share of employed working in a given occupation, which is in line with Goos et al. (2009).

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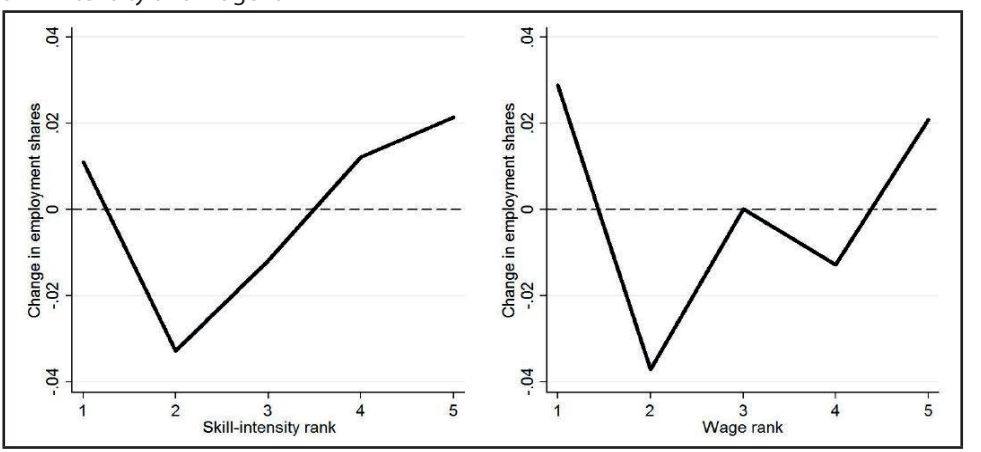
5 Elliott and Gerova (2005) propose a crosswalk between the 2000 Census occupational classification and 88-ISCO, while the skill-intensity measure is available for the 1990 Census occupational classification.

6 Finland has data available from 1997, Iceland from 1995, Norway from 1996, Sweden from 1997, and Spain till 2000.

Following Goos et al. (2009), I use the European Union Labour Force Survey[7] (EU LFS) to picture job polarization in Europe. This is the largest available dataset offering a reasonable coverage of the last decade of 20th century[8] and assuring cross-country consistency in terms of variable definitions. In the anonymized version of the EU LSF occupations are aggregated at 2-digit level of ISCO-88 classification, which after the elimination of public and agricultural sectors[9] leaves me with 21 distinct occupations.

Each of the 21 occupations is matched with the respective estimate of occupational skill requirement and then classified into one out of five skill groups: low, middle-low, middle, middle-high, and high. Classification into skill groups is done on the basis of 1993 skill requirements and employment shares. Occupations with the lowest skill requirements employing 20% of the European workforce are classified into the low skill group, occupations further on the skill requirements scale employing the next 20% of European workforce are classified into the middle-low skill group, and so on. The reason for analyzing five instead of three skill groups stems from the goal of this paper to capture detailed cross-country differences in the shape of job polarization. In this context I introduce the notion of the extent of polarization understood as the difference between employment change in middle-skilled occupations and low- or high-skilled occupations.

Figure 1: Changes in employment share in Europe between 1993-2001 by occupational skill-intensity and wage rank



Note: Both graphs were obtained using the European Union Labour Force Survey. For countries with shorter time spans (Finland, Iceland, Norway, Spain and Sweden), man-hours worked were imputed on the basis of average annual growth rates. Skill-intensity rank corresponds to the position of each occupation in the skill-intensity distribution (5 = the most skilled); the wage rank corresponds to the position of each occupation in the US wage distribution (5 = the highest wage).

