Relative Unemployment, Skill Gaps and Cohort Effects in Europe: Economic Factors and Labour Market Institutions

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Abstract

We analyse the effects of demographic and educational changes on unemployment rates in Europe. Using a panel of European countries for the 1980-2000 period -- disaggregated by cohort, gender and education --, we empirically test the economic effects of two stylised facts that have occurred in recent decades: the "baby bust" and the "educational boom". We find that structural shifts in the population age structure play an important role and that a lot of variation is also attributable to educational changes, the latter usually neglected in aggregate studies. Results show that demographic and educational shocks are qualitatively different for young (adult) workers as well as for more (less) educated people. While adult workers and more educated individuals, in general, experience lower unemployment rates, changes in the population age structure ("baby bust") appear to be positively related to young workers' unemployment rates. Conversely changes in the skill structure ("educational boom"), even when controlling for skill-biased technological change, reduce the unemployment of the more educated. Labour market institutions also influence unemployment rates in different ways. Unemployment benefits are found to have a positive impact on unemployment, while bargaining coordination and employment protection reduce it.

JEL: E24, J31, J51, J65
Keywords: unemployment, demographic, education, labour market institutions

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1. Introduction

In recent decades most European economies have experienced a number of demographic shifts which have significantly altered the population age structure and changed the relative position of young versus prime-age workers in the labour market. Over the period 1970-2000 the ratio of the youth population to the adult population increased in most countries during the 1970s and 1980s and then fell in the following decades. Average unemployment rates for youths increased significantly, up to the late 1980s, then slightly decreased in the following decades, while adults' unemployment varied only marginally. Also unemployment rates by educational levels show significant variation: more educated workers are two to three times less likely to be unemployed as compared to their low education counterparts and over the business cycle their relative rates tend to diverge.

Almost all European countries experimented also an increase in the educational levels over the past decades: in this scenario the countries with traditionally low levels of education (at the start of the period) are catching up and the number of high-skilled people is growing in absolute and relative terms.

These patterns are highly policy-relevant and have attracted the interests of both economists and policymakers stimulating extensive research and a fierce debate on the economic effects of the increase in the youth share of population, and the relationship with the rise and the persistence of (youth) unemployment. The terms "baby boom" (and "baby bust") have been used in the literature to indicate the substantial increase (decrease) in the size of younger cohorts and other similar changes in the population age structure; while "generational crowding" has been often used to define the worsened economic conditions for the younger cohorts (OECD, 1986, Korenman and Newmark, 1997). Similarly another strand of literature has tried to investigate the effects of supply (the "education boom") and demand shocks (skill biased technological progress) on both unemployment and earnings (EU-Irs, 2000; Khan et al, 2001; Brunello et al., 2000; Flinn, 1993).

Although these patterns have some common grounds in most European countries, yet it should be stressed that the aggregate evidence conceals a lot of heterogeneity -- both across countries as well as between different groups of individuals within each country -- and limits significantly our ability to understand which factors are at work in the above scenario.

Along with demographic shifts and changes in the (relative) demand for skills, other relevant factors -- both of cyclical and structural nature -- have also contributed to the fortunes of youths in the labour market, for example to name a few: business cycle fluctuations, changes in participation

rates by gender and age, changes in schooling patterns and school-to-work transitions, technological change and the role of labour market institutions.

While, on the basis of standard textbook's 'supply-demand' analysis, there seems to be consensus that an increase (decrease) in the youth share of population -- *ceteris paribus* -- will eventually have a depressing (improving) effect on the economic opportunities of those participating to the labour market, yet consensus among economists on the empirical relevance of the above phenomena is still lacking. The large number of empirical studies that have investigated the economic effects of cohort size, on youth earnings and unemployment, are often difficult to compare due to data and methodological differences, and even when a comprehensive review of the studies is considered and the issue of comparability is carefully addressed, still a great deal of heterogeneity by country and time seem to characterise the experience of European countries (Zimmerman, 1991; Korenman and Newmark, 1997; Jimeno and Rodriguez-Palenzuela, 2002).

Finally, on some of the relevant issues research is still very scarce. For example, while there is some evidence that the effects of changing population age structure on unemployment are not necessarily symmetric, most studies have analysed the economic outcomes under the "baby boom" scenario, and little is still known as to the outcomes under the more recent "baby bust" scenario. Also, while we have significant evidence on the economic effects of demographic shocks on the (un)employment and earnings of youths, we know very little of the likely interactions by educational achievement and skill levels within and across cohorts and by gender.

Hence a number of questions are in order. What is the recent evidence about the (un)employment conditions of different cohorts in Europe and how the picture varies according to educational levels? Which are the countries, in Europe, that have been more (less) severely affected by both demographic shocks and changes in the skill structure, and what are the various trade-offs? What is the evidence on the changing fortunes of European young (adult) workers, in terms of employment opportunities, following demographic and (skill-biased) technological shocks? Which other economic factors, besides population changes, have played an important role in the labour market fortunes of European workers? To what extent labour market institutions have contributed to the worsening of the economic opportunities of the least protected workers, or have slowed down the process of adjustment putting all the burden on some group of workers?

This paper intends to address some of the above questions and contribute to the literature extending previous findings in a number of ways. First it uses a unique data set that combines data -- from different sources and for a relevant time period -- for various European countries and provides a disaggregation by educational levels which has not been used before.

Second, it provides an analysis of the European "baby-bust" phenomenon accounting for both the effects of demographic and educational shifts. Third, it extends the early findings to the more recent data, thus providing new evidence on the recent evolution of European labour market and discusses policy options in the light of the European Employment Strategy (EES). Finally, in contrast with the previous literature, it argues that an important part of the effects of demographic changes on unemployment rates can be explained by shifts in the relative supply and demand of more (less) educated workers. The paper is organised in the following way. In section 2 the relationship between demographics and unemployment, and the relevant literature is reviewed. Section 3 presents the data and some descriptive evidence. In section 4 and 5 we discuss the main results, also with reference to the role of labour market institutions. Section 6 summarises the main findings and concludes.

2. The economic implications of demographic and skill changes on unemployment

Empirical evidence on the economic effects of cohort size on unemployment rates is extensive and covers a large number of countries and time periods. While most of the studies concern the US experience, empirical evidence has also become increasingly available for Europe and a number of OECD countries. Results from the empirical literature are somewhat controversial. Most available evidence suggests that a large cohort size will (negatively) affect the earnings levels of the individuals (mainly of that cohort), as well as their (un)employment status (or labour force participation). The relevance of the two effects are likely to depend on a number of factors such as the functioning of the labour market, the state of the business cycle, public policies and, not least, the relevance of labour market institutions[1]. Typically studies for the US have found that relative wage effects are more important in the adjustment process following a demographic shock, although in some cases the effects on wages can persist over time (Flaim, 1979; Welch,1979; Berger, 1985). Differences in the effects on earnings have also been shown to depend on substitutability between young and adult workers and skill levels (i.e. more educated tend to be more severely affected) as well as to the mobility decisions of individuals (Stapleton and Young, 1988; Bloom, et al. 1987; Wright,1991; Nickell,1993)[2]. Conversely, empirical evidence for

[1] For example, depending on the elasticity of the labour demand the effect on wages will be more or less pronounced, wage rigidity or a statutory minimum wage may produce significant spill-overs to (un)employment. Macroeconomic conditions too may have an impact in the adjustment process by absorbing more or less easily the supply shock. Finally, also direct employment creation, collective bargaining and employment protection legislation may have an impact.

[2] It has been argued that individuals hit by an adverse shock tend to move to states or regions where unemployment is lower and the re-employment probability higher.

European countries has shown that unemployment and out-of-labour force are the most likely effects of a demographic shock (Korenman and Newmark, 1997). Other studies have found instead that a larger share of the youth population may reduce unemployment if labour markets are imperfect and there are trading externalities in firms' job posting and workers' search behaviour (Shimer, 2001; Nordstrom Skans, 2002).

While an extensive review of the empirical evidence is beyond the scopes of the present paper, excellent reviews -- with a wide coverage of the literature – are available, see for example among others: Bloom, et al. (1987), Korenman and Newmark (1997), and Johnson and Zimmerman (1993). Here we focus only on few papers that have specifically addressed the relationship between the population age structure and relative (un)employment rates in a cross-country (state) perspective thus providing a good starting point for a discussion on data, methodology and results. Also, in the literature examined, we found relatively little empirical evidence on the relevance of population age structure by educational achievements and, in the few cases, it dealt almost exclusively with earnings. The latter is somewhat surprising given the importance given to skill (biased) technological changes in the explanation of several labour market phenomena (Katz and Autor, 1999). For this reason, even if the main focus in this paper is on the relationship between the population age structure and (un)employment rates, some of the studies reviewed below also concern earnings.

The labour market consequences of generational crowding for selected industrialised countries (Australia, Canada, France, Japan, Sweden, UK and US) are analysed in Bloom et al. (1987) who try to discriminate between two alternative views: first, that low earnings and high unemployment for the young are in general age-related, and hence temporary; or second, that they emerge when a large cohort size enters the labour market, and being cohort specific tends to be permanent. They survey several empirical studies which have investigated the effects of cohort size on earnings and unemployment in a number of countries and report that the evidence suggest a negative impact of large cohort size on (expected) earnings and a marked trade-off between the relative earnings effect and the relative employment effect. Their results confirm the evidence from previous literature and show that the effect of cohort size is stronger on relative earnings in some countries (US and Australia), on relative (un)employment in others (Canada, France and UK) while little or no effects is detected in some others (Sweden and Japan); the latter is interpreted in terms of influence of institutionally-determined factors. Also, cohorts that have been hit more severely by the change in the population age structure are found to converge to the patterns that would have resulted otherwise, but their lifetime (expected) earnings appear to be permanently reduced.

In a more recent study, Korenman and Newmark (1997) investigate the effects of changes in the population age structure on the economic conditions of youths in labour markets in a number of advanced economies (US, Canada, Australia, Japan and other European countries) over the 1970s, 1980s and early 1990s. They provide an extensive survey of more recent empirical studies which show a rather more mixed evidence: on the one hand main results seem to support the economic effect of cohort size on relative earnings and (un)employment as found in the previous literature; on the other hand, they highlight a number of data and methodological problems that concerns empirical findings. For example, it is stressed the importance of using cross-section time-series data, for the lack of cross-national (or state) variation in the data relating to the size or timing of the demographic shocks may confound cohort and time effects (i.e. such as business cycle) making results difficult to interpret (Flaim, 1979, 1990; Nardone, 1987)[3]. Furthermore, the potential endogeneity of relative cohort size is discussed since migration decisions of workers or schooling decisions may be related to economic conditions and, finally, particular care is paid to the role of labour market institutions in influencing the sensitivity of the relationship between cohort size and (un)employment. Their main conclusions lead to the finding that large youth cohorts significantly affect the relative unemployment rate of younger workers relative to adults -- i.e. with an elasticity close to 0.5 – and that institutional setting that decrease flexibility may lead to greater fluctuation in the (un)employment rates of youths.

These findings are challenged in a paper by Shimer (2001), who argues that an increase in the youth share of the working age population can cause a sharp reduction in the relative unemployment rate. While this result is contrary to what standard economic theory would predict, still it is claimed that when workers of different ages are not perfect substitutes and labour market frictions are present, then a demographic shock will have a differential impact on young and adult workers such that the "relative" effect is indeterminate. Hence, contrary to most findings in the literature using data for US states from the late 1970s to the late 1990s, Shimer (2001) finds that an increase in the youth share of the working age population reduces significantly both the youth and the adults unemployment rates -- i.e. the former with an elasticity close to -1.5, while close to -3.0 for the latter.

A number of more recent studies have concentrated attention, in particular, on the role of the institutional setting and the effects on relative unemployment rates. Jimeno and Rodriguez-Palenzuela (2002), for example, extend and update some of the previous studies using a panel of 19 OECD countries over the period 1968-1996, putting particular emphasis on the role of the

[3] The problem can be illustrated as follows, when a large cohort size enters the labour market and the economy is in a slack, it might be difficult to determine the relative importance of the two effects. However, if there is enough variation

institutional setting to explain the differences in (un)employment rates, by gender and cohort, between the US and European countries. Their empirical findings suggest that some labour market institutions have contributed to increase youth unemployment and that the burden of adjustment to demographic and macroeconomic shocks has been borne mainly by young workers, as compared to adult workers. In a similar way, Bertola et al. (2002) find that the interaction between economic (and demographic) shocks and labour market institutions are more relevant for the composition of employment and the incidence of unemployment (for example, by age and skill) in the working-age population, rather than on the overall level. They also show that demographic shocks interacted with some labour market institutions can explain much of the differences in unemployment rates of young and female workers between the US and EU countries.

Although many of the studies reviewed above note the relevance of educational choices, enrolment rates and returns to education in assessing the effects of demographic shocks on earnings and (un)employment, there is still relatively little empirical evidence looking at the implications of the population age structure by schooling achievements in a cross-country perspective. Stapelton and Young (1988) investigate the effect of cohort size on returns to education and on schooling attainment for the US. They argue that if substitutability between young and adult workers is inversely related to education (i.e. it declines as education increases), highly educated workers belonging to large cohorts are likely to be worse off, in terms of present value of lifetime earnings, as compared to less educated workers and will, ceteris paribus, invest less in human capital. Their findings confirm a decline in college completion rates of baby-boomers, between the 1970s and 1980s, and an increase for those (baby-bust) cohorts that came after the demographic shock[4]. Card and Lemieux (2000), Brunello et al. (2000), and Brunello and Lauer (2004) analyse the effect of the relative supply of highly-educated workers across cohorts on the college-high school wage gap. In the first study Card and Lemieux (2000), using cross-country evidence for the US, UK and Canada, show that the elasticity of substitution between different age groups is finite and larger than that between different education groups. Also, the age distribution of educational attainment is found to be very important in explaining the change in the distribution of wages and the increase in the college wage premium occurred in the countries considered over recent decades. In the second study Brunello et al. (2000), using data for 10 European countries and two cohorts, show that there

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across countries in the timing of the demographic shocks the identification of the two effects can be better achieved.

[4] Note that in this case, the cohorts that follows the baby-boomers will have both lower opportunity cost of investment in human capital with no decrease in returns, so the effects will be particularly significant. Flinn (1993) also reaches similar results analysing on-the-job training patterns for the US. Wright (1991) analysing cohort crowding effects for Great Britain finds a greater impact on earnings for more highly-educated workers. Conversely an opposite conclusion is reached by Hartog et al. (1993), who find a lower impact on earnings levels of large size cohorts of high-educated workers with respect to less-educated ones.

is significant heterogeneity across European countries in terms of college-high school wage gap for different age groups. In particular, the main findings suggest that institutions play a relevant part in shaping the evolution of educational wage differentials face to economic and demographic shocks. In the latter study Brunello and Lauer (2004) document a (small) negative and statistically significant effect of cohort size on earnings, that varies by education and age, while the impact of demographic changes is found to be stronger than the impact of educational changes.

The main findings from the literature reviewed -- even if some care should be used when comparing studies which are different in terms of data, methodology and coverage -- draw attention to a number of open questions. First, there is contrasting evidence on the sign of cohort size effects on unemployment. Second, there is evidence that results depend on the chosen definition of (relative) cohort and unemployment, and on the specification used -- i.e. controlling for the business cycle, cohort's position in the demographic cycle, country and time fixed effects, and other features. Third, studies based on very aggregate data, by assuming perfect substitution across age groups, gender and skills, can distort the overall picture. Fourth, there is indirect evidence that cohort size effects are stronger for some group of workers (i.e. more educated), although this issue has not been adequately addressed. Fifth, while labour market institutions and policy measures seem to matter a lot for (un)employment rates the evidence, particularly in European countries, is still scarce.

2.1. The analytics of demographic and educational changes

Most of the existing research on the effects of demographic shocks on unemployment has mainly focused on aggregate or cohort specific factors (Shimer, 2001; Jimeno et al., 2002). In the former case, the implicit assumption is that individuals belonging to different cohorts (young or adult) are perfect substitutes in production, that is the only thing that matters is the overall supply of workers and the effect produced on the aggregate unemployment rate. Alternatively, in the latter case, when the focus is on relative cohort effects and relative unemployment rates (i.e. young-adults) some allowance is made for the fact that workers of different ages might be imperfect substitutes in production and that the relative (un)employment rates will be somehow proportional to the (relative) demographic shock and to the (in)ability of (relative) wages to adjust. One problem with the above approach is that it completely neglects the role that skills and education have in production or, that is the same, it assumes that workers with different skills and education are perfect substitutes in production. This, as already noted, is quite surprising given the emphasis that explanations based on skill-biased technological changes have received in accounting for a wide range of economic facts occurred to developed countries in recent decades, such as increasing

inequality to the evolution of skilled-unskilled relative unemployment rates (Nickell and Bell, 1996; Acemoglu et al., 2001; Acemoglu, 2003).

In other studies, cohort size has been defined for a given education level as the proportion of an age group relative to total population; in this case, however, the implicit assumption is that the labour market is segmented by skills and that substitution across educational groups is very difficult (Welch, 1979). In other words, under this definition of cohort size, changes in the number of young individuals with a given skill level should have no effect on the employment opportunities of the less skilled. This makes difficult to disentangle the effects of demographic and the educational shocks on the unemployment rate.

In the light of the above discussion, since we are interested in the effects of both demographic and educational composition of the population on unemployment rates, it is important to define the appropriate level of aggregation. Given that our panel of countries is defined over gender, cohort and educational groups for each year, we specify the dependent variable (i.e. unemployment) at the highest degree of disaggregation available. Conversely, the definition and the level of aggregation of demographic and educational terms will depend upon the unemployment-generating mechanism and the (shape of) production function. For example, when a CES specification is chosen -- with skilled and unskilled labour as factors of production[5] -- but wages are assumed to be completely flexible there will be no (involuntary) unemployment. Alternatively if wages are rigid and unemployment is the focus of the analysis, as it is in this paper, the estimated coefficients will depend on a number of factors such as: the technology and the wage determination process. Here we do not impose a particular structural form to the production function and simply work with a reduced-form specification to estimate the relationship between group[6] specific unemployment rates, aggregate demographic changes, aggregate changes in the education composition, controlling for various other factors as well as the institutional environment.

This approach allows us to compare results with previous studies in the literature. Korenman and Neumark (1997), as already discussed, only consider two cohorts and make no distinction either by gender or education. In that context, there is no difference between an aggregate and a cohort specific demographic shock: by assumption the two coincide. Both Jimeno et. al (2002) and Shimer (2001) also maintain the hypothesis of a common aggregate demographic shock[7] (measured by the relative share of the young and adult cohort). Compared to the above mentioned studies, our paper also addresses the education dimension. In this way we are able to condition upon skill/education

[5] This assumption is made in Card and Lemieux (2002) to estimate structural parameters.
[6] These are the "High skill" (H) type, while belong to the "Low-skill" (L) type those with primary education or less.
[7] The relevant aggregate demographic variable can be defined at the State level, as in Shimer (2001), in which case it is a State-specific aggregate demographic shock.

features besides age and gender, and we can investigate the effects of aggregate shocks reflecting changes in the education composition of the population. The definition of the (aggregate) demographic term we use (YOUTHSHARE), is given by the number of individuals in the 15-24 age interval (the young cohort)[9] over the number of individuals in the 15-54 age interval. To account for the changes in the composition of education, we use two different definitions. The first one (EDUCSHARE1), measures the share of those who have achieved upper secondary education or more[10] over the total population in the age interval (15-54) and can be interpreted as the share of skilled individuals -- those with more than compulsory education – on total human capital. The second variable (EDUCSHARE2), is defined as the share of those with upper secondary education or more within the young cohort (i.e. the 15-24 age interval), thus proxying for the distribution of skills and human capital within the youngest cohort. The underlying idea, is that individuals compete for skills mainly within their own cohort, while the extent of competition between young and adult workers in the market (for a given skill) is less relevant. Notice also that while EDUCSHARE1 mixes the effects coming from the demographics with those coming from shifts in the education composition, EDUCSHARE2 captures exactly the education composition of the young cohort conditional on the demographics[11] (i.e. expressed by YOUTHSHARE[12]).