7 *The EU LFS data used in this research project have been provided by Eurostat. A detailed description of this dataset is provided in the appendix.*

8 *The last decade of the 20th century is when polarization was first observed and documented.*

9 *Public and agricultural sectors are removed from the analysis because these are strongly protected and highly regulated in Europe.*

Using the above-described approach and pooling all countries together, Figure 1 depicts job polarization in Europe with high- and low-skilled occupations experiencing employment expansion and middle-skilled occupations experiencing a decrease or stagnation of employment between 1993 and 2001. For comparison, the two panels of this figure use different measures of skill requirements of occupation: the left panel employs the skill-intensity measure described in Section 2 and the right panel employs average wage.[10]

Polarization is present in each graph, although there are significant differences between them. While in both graphs we observe the minimum change in employment shares for the group of middle-low-skilled occupations, the behavior of other middling occupations depends on the measure used to capture kill requirements of occupations. Starting at middle-low-skilled occupations, the change in employment shares grows monotonically with increasing skill requirements when the skill-intensity measure is used, but varies irregularly under the average wage measure. These differences are driven by the characteristics of the two measures used to capture skill requirements of occupations. The average wage measure captures not only the technologies used by different occupations but also depends on the supply of workers. Specifically, high (low) supply of workers to certain occupations results in relatively low (high) wages and these occupations being classified as less (more) dependent on skills than they actually are. This causes shifts in the classification of occupations according to their skill requirements. Note that the use of CES occupation-specific production function to derive occupation-specific relative productivity makes the skill-intensity measure independent of supply factors and thus disentangles the labor supply effects from demand-driven job polarization.

To better understand the differences between the two measures of skill requirements of occupations, Table 1 documents the ranking of 2-digit ISCO occupations obtained using the skill-intensity and the average wage measures. Note that, while the rankings of occupations prepared according to the two alternative skill requirement measures are highly correlated,[11] 11 there are well visible differences between them. These concern occupations such as managers of small enterprizes, which in 1993 paid higher wages than many professional occupations because of the short supply of workers educated in management; or sales and service occupations, which paid relatively low wages due to the high supply of potential workers.

In the rest of this paper I use the skill-intensity measure to rank occupations according to their skill requirements. All figures and tables obtained using the wage measure can be obtained from the author on request.

10 Occupations are ordered according to the 1993 average US wage to ensure consistency with ordering according to the skill-intensity. Nevertheless, there are only minor differences between ordering of occupations according to the US and European average wage.

11 The coefficient of correlation between the skill-intensity measure and the average wage measure is 0.657 and is statistically significant at 1% level.

Table 1: Comparison of occupational ranking using the 1993 skill-intensity and 1993 average wage measures

Skill-intensity rank	Wage rank	Occupation
5	5	Physical, mathematical and engineering science professionals
5	4	Other professionals
5	5	Life science and health professionals
5	5	Corporate managers
4	4	Other associate professionals
4	4	Models, salespersons and demonstrators
4	5	Managers of small enterprises
4	3	Life science and health associate professionals
3	4	Physical and engineering science associate professionals
3	1	Sales and services elementary occupations
3	1	Personal and protective services workers
2	2	Oce clerks
2	1	Customer service clerks
2	2	Precision, handcraft, craft printing and related trades workers
2	3	Stationary plant and related operators
2	3	Metal, machinery and related workers
2	1	Other craft and related trades workers
1	2	Machine operators and assemblers
1	3	Extraction, shot rers, stone cutters and carvers
1	1	Laborers in mining, construction, manufacturing and transport
1	3	Drivers and mobile plant operators

Note: The skill-intensity rank is obtained using the occupation-specific skill-intensity measure derived from the U.S. March CPS data; the wage rank is obtained using the occupation-specific average wage as observed in the U.S. March CPS.

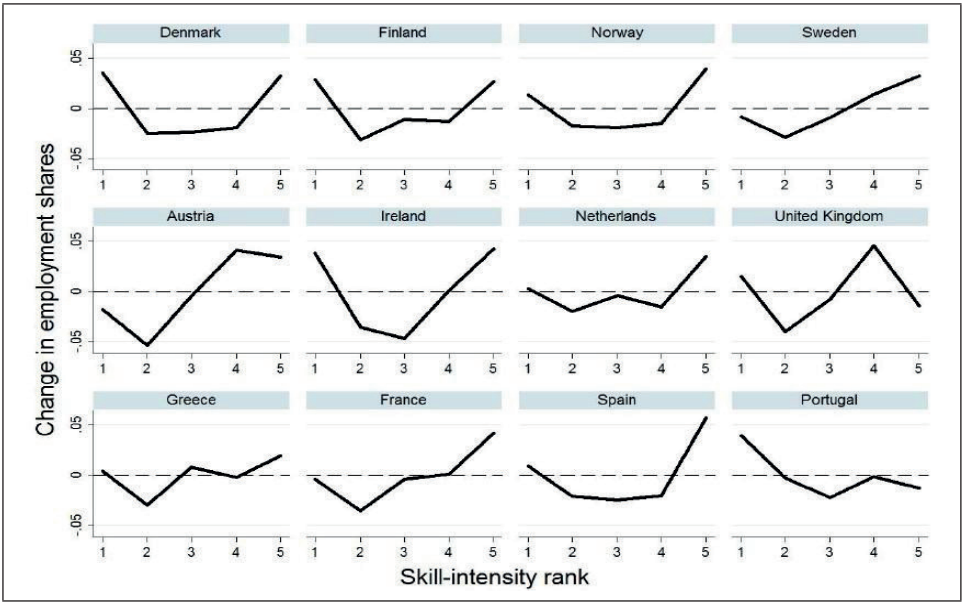
4 Explaining Cross-country Differences in the Extent of Polarization

The aggregate picture of job polarization presented in Figure 1 hides significant cross-country differences in polarization patterns. As Goos et al. (2009) show, job polarization was stronger in some countries than other. To illustrate these differences, Figure 2 plots changes in employment shares against the skill-intensity rank for 12 European economies over the 1993-2001 period.

Although all the presented countries experienced job polarization over the analyzed time interval, the differences across them are striking. In the majority of Nordic countries (Sweden is an exception here) all three middling occupation groups experience signifi-

cant drop in employment share at the benefit of the low- and high-skilled occupations between 1993 and 2001. On the other hand, in the majority of southern countries (Spain being an exception) only one group of middling occupations shrunk, while the other two did not experience any significant employment changes. One can also observe variation in the extent of polarization measured as the difference between the lowest change in employment share for middle-skilled occupations (skill intensity rank 2 to 4) and the highest change in employment share for low-skilled occupations (skill intensity rank 1). According to this measure, polarization was the strongest in Denmark, Finland, and Ireland and the weakest in the Netherlands and Sweden. Linking these cross-country differences in polarization patterns with country economic and social characteristics can shed some light on factors influencing employment adjustments at national levels.

Figure 2: Changes in employment share across European countries between 1993-2001 by occupational skill-intensity rank



Note: Source: European Union Labour Force Survey. For countries with shorter time spans (Finland, Iceland, Norway, Spain and Sweden), man-hours worked were imputed on the basis of average annual growth rates. Skill-intensity rank corresponds to the position of each occupation in the skill-intensity distribution.

The polarization literature discusses two main sources of polarization. First, the decrease of employment in middle-skilled occupations is attributed to routinization (Autor et al., 2006), i.e., substitution of routine job tasks by modern technologies. Since machines carry out routine, precision tasks previously performed by administrative clerks or production workers, the demand for workers in occupations involving these tasks drops. The second hypothesized reason for the contraction of employment in middle-skilled occupations lies in offshoring (Acemoglu and Autor, 2010). The development of communication and transport technologies makes it cheaper to outsource certain job tasks to low-wage countries, which decreases the demand for occupations involving these tasks in the developed

economies. Additionally, Goos et al. (2009) show that routine tasks content[12] has a negative influence on occupation-specific employment changes, while abstract tasks content has a positive influence on occupation-specific employment changes. Although Goos et al. (2009) do not find any effects of offshorability[13] on employment changes in the UK, Firpo et al. (2009) show that offshorability[14] is a strong determinant of the development of occupational wages in the US.