3. Data and some descriptive evidence

The data we use contain information on population, employment and labour force for ten European countries from 1975 to 2002 (depending on the country). The dataset is structured as a panel further disaggregated by gender, cohort (age groups, 15-24, 25-54 and 55-64) and educational levels (primary, upper secondary and tertiary according to the ISCED definition)[13].

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[9] The adult cohort is made up by those in the (24-54) age interval.

[10] Notice that YOUTHSHARE captures only the effects of demographic changes, regardless of educational changes.

[11] The impact of this variable on unemployment captures, conditional on the aggregate demographic shock, whether being better educated affects the (un)employment rate. In other words, being high skilled within an age group in which many people are also high skilled may, in the presence of wage rigidity, increase competition for available jobs and reduce employment opportunities.

[12] If we assume that aggregate human capital can be obtained by summing over individuals (whose characteristics could change across cohorts and skills), and that individual human capital itself is proportional to years of education, then EDUCSHARE2 would be a proxy for the share of skilled human capital over total human capital conditional on being in the young cohort. Conversely, EDUCSHARE1 could be interpreted as a proxy for the share of those who have achieved upper secondary education or more over the entire stock of human capital, not conditioning upon a given cohort (it would be a function of demographics and the educational choices of those belonging to the various cohorts). Under the assumption of linearity these variables would be exact measures of the shares just mentioned if productivity were the same across cohorts and skills. If the aggregate production function is not linear in the number of workers, the effects of pure demographic shocks can hardly be interpreted in a structural sense without choosing a specific functional form.

[13] In practice, primary corresponds to ISCED levels 0 to 2, secondary to ISCED 3 and tertiary to ISCED 5 and 6.

Table 1 below reports, for each country covered, the source of the data and the period available[14].

Table 1 – Country coverage, statistical sources and time period

Country	Source	years available
Finland	Labour Force Survey	1982, 1989, 1991, 1992 and 1994-2002
France	Labour Force Survey	1983-2001
Germany	Labour Force Survey	1991, 1992, 1994-2002
Greece	Labour Force Survey	1987-2002
Italy	Labour Force Survey	1978–2001
Norway	Labour Force Survey	1975-2002
Portugal	Labour Force Survey	1989, 1991, 1994-1996, 1998-2002
Spain	Labour Force Survey	1977-2002
Sweden	Labour Force Survey	1986-2002
U.K.	Labour Force Survey and General Household Survey	1980–2000 (biannual from 1996)

The empirical analysis restricts the focus to two cohorts "young" (Y; age 15-24) and "adults" (A; age 25-54), since the inclusion of the "old" cohort (age 55-64) would have implied a significant number of missing observations. Additional information on business cycle indicators and labour market institutions has been collected and matched to the above data set[15]. Table 2 reports for each country considered the average unemployment rate by age groups (youth and adults) and educational levels (primary and upper secondary or more) and their relative ratios.

[14] In the Statistical Annex, reported at the end of the paper, we aggregate up our data to compare it with OECD data used in most of the previous studies.

[15] As a business cycle indicator we have computed GDP deviations from a linear trend (source: ENERDATA). Some unpublished data have been provided by Oecd, while data for Spain have been kindly made available by Juan Jimeno. Labour market institutions data have also been kindly provided by Steve Nickell and Luca Nunziata. The following variables are available for the 1970-1998 period: net union density, bargaining coordination, tax wedge, employment protection, unemployment benefit duration and benefit replacement rate.

Table 2 – Average Unemployment Rates by Cohort and Education (1991 – 2002)

Country	Years available	Cohort			Education		
		Young (Y)	Adult (A)	Y/A	Primary (P)	Secondary or more (S)	P/S
Finland	11	0.25	0.10	2.39	0.20	0.17	1.18
France	11	0.22	0.09	2.42	0.14	0.15	0.93
Germany	10	0.08	0.08	1.06	0.11	0.08	1.38
Greece	12	0.29	0.10	3.05	0.16	0.22	0.73
Italy	11	0.38	0.10	3.74	0.20	0.26	0.77
Norway	12	0.11	0.04	3.19	0.08	0.07	1.14
Portugal	9	0.12	0.05	2.45	0.08	0.09	0.89
Spain	12	0.34	0.16	2.15	0.25	0.25	1.00
Sweden	12	0.12	0.05	2.33	0.08	0.08	1.00
U.K.	8	0.16	0.07	2.26	0.16	0.09	1.78

Source: National Labour Force Survey (various years)

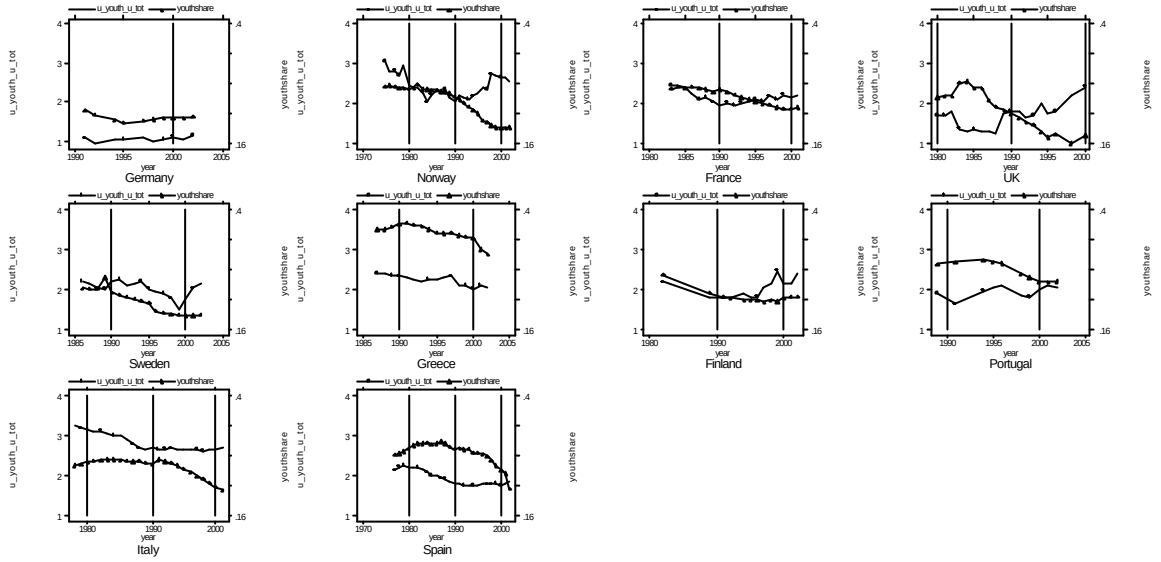
Looking at the patterns of youth unemployment rates for the last ten years (since 1991) we notice a group of countries (Germany, Norway, Portugal, Sweden and the UK) which are characterised by low unemployment rates – on average less than 16 percent – while the remaining countries (Finland, France, Greece, Italy and Spain) show rates ranging between 22 and 38 (France and Italy respectively). Over the same period the mean of the adult unemployment rate in the first group of countries is between 4 and 8 percent and 9 to 16 percent in the second group. The same grouping of countries can be recognised when we analyse the average unemployment rates by educational levels. Relative unemployment rates by age groups show that youth unemployment is, in general two to three times higher than adult unemployment (with the only exception of Germany where is almost the same). Conversely, when we compute relative unemployment rates by skill (last column of table 2), we find that the ratio is in general slightly above 1 (with the exception of the UK where is higher), while in other countries (Italy, Greece, Portugal and France) the average unemployment rate of the more educated is higher compared to those with only primary education. Hence, there seems to be substantial variation across countries in the relative unemployment rates by age and educational groups that needs to be explained.

3.1. An overview of aggregate demographic and educational effects on unemployment

In order to provide some preliminary descriptive evidence in figure 1 we plot the youth population share and the (relative) youth unemployment rate. The empirical evidence shows, with some

differences in magnitude, a generalised decline in the youth population share from approximately 1980s to late 1990s, the so-called "baby bust"[16].

Figure 1 – Youth population share and youth unemployment rate

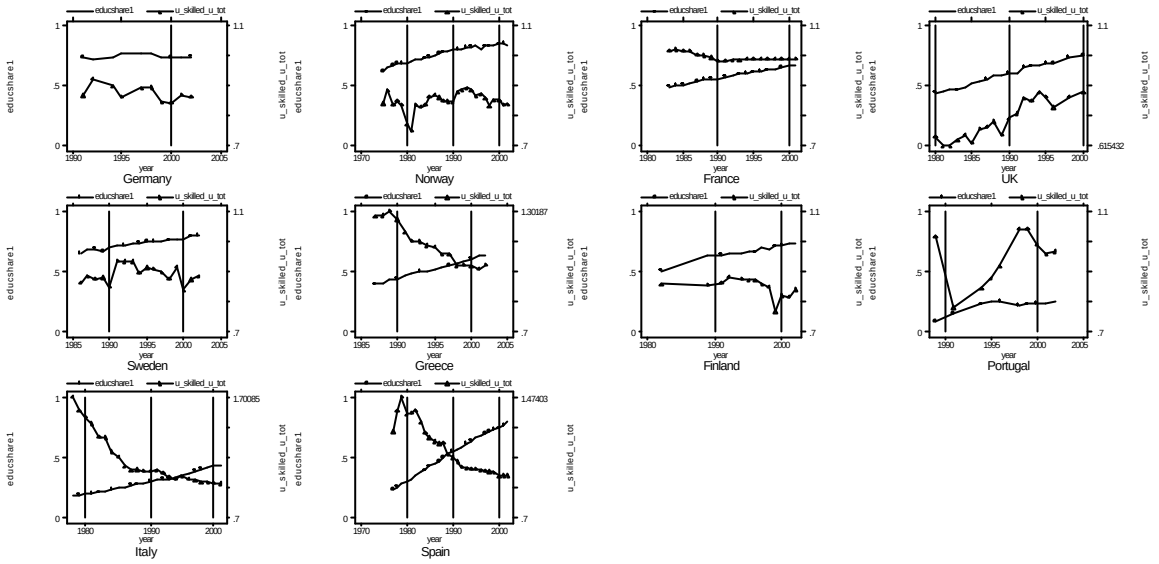


The evolution of the youth unemployment rate (relative to total unemployment), instead, shows a "U" shape pattern in most countries with relative unemployment first declining and then slightly increasing from the late 1990s through the end of the period. The "educational boom" experienced by the European countries in the last decades is shown in figures 2 and 3 where the evolution of the share of skilled people is plotted against the (relative) unemployment rates for the same skill[17]. In particular, figure 2, plots the evolution of the share of individuals with upper secondary education or more over the total population (our EDUSHARE1 variable) on the relative unemployment rate for the same educational level over total unemployment.

[16] The relevance (in terms of levels and changes) of the baby bust varies across countries.

[17] We use two definitions to capture the "education boom": EDUSHARE1 (the share of those with upper secondary or more over the total, and EDUSHARE2 (the share of those with upper secondary or more within the young cohort over the young cohort).

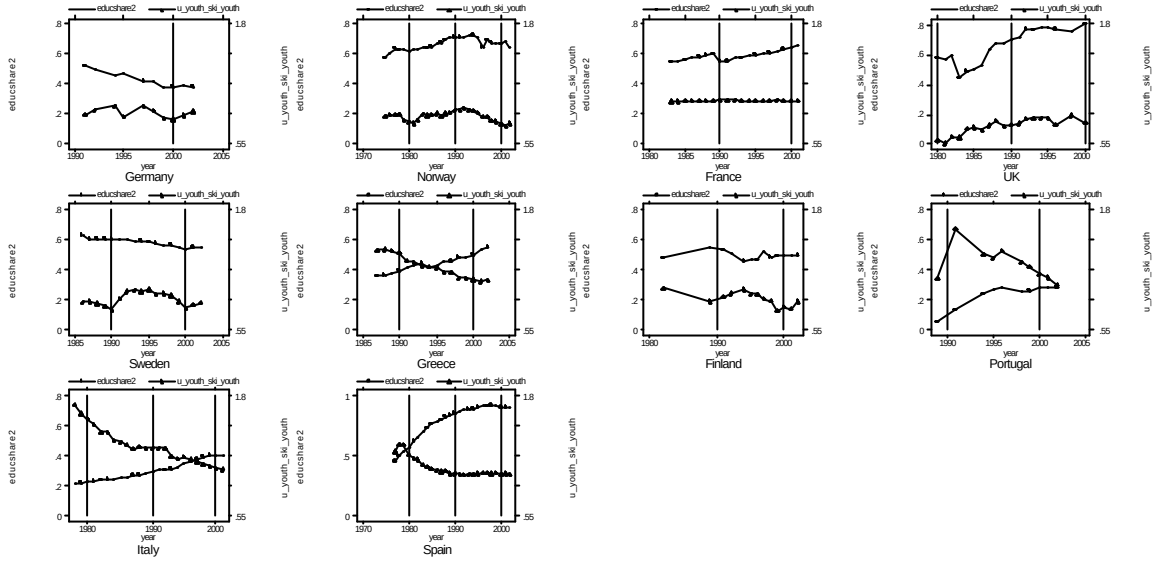
Figure 2 – Share of people with secondary education or more and relative (skilled) unemployment rate



In general, the aggregate trends suggest that while the share of more educated people increased almost everywhere (both in absolute and in relative terms), the specific relative unemployment rate declined (Greece, Italy and Spain), fluctuate cyclically around a constant trend (Germany, Norway, Finland, Sweden and France) or increased (Portugal and United Kingdom).

Figure 3, conversely, describes the share of those with upper secondary or more within the young cohort over the young cohort (our EDUSHARE2 variable) on the relative unemployment rate for the same educational level over youth unemployment. The aggregate patterns mostly confirm previous evidence, the share of young educated individuals shows an upward trend, while the evolution of the education specific (relative) unemployment rates exhibits a decline in some countries and a stable or growing trend in other.

Figure 3 – Share of young people with secondary education or more and relative (skilled) unemployment rate of young people



In other words, while the share of those belonging to the young cohort over the population in the 15-54 interval has been declining since the mid eighties for all countries, the share of those who have completed secondary school or more has been rising. Also, a negative association seem to be found between the initial position in the ordering (i.e. the value in 1999) and growth rates suggesting a sort of "catching up" mechanism. The effect on the (relative) unemployment rates, conversely, have been more mixed with unemployment for the more educated falling relative to total (or young) unemployment in some countries and rising in others. Figure 2 and 3, document a significant heterogeneity in the evolution of unemployment by age and educational achievements across countries and highlight the complex dynamics which underlies demographic and skill changes. Also it emerges the mismatch that can occur when frictions (institutions or other features) prevent clearing on the labour market.

Henceforth, while some common shocks can explain the trends in unemployment rates over time, the heterogeneity of individual country experience both in the levels and in the age-education

[18] The relevance (in terms of levels and changes) of the baby bust varies across countries.

[20] Finland, Norway and Germany are outliers because they actually show a decline: from our data we are not able to observe a very long period and hence we do not know whether they are just anticipating a pattern common to other countries.

structure of unemployment calls for an explanation. The theories reviewed above suggest that demographic, educational shocks and other common shocks factors rates may account for some of the observed evidence. As a first step, we explore the patterns in terms of gender-cohort-education specific effects controlling for country-time specific effects in unemployment. As shown in [1] below, to do this we simply regress the unemployment rate, on country, time and other group dummies,

$$\boldsymbol{un}_{sjict} = \boldsymbol{s}_s + \boldsymbol{c}_j + \boldsymbol{e}_i + \boldsymbol{C}_c + \boldsymbol{T}_t + e_{sjict} \qquad [1]$$

Where un_{sjict} stands for unemployment for the (*s)* gender, (*j)* cohort (*i)* education, (*c)* country and *(t)* time breakdown, $\boldsymbol{s}$, $\boldsymbol{c}$ and $\boldsymbol{e}$ are set of dummies for gender, cohort and education, $\boldsymbol{C}$ is a country fixed effect, $\boldsymbol{T}$ is a common time effect, and e_{sjict} is the residual term. This decomposition allows us to get a general idea of the general patterns of unemployment in Europe – i.e. given time invariant country effects and common time effects. For example, estimating equation [1] over the 1990-2002 period considered, we find that youth unemployment was on average 13 percent higher than adult unemployment while unemployment among college educated youths was only 4 percent (1.8 percent) lower than those with primary (upper secondary or more) education. Considering gender differences we notice that unemployment is 3% higher for women. Alternatively, if we take two countries, Italy and Germany, for example the country effect are, respectively, 0.18 and 0.001 percent suggesting strong country specific differences in unemployment rates.

Finally, when we compare the predicted with the actual rates we find that, more than any other dimension, our model performs poorly in terms of the age structure of unemployment: in particular, youth unemployment is consistently overestimated, while adult unemployment is underestimated with respect to what a "common" behaviour in Europe would have implied. How can we explain this residual? Clearly, there are lot of important factors missing in equation [1], and the age structure of the population and the educational composition are a good candidate to reconcile the evidence.

4. The empirical model

Given our definition of the relevant variables and the framework of analysis chosen in which wages are inflexible, we expect that everything else constant, a (negative) demographic shock (the "baby bust") should tend to favour young cohorts within every skill group, while, an increase in the relative size of the population with higher education should worsen the relative position of skilled

[21] It is exactly the combination of a baby burst and a reduction in the share of those that access higher education in the young cohorts that give rise to this result for Germany, Norway and Finland.

workers. In this purely supply-side framework (which would have a hard time explaining why we observe such a huge change in the education composition in the first place) the presence of both a "baby bust" and an increase in the educational attainment of the population (conditional on the demographics), suggest that young cohorts of unskilled workers should be relatively better off[22], while adult cohorts of skilled workers should be relatively worse off[23] (within this context, "better/worse off" means lower/higher unemployment). As for the other groups, the relative effects would depend upon the relative importance of the demographic versus the education compositional change. One complication with respect to the above supply-side framework is that relative demand for skills might change[24]. For example, an increase in the relative demand for skilled labour would easily accommodate the higher share of skilled workers with ambiguous effects on the relative unemployment rate. In other words, given the demographics and the shifts in education composition just described, even the effects for the two groups previously mentioned may become ambiguous: young cohorts of unskilled workers are now affected by a demand shift that makes them worse off and adult cohorts of skilled workers are now affected by a demand shift that makes them better off.

[Figure 4]

If we focus only on the young cohort and use a simple demand-supply framework for the analysis, a picture that can prove consistent with the empirical evidence previously described would imply an inner shift of the supply schedule (for the demographics) more than compensated by the increase in the share of skilled/educated people (for the educational boom) in the skilled labour market and largely unaffected for the low skilled/ educated individuals. On the demand side, technological change (skilled-biased) would shift the demand for skilled labour outward while an opposite shift would be observed in the low skill/education market. Depending on the relative shifts and the extent of wage rigidity caused by institutions and other frictions, an excess demand (ED in Figure 4b) would characterise the market for skilled labour, while unemployment (UNE in Figure 4a) would characterise instead the market for low skill/education labour (despite the reduction in cohort size). Hence, even in a simple world such as the one described above, the overall effect is a purely empirical question. Before turning to the estimates, we briefly discuss the issue of endogeneity.

First, if we consider the share of young worker in the population and their relative unemployment rates, the two could turn out to be co-determined if young workers would move across countries according to the available employment opportunities. Second, when considering educational choices it cannot be excluded that they are potentially affected by the same variables determining labour market outcomes (i.e unemployment). While, we can reasonably exclude that migration of

[22] When compared to both young cohorts of skilled workers and old cohorts of unskilled workers.
[23] When compared to both old cohorts of unskilled workers and young cohorts of skilled workers.

young individuals across European countries is sizeable and thus consider that the demographic composition is exogenous, the same might not be true for education. Hence at the estimation stage we take into account the issue of potential endogeneity for the variable capturing the educational composition. Also, since the demographic and educational terms are defined at a different level of aggregation, we have to take into account the 'common error components' bias by clustering errors by cohort and country.