The channels through which routinization and offshorability affect allocation of labor across occupations might be strongly influenced by the economic and social situation of a country. For example, in low wage countries firms have less incentives to offshore or to substitute workers with sophisticated machines, hence we expect polarization to be less visible in these countries. Also changes in the average educational attainment of a country's workforce might affect polarization. If more people obtain college education on cost of high school education, strong polarization effects are expected due to drop in the labor force in low to middle-skilled occupations. On the other hand, if more people obtain high school education on cost of primary education, the opposite effect might be observed because of short supply of workers to low-skilled occupations. But most of all, the extent to which polarization is observed depends on the industrial structure of an economy. As production firms are the ones which can potentially benefit the most from introduction of labor-saving technologies, countries with strong manufacturing industry are more prone to be affected by routinization and offshoring than countries relying on service industry.

In addition to the above-discussed forces, the extent to which routinization and offshoring are expected to affect the shape of job polarization might be influenced by labor market institutions. In countries with high employment protection, it is more difficult to adjust employment to the prevailing technological conditions (Samaniego, 2006; Kugler and Pica, 2008) and thus the possibility of substituting workers with machines might be limited there. On the other hand, in countries with flexible labor markets employment adjusts to the changing structure of occupational skill-requirements. Additionally, as employment protection has affected the process of adjusting the labor market to economic and technological conditions also before the analyzed period, we might observe different initial shares of occupation-specific employment across countries with different employment protection policies. As the initial conditions also determine the extent of polarization, the total effect of employment protection policies on polarization is not clear.

Exploring the cross-country differences in polarization patterns presented in Figure 2, one can identify country-level factors affecting the strength of employment adjustments. To do so, first, I quantify the extent of polarization as the difference between the lowest change in employment share for middle-skilled occupations (skill intensity rank 2 to 4) and the highest change in employment share for low-skilled occupations (skill intensity rank 1). At this stage it is crucial that occupations are classified into the respective skill

12 The routine tasks index is reported in the Occupational Information network dataset (ONET).

13 Goos et al. (2009) measure offshorability as the number of occurrences in the European Restructuring Monitor.

14 Firpo et al. measure offshorability as an index based on ONET information about the necessity of face-to-face contact on site work, and decision-making for each occupation.

requirement ranks using a measure of occupational skill-intensities which is exogenous to the European labor market and uniform for all the analyzed countries. This assures that the classification is not driven by any of the observed or unobserved country-specific variables affecting the extent of polarization. Second, I regress the extent of polarization on country characteristics such as the growth in educational attainment, industrial structure and the extent of employment protection. Due to the limited number of observations, also the number of explanatory variables had to be reduced to a minimum. The chosen variables concisely describe the structure and organization of countries' labor markets, which is expected to have the strongest effect on polarization patterns.

Table 2: The relationship between the extent of job polarization (1993-2001) and country characteristics

	Extent of polarization
Growth in educational attainment	-2.128**
	(0.496)
Share of employment in manufacturing sector	0.080**
	(0.016)
Employment protection index	-0.027**
	(0.006)
Adjusted R-squared	0.75

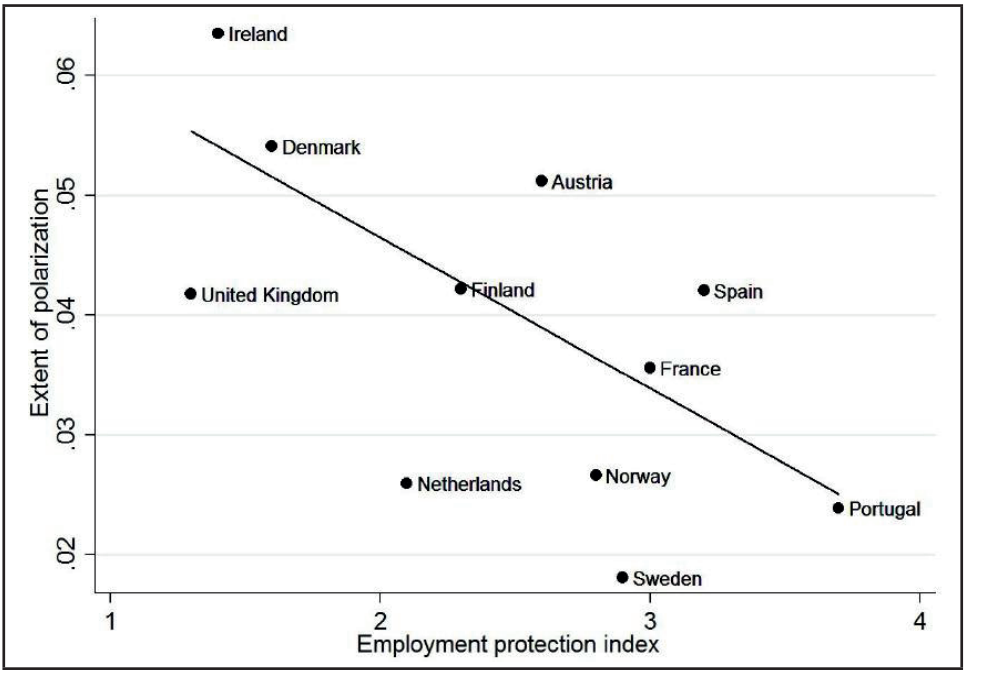
Standard errors in parentheses: * p < 0.05, ** p < 0.01, *** p < 0.001
Note: The extent of polarization is measured as the difference between the lowest change in employment share (occurring at 2nd, 3rd, or 4th quintile of the occupational skill-intensity distribution) and the highest change in employment share (occurring 1st quintile of the occupational skill-intensity distribution). Industrial structure is measured as of 1993. The employment protection index is an index decreasing on the <0, 5> range developed by Allard (2005) on the basis of the OECD methodology and updated by the author.

The results of the simple regression analysis, aimed at revealing the correlation between the characteristics of countries' labor markets and the extent of polarization, are presented in Table 2. As expected, the initial share of employment in manufacturing sector has a positive effect on polarization. On the other hand, I find that growth in educational attainment has a negative effect on the extent of polarization. This suggests that the falling number of low-skilled workers acts against the trend of increasing employment at the low end of occupational-skill distribution. Finally, the extent of polarization appears to be negatively correlated with the strength of employment protection, which implies that restrictive employment protection legislation slows down the process of adjusting the labor market to current economic and technological conditions. Despite the limited number of observations, all estimates are statistically significant, which suggests that the estimated correlations are strong.

To visualize the relationship between employment protection and polarization, Figure 3 plots the correlation between the extent of polarization (after controlling for country-specific average educational achievement growth and industrial structure) and employment protection. It is evident in the figure that countries with strong employment protection (the Southern European and some Scandinavian countries) experience stronger

polarization than other countries. Specifically, the conditional correlation between the Allard's employment protection index and the extent of polarization is -0.58.

Figure 3: The relationship between the extent of job polarization (1993-2001) and employment protection



Note: This graph is constructed controlling for country-specific average educational achievement and GDP growths as well as the share of employment in manufacturing sector as of 1993. The extent of polarization is measured as the difference between the lowest change in employment share (occurring either at 3rd or 4th fifth of the occupational skill-intensity distribution) and the highest change in employment share (occurring either at 2nd or 3rd fifth of the occupational skill-intensity distribution). The employment protection index is an index decreasing on the <0, 5> range developed by Allard (2005) on the basis of the OECD methodology and updated by the author. This index is unavailable for Iceland and Luxembourg.

Conclusions

Polarization of the labor market is a new phenomenon and there is still a lot of research needed to better understand its causes and draw conclusions for the future development of the labor market, as Acemoglu and Autor (2010) sum up in their recent chapter of the Handbook of Labor Economy. This study applies a new measure of the skill requirements of occupations, which is independent of local labor market conditions, to analyze job polarization across Europe and reveals extensive cross-country differences in polarization patterns. Specifically, one can observe that polarization is the strongest in Denmark, Finland, and Ireland, while it is the weakest in the Netherlands, Norway and Sweden. Exploring these cross-country differences and taking advantage of the exogeneity of the skill requirements measure, I show that these differences in the extent of polarization are

not only correlated with country-specific educational attainment growth and industrial structure, but also with the strength of employment protection.