4.1. Main results

The effect of demographic and educational changes on unemployment is first captured by aggregate terms. Our basic specification is,[25]

$$\ln \boldsymbol{un}_{sjict} = \boldsymbol{s}_s + \boldsymbol{c}_j + \boldsymbol{e}_i + \boldsymbol{C}_c + \boldsymbol{T}_t + \boldsymbol{lyouthshare}_{ct} + \boldsymbol{leducshare1}_{ct} + \boldsymbol{deviation}_{ct} + e_{sjict} \qquad [2]$$

where ln***un***, is the log of unemployment as previously defined, $\boldsymbol{lyouthshare}_{ct}$ and $\boldsymbol{leducshare1}_{ct}$ are the log of YOUTHSHARE and the log of EDUSHARE1 in country c and year t, $\boldsymbol{deviation}_{ct}$ measures the deviation of GDP from its trend, and other controls and parameter to be estimated are as previously defined.

[Table 3]

Results indicate that, ceteris paribus, positive deviations of the GDP from its trend tend to be negatively correlated with the unemployment rate, that the unemployment rates for males are lower than those of females, that the unemployment rates of skilled workers are lower than those of unskilled workers and that the unemployment rates of adults are lower than those of young workers. When testing the "cohort" hypothesis, in column (1), we restrict the education shock to be zero and focus on the demographic effects only. We find a positive (0.288) but not significant coefficient (at standard confidence levels) on ***lyouthshare***. However, when we interact it with a cohort dummy (see col. 2) we find a positive (and statistically significant) coefficient for the young cohort (0.715) and a negative coefficient (-0.854) for the older cohort. Conditional on this specification, the above evidence can be interpreted as showing that a reduction in the size of young cohorts over the population tends to favour them *vis-à-vis* adult cohorts, also implying a reduction in the relative young-adult unemployment rate[26]. Next, we add to the previous specification the education composition term ***leducshare1*** as previously defined. When we fit the full specification (column 3

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[24] In fact many have been testing the skill-biased technological change hypothesis.

[25] Our specification is in log of unemployment rates in levels and not in relative unemployment rates (or logs of relative unemployment rates), for in the relative term specification we would not be able to disentangle changes affecting the numerator from changes affecting the denominator.

[26] Notice that this would have the effect of making the predicted relative unemployment rates closer to the observed ones, when compared to a naïve model that uses only gender, cohort, education, country and time dummies.

in table 4) ***lyouthshare*** enters with a positive (0.569) sign while ***leducshare1*** enters with a negative (-0.391), indicating that controlling also for the educational composition may be important when estimating the demographic effects. Interaction terms with the demographics and educational terms – respectively cohort (adult) and educational attainment (upper secondary and more) dummies -- have been added to the specification, to assess whether there are differences in the elasticities by age and skill groups (see col. 4). The coefficient on *lyouthshare* (0.996 young; -0.854 adult) indicates that young cohorts benefited relatively more from the baby bust when confronted to the adult cohort. As for the role of education, we find a non statistically significant (negative) relationship between *leducshare1* and the unemployment rate of the low-educated and a strongly (statistically) significant negative relationship (-0.547) with the unemployment rate of the skilled. This result indicate that a one percentage increase in the share of the population with upper secondary diploma or more will, ceteris paribus, decrease unemployment by half percentage point.

Next, we used a different definition for the education share term (***leducshare2***) – i.e. the share of those with secondary education or more within the young cohort –, such that once we have controlled for the demographic composition, the aggregate shock to education will be mainly due to the choices of the young cohort. In other words, a higher share of skilled workers within the cohort will increase competition for skilled jobs, while through spillover effects also unskilled workers could be affected. Main results (see col. 5 and 6) indicate that ***lyouthshare*** is positively associated to the unemployment rate (still not statistically significant), ***leducshare2*** has a negative and statistically significant coefficient (-0.203) suggesting that a higher share of educated people within the young cohort is, on average, negatively associated to unemployment rates. When we allow for interaction terms (col. 6) results confirm previous findings: the demographic variable has a positive correlation with the unemployment rate for the young cohorts, while for the adult cohort the elasticity is negative and highly significant (-0.854), as far as the effects of the education share is concerned the negative correlation is significant only for the skill group, hence indicating that the effects of the baby bust have a strong bearing on the educational composition and are concentrated in the young cohort. While this result is puzzling under the pure supply framework, if we were to release the implicit assumption of constant relative labour demand an increase in the share of those with more than upper secondary education (over the total population or within the young cohort) could more than compensate the increased competition among the skilled, hence lowering the relative unemployment rate. Moreover, if the demand takes the form of a skilled-biased technological shock, the effect on total unemployment is likely to depend on the ability of relative wages to adjust and on the net effect on the skilled/educated versus the low skilled/low educated workers. To do this we include two different demand-side mismatch terms, which are country and

time specific. The first is defined as the share of investment in ICT (Information and Communication Technology) over total investment (*ict_share*); the second is the share of R&D expenditures over GDP (*R&D_share*). These variables, are meant to capture the extent to which the composition of aggregate labour demand may be biased towards skilled workers.[27] In table 4, we include both variables among our regressors.

[Table 4]

In general, results for our demographic and educational variables are not significantly altered, the demographic shock is now much higher for the younger cohort and still negative for the adults, while the education shock remains negative and statistically significant for skilled workers. More interesting are the results of the demand-side mismatch variables included. While *ict_share* is never statistically significant, the *R&D_share* confirms the skill biased nature of demand shock with a negative and statistically significant coefficient on the interaction with the skilled dummy. A number of estimation issues have also been addressed in table 5, such as serial correlation in the residuals and heteroscedasticity. We have regressed the (panel specific) errors on their one and two periods lag values, controlling for all the explanatory variables. The findings show a significant estimate for the average first order autocorrelation coefficient (0.93). Hence we have conducted a more formal test for serial correlation in the errors, using a procedure developed by Wooldridge (see Wooldridge 2002), that uses the fact that the errors obtained from first differencing the data should have a correlation coefficient equal to 0.5 in case of no serial correlation in the errors for the levels. The results indicate that we can reject the Null hypothesis of no first order serial correlation. For this reason we have re-estimated the model allowing for both panel specific heteroscedastic and serially correlated (AR(1)) error structures. Results are very robust to the above extensions and estimates are largely unaffected.

[Table 5]

More interesting is the issue of the endogeneity of educational choices. While it is certainly true that an increase in the share of skilled people can reduce the mismatch induced by skill-biased technological change in the labour market; it cannot also be excluded that the depressed labour market conditions (i.e. unemployment), by lowering the cost of investing in education, increase the share of educated workers. In other words, we face a problem of reverse causation and the estimates could be biased. One way to deal to this is to find appropriate instruments that are correlated to the decision to invest in education and are uncorrelated with the residual in the unemployment

[27] The *ict_share* varaible is not available for Norway so we have set it to zero and let the country dummy pick up the effect .

equation. While in our data set the choice of instruments is rather restricted, we have experimented two different options: (i) in the first case, we use the lag values of the education terms; and (ii) in the second case, under the assumption that current educational choices depend on the choices made by previous cohorts, we instrumented the educational term in the estimated equation with the share of individual with upper secondary education or more in the adult cohort (which is a predetermined variable). The results obtained with Instrumental Variables estimation are reported in table 6 and largely confirm those obtained with OLS. The main difference being that the elaticities of the demographic shocks for both the young and adult cohorts are now slightly smaller, while the estimates of the educational terms are larger and statistically significant in both specifications.

[Table 6]

The overall picture emerging from the above exercises suggests that demographic changes impact positively on the young cohort, while both *leducshare1* and *leducshare2* are negatively correlated with the unemployment rate (i.e. of the skilled group in particular). Our results also indicate that previous studies, by not accounting for changes in the composition of education, as well as changes in the demographic composition, are unable to explain the full picture. The share of young workers which has been declining in all countries in the time period considered here, is positively and highly correlated with the unemployment rates of young cohorts. This implies that, everything else constant, young cohorts have benefited from the "baby bust", and this is hardly compatible with models in which the average age has positive effects on the matching function. We find that young cohorts, everything else constant, do better on the labour market because they are less numerous (and relatively more educated), not because they benefit from network externalities (see, Shimer, 2001). Also, we find that "education matters", in the sense that the share of those having more than compulsory education (relative to either the whole population in the 15-54 age interval or just to the youngest cohort) is negatively related to the unemployment rate, but this beneficial effect is limited to those who have upper secondary or higher education (the skilled)[33]. Since in most countries the rise of the latter is mainly driven by the young cohort, by not conditioning on education the effects of demographics and those arising from shifts in the education composition will be mixed.

5. Comparing economic and institutional factors

In order to investigate whether institutional factors also play a role in the determination of unemployment rates (for different groups of individuals), after conditioning on demographic,

educational, cyclical and technological patterns, we augmented our preferred specification with a set of (time-varying) institutional indicators such as: employment protection (EPI), replacement ratios and duration of unemployment benefits (BR, BD), (net) union density (UDNET) and degree of coordination of the wage bargain (COI) (Blanchard and Wolfers, 2000; Katz and Autor, 2000; Belot and Van Ours, 2004; Layard and Nickell, 1999; Nickell et al., 2004).