Documenting the negative relationship between the strength of employment protection and the extent of polarization is especially interesting, as it indirectly confirms the existing theories explaining polarization – the routinization and offshoring hypotheses. According to these theories, polarization is driven by workers employed in middle-skill occupations being substituted by modern technologies or by cheaper workforce in distant locations. Employment protection limits the possibility of adjusting firms' workforce in response to technological change and thus dampens the polarization effect. This finding suggests that employment structure of an economy is highly persistent under strong employment protection. If policymakers aim at reducing low-end inequality, they should consider relaxing some of the employment protection legislation and let the low-skill employment expand.

The analysis presented above is the first step towards documenting and understanding cross-country differences in polarization patterns. The natural next step in the development of the polarization literature in the context presented in this paper would be to explicitly model the interaction between labor market institutions and occupational allocation of workers (Goos et al., 2010).

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Appendix

1 Estimation of Occupation-specific Skill-intensity

The data used to estimate 1993 skill-intensity measure come from the 1993-1995 March Supplement to the U.S. Current Population Survey (March CPS), which means that I observe earnings for the years 1992 through 1994. Due to the limited number of observations offered by each wave of March CPS, three consecutive years had to be merged to obtain sample size large enough to allow the data-hungry occupation-level analysis to be conducted. This means that data used to analyze year t are composed of t - 1, t and t + 1 March CPS samples.

Only male and female workers with at least a high school diploma and no more than a college degree are included in the sample. I do not construct college equivalents and high school equivalents, as many studies do. Instead, I focus on occupational allocation of college graduates with no higher degree as compared to high school graduates not having a college diploma. To avoid the issue of imperfect substitutability between experience groups, as discussed by Card and Lemieux (2001), I concentrate on recent school leavers defined as individuals with 10 or fewer years of potential labor market experience.[15] Both full-time and part-time workers are included in the sample to ensure a sufficient number of observations. However, self-employed individuals are excluded from the sample as are those with reported working hours per week of zero or above 98. The earnings measure used in this analysis is the log of weekly earnings defined as yearly wage and salary income divided by weeks worked last year. Earnings are expressed in 2000 dollars. I deal with earnings censoring by assigning the cell- means of earnings to the top-coded individuals. The value of cell-means are taken from Larrimore et al. (2008). Occupations coded according to 1990 U.S. Census occupational classification are matched with ISCO-88 counterparts according to Lambert (2003) and aggregated at 2-digit level of the ISCO classification.

Regression-adjusted wages of individuals are used to calculate the relative wages of college and high school graduates. The controls included in the log-wage regressions, widely used to estimate returns to college, are experience, gender, race, education, full-time work status, and dummies for years t - 1 and t + 1.

Relative employment is calculated as the ratio of the numbers of college and high school graduates observed in a given occupation in a given year weighted by individual sample weights.

The skill-intensity measure is calculated by substituting occupation-specific relative wages and employment to equation (2) together with $\sigma j = 1.5$.

15 The potential labor market experience is calculated as age - years of schooling - 6

2 European Union Labor Force Survey Data

To analyze job polarization in Europe, I use the 1993-2001 waves of the EULFS microdata for scientific purposes. This is a collection of harmonized labor force surveys conducted at national levels in all EU member states and associated countries. The availability of this dataset for all European economies, its comparability across countries and over time, and its representativeness on 2-digit occupation level makes it the best applicable for this study. The chosen time span corresponds to the time period when polarization has been documented (Goos and Manning, 2007).

Given limitations in data availability for some countries, this study investigates 12 Western European economies: Austria, Denmark, Finland, France, Greece, Ireland, Netherlands, Norway, Portugal, Spain, Sweden and the United Kingdom. Employment is measures as men-hours worked. For countries with shorter time spans, 17 man-hours worked in each of the 21 2-digit occupations were extrapolated on the basis of average annual growth rates in industry-occupation-specific employment using the procedure prepared by Goos et al. (2009). This study covers the whole working population of the above-mentioned 12 countries.