Union density, as traditionally done in the literature, is introduced to capture union influence on wages and employment. Among other things, unions are expected to reduce wage flexibility and compress differentials such that – ceteris paribus -- the effect on unemployment is expected to be positive. Replacement ratios and duration of unemployment benefits, by improving the outside opportunities of workers and unions in the bargaining process, are also expected to be positively associated to unemployment. Employment protection measures[34], aim at protecting long term relationship *vis-à-vis* temporary work, as well as raising firing costs to reduce churning on the labour market. The impact on unemployment is likely to depend on the extent of transaction costs, compression of the wage structure and the relevance of specific human capital (Bertola and Rogerson, 1997). Finally, economies with more centralized wage setting institutions are expected to better internalize the wage-employment trade off and then should be associated to lower unemployment rates (Calmfors and Driffil, 1988). There is also evidence that demographic, macroeconomic shocks and institutions interact in a very diverse way across different groups workers, in particular the burden of adjustment is often found to bear more on young workers (Bertola et al., 2002). The latter can be explained in the light of the "two tier" mechanism of reforms, where high protection was granted to (adult) incumbent workers and more flexible rules applied to (young) labour market entrants.

[Table 7]

The main set of results are reported in Table 7 and 8. The estimated coefficients on the institutional variables, in general, have the expected sign and are, both individually and jointly, significantly different from zero. Both replacement ratios and (average) duration of unemployment benefits, in column 1, show strong displacement effects on unemployment. Conversely union density – controlling for everything else -- does not have a statistically significant effect on unemployment. The negative sign on employment protection suggests that, when accounting for the skill

[33] This results would be consistent with a model *à la* Shimer in which the matching function is positively affected by the share of the population possessing higher education.

[34] The employment protection measure used is a weighed average of the overall strictness of protection against dismissal for "regular employment" (procedural inconvenience, advance notice and severance pay, and difficulty of dismissal), and the overall strictness of regulation for "temporary work" (which is a weighted average for the fixed-term contracts and the temporary work agency) published by OECD (1999)

composition of the labour force, the impact of firing restraints on unemployment can be beneficial -- i.e. reducing labour market churning and promoting long term human capital investments. Finally, the degree of centralization in the wage bargain is found, as it is often the case in the literature, to significantly reduce unemployment. The above results are confirmed, with some interesting difference, when we interact the cohort dummy with all institutional factors. In particular, there is evidence that in most countries changes in the institutional environment (i.e. decline in union density, lower generosity of unemployment benefits and less employment protection) have affected adult unemployment relatively more. Conversely, the process of decentralization in wage bargaining, while worsening the overall wage-(un)employment trade-off, seem to have improved the employment opportunities of adults more than those of younger workers.

[Table 8]

Results are robust to alternative estimation methods to account for serial correlation and heteroscedasticity.

6. Concluding remarks

In this paper we have investigated the effects of demographic and educational shifts on the labour market position of young and prime-age workers in a number of European countries. Results show that demographic and educational shocks are qualitatively different for young (adult) workers as well as for more (less) educated people. While adult workers and more educated individuals, in general, experience lower unemployment rates, changes in the population age structure ("baby bust") appear to be positively related to young workers' unemployment rates. Conversely changes in the skill structure ("educational boom"), even when controlling for skill-biased technological change, reduce the unemployment of the more educated. Our findings also indicate that, most previous studies, not distinguishing between demographic changes and shifts in the education composition were unable to account for the full picture. The fact that young cohorts, face to the "baby bust", do relatively better, is due to the fact that they are less numerous (and relatively more educated), which is not compatible with models in which there are search externalities and age has a positive impact on the matching function. We also find that "education matters", in the sense that the share of those having more than compulsory education is negatively related to the unemployment rate. The latter results is also confirmed when the endogeneity of educational choices is accounted for using instrumental variables. Labour market institutions also influence unemployment rates in different ways. Unemployment benefits are found to have a positive impact on unemployment, while bargaining coordination and employment protection reduce it.

The policy implications from the above evidence are of particular relevance given the aging of the European population and given the deterioration of the age-dependency ratios.

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Figure 4 – Supply and demand for skill among the young cohort

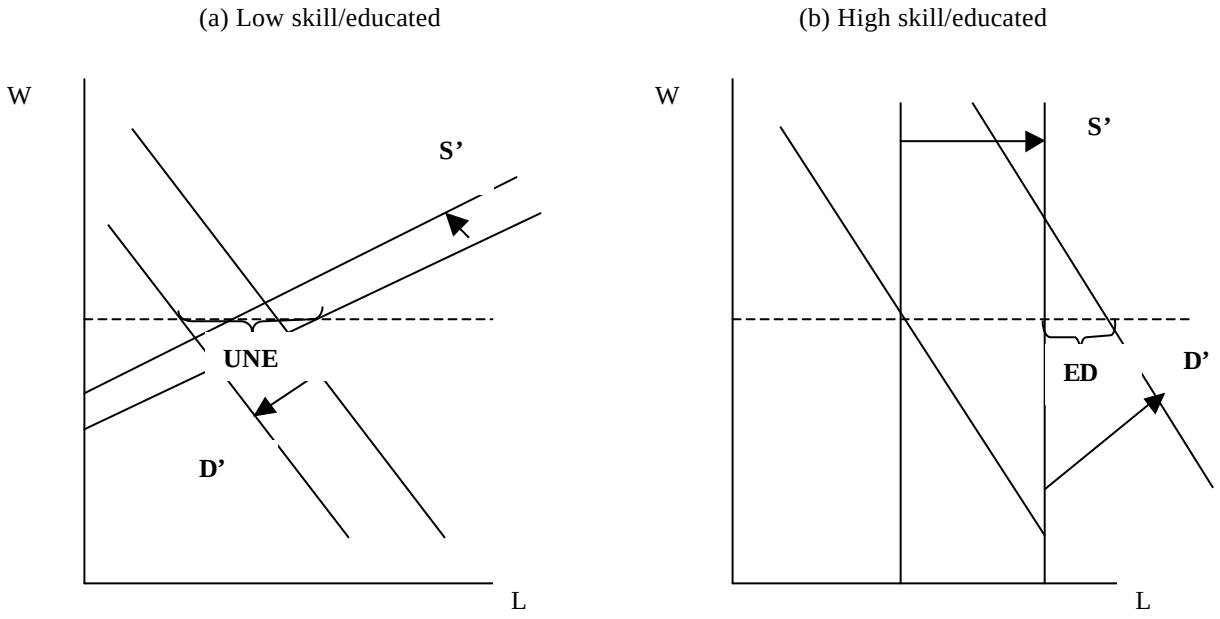

Table 3 – Estimates of Unemployment equations with Demographic and Education

Model	(1)	(2)	(3)	(4)	(5)	(6)
variables	Ln(une_rate)	Ln(une_rate)	Ln(une_rate)	Ln(une_rate)	Ln(une_rate)	Ln(une_rate)
Ln(Youthshare)	0.288 (0.6)	0.715 (1.29)	0.569 (1.23)	0.996 (1.67)	0.359 (0.79)	0.787 (1.41)
Ln(Youthshare)*Dcohort	-	-0.854 (-2.32)	-	-0.854 (-2.38)	-	-0.854 (-2.36)
Ln(Educshare1)	-	-	-0.391 (-1.62)	-0.117 (-0.56)	-	-
Ln(Educshare1)*D_sec&more	-	-	-	-0.547 (-5.04)	-	-
Ln(Educshare2)	-	-	-	-	-0.203 (-1.47)	0.008 (0.06)
Ln(Educshare2)*D_sec&more	-	-	-	-	-	-0.423 (-2.75)
Deviation	-0.0002 (-6.21)	-0.0002 (-6.19)	-0.0002 (-6.09)	-0.0002 (-6.15)	-0.0002 (-6.14)	-0.0002 (-6.20)
Dcohort25_54	-1.019 (-12.74)	-2.194 (-4.44)	-1.019 (-12.73)	-2.194 (-4.56)	-1.019 (-12.73)	-2.194 (-4.51)
Dmales	-0.239 (-3.01)	-0.239 (-3.00)	-0.239 (-3.99)	-0.239 (-3.00)	-0.239 (-3.00)	-0.239 (-3.00)
Deduc_sec&more (dummy)	-0.215 (-2.57)	-0.215 (-2.57)	-0.215 (-2.57)	-0.568 (-6.75)	-0.215 (-2.57)	-0.501 (-3.62)
constant	-2.042 (-2.44)	-1.454 (-1.72)	-1.952 (-2.38)	-1.188 (-1.38)	-2.179 (-2.58)	-1.449 (-1.77)
Country dummies**	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
R-square	0.7952	0.8021	0.7972	0.8221	0.7963	0.8128
N-obs	1456	1456	1456	1456	1456	1456

Notes: cluster robust t-statistics are in parentheses.
* Dummy variables are indicated with a “D” before the variable name

Table 4 – Estimates of Unemployment equations with Demographic and Education

Model	(1)	(2)	(3)	(4)
variables	Ln(une_rate)	Ln(une_rate)	Ln(une_rate)	Ln(une_rate)
Ln(Youthshare)	1.004 (1.73)	1.002 (1.67)	0.747 (1.34)	0.817 (1.44)
Ln(Youthshare)*Dcohort	-0.854 (-2.40)	-0.854 (-2.38)	-0.854 (-2.36)	-0.854 (-2.36)
Ln(Educashare1)	-0.224 (-1.04)	-0.143 (-0.70)	-	-
Ln(Educshare1)D_sec&more	-0.542 (-5.07)	-0.431 (-3.22)	-	-
Ln(Educashare2)	-	-	-0.020 (-0.14)	-0.033 (-0.23)
Ln(Educshare2)*D_sec&more	-	-	-0.415 (-2.74)	-0.309 (-1.96)
Ln(Ict_share)	0.087 (1.06)	-	0.061 (0.71)	-
Ln(Ict_share)*D_sec&more	0.026 (1.19)	-	0.020 (0.55)	-
Ln(R&D_share)	-	0.114 (1.50)	-	0.153 (2.40)
Ln(R&D_share)*D_sec&more	-	-0.121 (-1.86)	-	-0.172 (-3.38)
Deviation	-0.0002 (-6.11)	-0.0002 (-6.43)	-0.0002 (-6.13)	-0.0002 (-6.65)
Dcohort25_54	-2.194 (-4.60)	-2.194 (-4.56)	-2.194 (-4.52)	-2.194 (-4.51)
Dmales	-0.239 (-3.00)	-0.239 (-3.00)	-0.239 (-3.00)	-0.239 (-3.00)
Deduc_sec&more (dummy)	-0.618 (-8.09)	-0.530 (-6.03)	-0.537 (-3.54)	-0.476 (-3.92)
constant	-1.452 (-1.65)	-1.181 (-1.36)	-1.669 (-1.94)	-1.409 (-1.70)
Country dummies**	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
R-square	0.8238	0.8255	0.8138	0.8206
N-obs	1456	1456	1456	1456

Notes: cluster robust t-statistics in parentheses.
* Dummy variables are indicated with a "D" before the variable name
** In models 1 and 3 the value of the variable Ln(Ict_share) is zero for Norway

Table 5 – Estimates of Unemployment equations with Demographic and Education- FGLS

Model	(1)	(2)	(3)	(4)
variables	Ln(une_rate)	Ln(une_rate)	Ln(une_rate)	Ln(une_rate)
Ln(Youthshare)	0.670 (4.39)	0.665 (4.29)	0.661 (4.45)	0.644 (4.18)
Ln(Youthshare)*Dcohort	-0.505 (-2.92)	-0.499 (-2.90)	-0.528 (-3.15)	-0.475 (-2.79)
Ln(Educashare1)	0.274 (3.52)	0.263 (3.33)	-	-
Ln(Educshare1)D_sec&more	-0.448 (-8.40)	-0.424 (-7.26)	-	-
Ln(Educashare2)	-	-	0.152 (3.07)	0.165 (3.17)
Ln(Educshare2)*D_sec&more	-	-	-0.322 (-6.34)	-0.318 (-5.72)
Ln(Ict_share)	-0.004 (-0.26)	-	-0.003 (-0.23)	-
Ln(Ict_share)*D_sec&more	0.0003 (0.03)	-	0.002 (0.26)	-
Ln(R&D_share)	-	0.001 (0.08)	-	0.006 (0.39)
Ln(R&D_share)*D_sec&more	-	-0.008 (-0.41)	-	-0.016 (-0.80)
Deviation	-0.0002 (-21.23)	-0.0002 (-21.42)	-0.0002 (-21.27)	-0.0002 (-21.33)
Dcohort25_54	-1.818 (-7.48)	-1.792 (-7.42)	-1.815 (-7.77)	-1.740 (-7.31)
Dmales	-0.234 (-6.88)	-0.256 (-7.12)	-0.252 (-7.76)	-0.274 (-7.80)
Deduc_sec&more (dummy)	-0.548 (-9.10)	-0.512 (-8.40)	-0.408 (-6.66)	-0.399 (-6.48)
constant	-0.830 (-3.35)	-0.985 (-3.89)	-1.110 (-4.71)	-1.152 (-4.62)
Country dummies**	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
N-obs	1456	1456	1456	1456

Notes: z-statistics, robust to panel heteroscedasticity and serial correlation, are in parentheses.
* Dummy variables are indicated with a "D" before the variable name
** In models 1 and 3 the value of the variable Ln(Ict_share) is zero for Norway

Table 6 – IV Estimates (2SLS) of Unemployment equations with Demographic and Education

Model	(1)	(2)	(3)	(4)
variables	Ln(une_rate)	Ln(une_rate)	Ln(une_rate)	Ln(une_rate)
Ln(Youthshare)	0.862 (2.75)	0.839 (2.76)	0.475 (1.51)	0.516 (1.74)
Ln(Youthshare)*Dcohort	-0.794 (-4.67)	-0.794 (-4.92)	-0.794 (-4.44)	-0.794 (-4.72)
Ln(Educashare1)	-0.471 (-2.65)	-0.390 (-2.23)	-	-
Ln(Educshare1)D_sec&more	-0.625 (-7.96)	-0.508 (-5.73)	-	-
Ln(Educashare2)	-	-	-0.690 (-1.76)	-0.567 (-1.65)
Ln(Educshare2)*D_sec&more	-	-	-1.225 (-6.87)	-0.951 (-5.32)
Ln(Ict_share)*D_prim	0.087 (1.87)	-	0.131 (2.26)	-
Ln(Ict_share)*D_sec&more	0.113 (2.47)	-	0.119 (2.15)	-
Ln(R&D_share)*D_prim	-	0.087 (2.00)	-	0.073 (1.47)
Ln(R&D_share)*D_sec&more	-	-0.042 (-1.03)	-	-0.070 (-1.43)
Deviation	-0.0002 (-8.64)	-0.0002 (-9.09)	-0.0002 (-7.19)	-0.0002 (-8.08)
Dcohort25_54	-2.115 (-8.93)	-2.115 (-9.45)	-2.115 (-8.43)	-2.115 (-8.99)
Dmales	-0.249 (-9.34)	-0.249 (-9.41)	-0.249 (-8.35)	-0.249 (-8.80)
Deduc_sec&more (dummy)	-0.651 (-10.98)	-0.564 (-10.29)	-0.974 (-9.60)	-0.864 (-7.80)
constant	-2.008 (-4.50)	-1.752 (-4.23)	-3.301 (-4.94)	-2.728 (-5.05)
Country dummies**	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
N-obs	1456	1456	1456	1456

Notes: z-statistics, robust to panel heteroscedasticity and serial correlation, are in parentheses.
* Dummy variables are indicated with a "D" before the variable name
** In models 1 and 3 the value of the variable Ln(Ict_share) is zero for Norway

***In all columns the instrument is the share of those with secondary education or more within the adult cohort (i.e. in the age interval 25-54).

Table 7– Estimates of Unemployment equations with Demographic, Education and Institutions

Model	(1)	(2)	(3)	(4)	(5)	(6)
variables	Ln(une_rate)	Ln(une_rate)	Ln(une_rate)	Ln(une_rate)	Ln(une_rate)	Ln(une_rate)
Ln(Youthshare)	0.178	0.847	0.588	-0.135	0.534	0.275
	(0.23)	(0.78)	(0.69)	(-0.18)	(0.53)	(0.35)
Ln(Youthshare)*Dcohort	-	-1.338	-0.820	-	-1.338	-0.820
		(-2.59)	(-1.23)		(-2.55)	(-1.18)
Ln(Educshare1)	-0.360	-0.085	-0.085	-	-	-
	(-1.26)	(-0.27)	(-0.30)			
Ln(Educshare1)*D_sec&more	-	-0.551	-0.551	-	-	-
		(-5.02)	(-5.01)			
Ln(Educashare2)	-	-	-	-0.081	0.124	0.124
				(-0.58)	(0.66)	(0.72)
Ln(Educshare2)*D_sec&more	-	-	-	-	-0.411	-0.411
					(-2.52)	(-2.52)
Udnet	0.366	0.366	0.653	0.469	0.469	0.755
	(0.37)	(0.38)	(0.76)	(0.44)	(0.46)	(0.80)
Udnet*Dcohort25_54	-	-	-0.572	-	-	-0.572
			(-2.04)			(-2.02)
Epi	-0.704	-0.704	-0.439	-0.627	-0.627	-0.363
	(-3.13)	(-4.36)	(-2.30)	(-2.70)	(-3.79)	(-1.83)
Epi*Dcohort25_54	-	-	-0.528	-	-	-0.528
			(-2.51)			(-2.48)
Bd	1.012	1.012	0.985	0.965	0.965	0.938
	(2.42)	(2.47)	(2.09)	(2.27)	(2.29)	(1.98)
Bd*Dcohort25_54	-	-	0.053	-	-	0.053
			(0.16)			(0.16)
Br	0.840	0.840	0.591	0.887	0.887	0.639
	(2.30)	(2.56)	(1.57)	(2.29)	(2.54)	(1.63)
Br*Dcohort25_54	-	-	0.496	-	-	0.496
			(2.30)			(2.30)
Coi	-0.650	-0.650	-0.830	-0.625	-0.625	-0.805
	(-3.92)	(-4.79)	(-4.02)	(-3.96)	(-4.95)	(-3.92)
Coi*Dcohort25_54	-	-	0.359	-	-	0.359
			(1.56)			(1.55)
Ln(Ict_share)	0.112	0.104	0.104	0.083	0.077	0.077
	(1.48)	(1.51)	(1.80)	(1.08)	(1.03)	(1.24)
Ln(Ict_share)*D_sec&more	-	0.016	0.016	-	0.011	0.011
		(0.77)	(0.77)		(0.27)	(0.27)
Deviation	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003
	(-10.48)	(-8.21)	(-8.70)	(-10.20)	(-8.46)	(-8.90)
Dcohort25_54	-1.051	-2.898	-2.173	-1.051	-2.898	-2.173
	(-11.93)	(-3.96)	(-2.11)	(-11.93)	(-3.89)	(-2.05)
Dmales	-0.184	-0.184	-0.184	-0.184	-0.184	-0.184
	(-2.19)	(-2.18)	(-2.18)	(-2.19)	(-2.18)	(-2.18)
Deduc_sec&more (dummy)	-0.239	-0.646	-0.646	-0.239	-0.532	-0.532
	(-2.52)	(-8.41)	(-8.38)	(-2.52)	(-3.24)	(-3.23)
constant	-0.108	1.018	0.655	-0.504	0.565	0.202
	(-0.06)	(0.50)	(0.34)	(-0.29)	(0.29)	(0.11)
Country dummies**	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
R-square	0.8323	0.8608	0.8836	0.8315	0.8509	0.8737
N-obs	1064	1064	1064	1064	1064	1064

Notes: cluster robust t-statistics in parentheses
* dummy variables are indicated with a “D” before the variable name
** Norway and Greece are not included.

Table 8– Estimates of Unemployment equations with Demographic, Education and Institutions: FGLS

Model	(1)	(2)
variables	Ln(une_rate)	Ln(une_rate)
Ln(Youthshare)	0.354 (1.69)	0.354 (1.76)
Ln(Youthshare)*Dcohort	-0.403 (-)1.90	-0.342 (-1.68)
Ln(Educshare1)	0.386 (4.26)	-
Ln(Educshare1)*D_sec&more	-0.484 (-9.51)	-
Ln(Educashare2)	-	0.248 (4.32)
Ln(Educshare2)*D_sec&more	-	-0.351 (-6.58)
Udnet	1.263 (4.03)	1.148 (3.59)
Udnet*Dcohort25_54	-0.273 (-2.03)	-0.209 (-1.60)
Epi	-0.011 (-0.12)	-0.009 (-0.10)
Epi*Dcohort25_54	-0.314 (-3.24)	-0.307 (-3.21)
Bd	0.324 (2.57)	0.272 (2.17)
Bd*Dcohort25_54	0.355 (2.51)	0.380 (2.66)
Br	0.028 (0.22)	0.009 (0.07)
Br*Dcohort25_54	0.309 (2.42)	0.329 (2.56)
Coi	-0.497 (-6.80)	-0.489 (-6.44)
Coi*Dcohort25_54	0.164 (2.09)	0.172 (2.13)
Ln(Ict_share)	0.081 (3.40)	0.084 (3.69)
Ln(Ict_share)*D_sec&more	-0.007 (-0.45)	-0.009 (-0.56)
Deviation	-0.0003 (-23.41)	-0.0003 (-24.24)
Dcohort25_54	-1.710 (-4.52)	-1.675 (-4.57)
Dmales	-0.167 (-5.21)	-0.181 (-5.46)
Deduc_sec&more (dummy)	-0.544 (-8.96)	-0.426 (-6.85)
constant	-0.639 (-1.22)	-0.828 (-1.62)
Country dummies**	Yes	Yes
Year dummies	Yes	Yes
N-obs	1064	1064

Notes: z-statistics, robust to panel heteroscedasticity and serial correlation, are in parentheses.
* dummy variables are indicated with a “D” before the variable name.
** Norway and Greece are not included.

Statistical Annex

A1 – Unemployment figures

The tables below compare our dataset (disaggregated by cohort and gender) with OECD *"Employment Outlook"* data (no labour force disaggregation by educational level is officially available). The first line of each table reports unemployment rates from OECD whereas the second line the ones drawn on our dataset.

The tables below do not show great discrepancy between the collected data and the OECD source.

Unemployment rates - 1983						
Country	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
	15_24		**25_54**		**55_64**	
France - OECD	15.0	25.5	4.4	7.7	6.0	6.9
France	14.3	19.9	3.7	6.4	4.1	5.4
Italy - OECD	23.8	34.9	2.6	8.1	1.5	2.4
Italy	23.4	37.6	2.9	9.0	1.5	4.5
Norway - OECD	8.2	9.6	2.6	2.9	1.1	0.8
Norway	8.1	9.4	2.3	2.7	1.7	1.5
Spain – OECD	33.7	43.7	11.5	11.6	8.8	2.9
Spain	39.6	42.9	11.4	11.2	7.3	2.5
Uk - OECD	20.9	18.2	9.4	9.7	10.6	7.3
Uk	19.0	14.3	8.8	6.5	12.2	5.8

Unemployment rates - 1990						
Country	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
	15_24		**25_54**		**55_64**	
France - OECD	15.3	23.9	5.9	10.7	6.0	7.6
France	14.2	20.3	5.5	9.5	4.8	6.9
Greece - OECD	15.1	32.6	3.2	8.6	1.8	1.2
Greece	15.1	32.4	3.8	10.0	1.8	3.2
Italy - OECD	26.2	37.8	4.5	12.2	1.6	2.3
Italy	25.7	37.7	4.5	12.2	2.1	2.9
Norway - OECD	12.4	11.0	4.7	3.9	3.0	1.9
Norway	12.7	10.7	4.5	3.9	2.6	1.8
Sweden - OECD	4.5	4.4	1.3	1.2	1.3	1.6
Sweden	3.8	3.5	1.2	1.1	1.3	1.6
Spain – OECD	26.2	39.7	9.3	20.6	8.4	7.2
Spain	25.5	39.1	9.4	20.7	8.1	6.7
Uk - OECD	11.1	9.0	5.6	6.0	8.4	5.0
Uk	13.7	10.0	6.1	4.2	7.7	2.6

Unemployment rates - 1995						
Country	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
	15_24		**25_54**		**55_64**	
Finland - OECD	41.3	28.1	14.6	14.6	16.3	22.8
Finland	31.7	28.8	15.2	14.6	25.3	22.2
France - OECD	21.0	32.2	8.8	12.6	7.7	6.6
France	19.6	26.9	8.0	11.2	6.2	7.0
Germany - OECD	8.1	8.0	6.4	9.7	10.4	13.1

Germany	7.8	8.1	6.2	9.4	9.7	13.4
Greece - OECD	19.4	37.7	5.1	10.9	3.6	2.9
Greece	20.3	40.6	6.4	13.7	3.7	5.8
Italy - OECD	29.0	37.6	6.7	12.6	4.1	4.9
Italy	36.5	46.3	7.8	15.9	4.2	4.6
Norway - OECD	11.9	11.8	4.3	3.7	3.2	1.9
Norway	11.9	11.7	4.3	3.7	3.2	1.8
Portugal - OECD	14.5	17.6	5.5	7.5	5.0	2.8
Portugal	14.6	18.0	5.2	7.2	4.8	2.8
Spain - OECD	37.0	49.1	15.3	27.5	12.6	11.4
Spain	36.3	48.0	15.2	27.5	12.1	10.1
Sweden - OECD	16.7	14.0	7.2	5.9	8.5	6.3
Sweden	16.6	13.9	6.9	5.9	8.5	6.3
Uk - OECD	17.9	12.2	8.5	6.’	10.1	3.7
Uk	19.8	11.8	8.9	6.4	11.2	3.4

Unemployment rates- 1998						
Country	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
	15_24		**25_54**		**55_64**	
Finland - OECD	23.2	24.5	9.0	10.1	14.0	13.9
Finland	22.8	25.4	9.0	10.0	13.0	13.0
France - OECD	21.8	30.0	9.2	12.7	8.2	9.3
France	21.1	26.2	8.4	11.4	6.4	7.6
Germany - OECD	9.7	8.2	7.8	9.2	13.6	16.4
Germany	9.7	8.3	8.3	9.9	14	17.8
Greece - OECD	21.4	39.3	5.7	13.9	2.9	3.7
Greece	21.4	39.2	6.4	15.6	3.7	6.9
Italy - OECD	27.2	39.0	6.8	12.9	3.8	3.8
Italy	36.5	46.8	8.2	17.0	5.1	4.7
Norway - OECD	8.9	9.4	2.3	2.4	2.0	1.6
Norway	9.0	9.3	2.3	2.3	1.9	1.9
Portugal - OECD	8.0	12.8	3.4	5.7	3.5	2.9
Portugal	8.2	12.9	3.5	5.7	3.6	2.9
Spain - OECD	27.1	43.4	11.5	24.1	9.6	12.1
Spain	29.4	43.5	11.7	24.1	9.1	11.3
Sweden - OECD	17.5	16.1	7.8	7.3	7.8	5.2
Sweden	12.7	10.7	6.0	5.6	7.0	4.7
Uk - OECD	14.0	10.4	5.4	4.5	6.8	3.1
Uk	14.9	9.6	5.0	3.9	4.5	3.2

Unemployment rates- 2000						
Country	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
	15_24		**25_54**		**55_64**	
Finland - OECD	21.2	21.8	7.2	8.8	9.3	9.4
Finland	21.1	22.2	7.2	8.9	9.1	9.2
France - OECD	18.4	23.7	7.5	11.1	7.6	8.3
France	18.7	22.7	7.0	10.1	5.6	5.6
Germany - OECD	8.1	7.2	6.7	8.0	12.6	15.0

Germany	8.6	7.2	6.7	7.6	11.6	14.3
Greece - OECD	22.1	37.7	6.1	14.7	3.5	4.4
Greece	22.1	37.7	7.2	16.9	3.8	7.2
Italy - OECD	25.4	35.4	6.2	11.7	4.4	2.9
Italy	34.3	43.2	7.7	15.8	4.9	4.9
Norway - OECD	9.5	10.9	2.9	2.3	1.8	0.7
Norway	9.5	10.2	2.9	2.3	1.5	0.9
Portugal - OECD	6.2	11.6	2.7	4.4	3.7	2.6
Portugal	6.2	11.6	2.7	4.4	3.7	2.6
Spain - OECD	19.4	32.9	8.0	18.9	8.6	11.3
Spain	19.5	32.3	7.9	18.7	8.8	11.0
Sweden - OECD	12.3	11.4	5.2	4.6	6.9	5.3
Sweden	8.4	7.3	4.2	3.7	6.1	4.7
Uk - OECD	13.2	10.1	4.8	4.0	5.5	2.8
Uk	12.9	9.0	3.4	3.3	5.9	1.1

A2 – Labour Market Institutions Data (from Nickell and Nunziata)

EPI: Employment Protection
Blanchard and Wolfers (2000) provide an employment protection time varying variable from 1960 to 1995, each observation taken every 5 years. This series was built chaining OECD data with data from Lazear (1990). Notice that the OECD data, used from 1985 onward, is constructed on the basis of a more extensive collection of employment protection dimensions, compared with data used by Lazear. This dataset includes an interpolation of the Blanchard and Wolfers series, readjusted in mean. Range is {0,2} increasing with strictness of employment protection.

UDNET: Net Union Density
This variable is constructed as the ratio of Total Reported Union Members (gross minus retired and unemployed members), from Visser (1996), on Wage and Salaried Employees, from Comparative Welfare Dataset (1997).

COI: Bargaining Coordination
This is an index with range (1, 3) constructed as an interpolation of OECD data on bargaining coordination. It is increasing in the degree of coordination in the bargaining process on the employers' as well as on the unions' side. The resulting series were matched with the data provided by Belot and Van Ours (2000).

BR: Benefit Replacement Rates
Benefit Replacement Rates data is provided by OECD with one observation every two years for each country in the sample. The data refers to first year of unemployment benefits, averaged over family types of recipients, since in many countries benefits are distributed according to family composition.

BD: Benefit Durations
The index is a weighted average of the unemployment benefit replacement rate perceived from the first year of unemployment to the fourth year of unemployment (with decreasing weights)