DISCUSSION PAPER SERIES

IZA

IZA DP No. 1299

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September 2004

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

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ABSTRACT

Are Wages in Southern Europe More Flexible? The Effects of Cohort Size on European Earnings*

We exploit the cross-country and time variation in the demographics and education structure in 11 European countries to study how cohort size has affected real earnings in Europe. When we pool the data of all countries, we find that cohort size has a negative and statistically significant effect on the earnings of the older cohorts – aged between 35 and 54 – but no statistically significant effect on the earnings of younger cohorts – aged 20 to 34. The negative effect of cohort size on earnings is completely driven by Southern European countries, a result which we relate to institutional differences. While the share of individuals aged 20 to 34 in the population has declined in the EU11 by 10.20 percent between 1991 and 2001, the share of individuals aged 35 and 54 has increased by 9.32 percent. Our estimates suggest that, as a consequence of these significant demographic changes, the real earnings of the younger cohorts have increased on average by a tiny 0.06 percent, while the earnings of the older cohorts have declined by 0.93 percent, a modest variation.

JEL Classification: J11, J31

Keywords: cohort size, wages, Europe

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* This paper has been produced within the TSER EDWIN Project, funded by the European Commission. We are grateful to Thomas Zwick and to audiences at the EDWIN meeting in Milan and Mannheim for comments and suggestions. The European Community Household Panel data used in this paper are from the December 2003 release (contract 14/99 with the Department of Economics, University of Padova). The usual disclaimer applies.

Introduction

Europe is ageing. The decline in the birth rate as well as in the child and old age mortality rate since the 1970s have substantially changed the age structure of the EU15 population. Table 1 shows the changes in cohort size for 13 European countries and two age groups, 20 to 34 and 35 to 54, between 1991 and 2001. The general pattern is a substantial decline in the size of the younger age group and an increase in the size of the older age group in all EU countries. These percentage changes are particularly marked in Germany, The Netherlands, Austria and Belgium and stronger in Northern than in Southern Europe.

Table 1. Changes in population cohort sizes between 1991 and 2001 (in percent).

	20-34 year-olds	35-54 year-olds
Germany	-14.95	13.35
Denmark	-6.71	5.46
The Netherlands	-14.97	13.96
Belgium	-14.54	13.19
France	-11.83	10.54
UK	-11.94	11.15
Ireland	-1.32	1.25
Italy	-7.77	6.91
Greece	-1.45	1.26
Spain	-5.37	5.42
Portugal	-4.74	4.35
Austria	-14.91	14.59
Finland	-11.80	9.00
North	-13.21	11.96
South	-6.01	5.58
EU11	-6.46	14.59

Source : Eurostat Labor Force Survey. South includes Italy, Greece, Spain and Portugal. EU11 excludes France and The Netherlands.

Ageing affects the economy and the labor market in a number of ways. The actual and potential effects on productivity, skill development, employment and social security have attracted considerable attention, and have been reviewed by OECD, 1998, the European Commission, 2003, Johnson and Zimmermann, 1993, and Boersch-Supan, 2001, among others.

The empirical investigation of the relationship between cohort size and earnings was initially motivated by the entry of the baby–boom birth cohorts in the labor market during the 1970s (see for instance Welch, 1979). Korenman and Neumark, 2000, review the existing and largely US oriented empirical literature on this topic. Broadly, the studies on the US support the hypothesis that individuals born in large cohorts face depressed (real) earnings. Typically, demographic changes are measured by changes in the relative cohort size of an age group, say the young. Assuming that individuals born in the same age cohort are perfect substitutes, an increase in the relative cohort size of the young is expected – ceteris paribus - to deteriorate their earnings because of the higher competition in the labor market – a relative supply effect.

Empirical evidence on the response of real earnings to changes in demographics is scarce for European countries, mainly because of the lack of comparative data on earnings. This is unfortunate, because the well known differences in the flexibility of European and US labor markets would suggest that the response of earnings to changes in cohort size might differ substantially in the two economic areas[1]. Among the few European studies, Wright, 1991, replicates for Great Britain the approach by Welch, 1979, and finds that – ceteris paribus – large cohorts face lower earnings, although the effect does not persist as each cohort ages.

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[1] See Bertola, Blau and Kahn, 2003.

The comparative evidence on the effects of ageing on employment and unemployment in Europe and the US is more abundant than the evidence on the effects on wages. Korenman and Neumark, 2000, and more recently Jimeno and Palenzuela, 2002, investigate whether changes in cohort size have significantly affected relative unemployment rates. These authors use pooled cross–section data for a group of OECD countries and find evidence of a positive correlation between the youth unemployment rate and the youth cohort size. Ahn, Izquierdo and Jimeno, 2000, also find a positive relationship between the relative size of the youth population and youth unemployment in a sample of Spanish regions. Finally, Bertola, Blau and Kahn, 2002, show that demographic shocks, such as changes in cohort size, interacted with labor market institutions, contribute to explaining the difference in the aggregate unemployment rate between the US and Europe[2].

Our paper adds to this literature by providing empirical evidence on the impact of cohort size on real earnings in Europe. We use the seven waves (1995 to 2001) of the European Community Household Panel, a large survey of individuals living in EU15, which contains comparable information on individual earnings. Since these are micro-data, we are able to control for a large variety of individual factors affecting wages, beside cohort size.

We show that the definition of cohort size used in the literature can be conveniently decomposed in a demographic effect and in a relative education effect. Because the covered period is relatively short, we use the cross-country heterogeneity in demographic patterns and educational shifts to identify cohort effects on earnings. We investigate whether the size of the cohort an individual belongs to significantly affects her earnings, and whether these effects vary with

[2] See also Jimeno and Palenzuela, 2002 and Shimer, 2001.

education, age and country. The divide by education and age is important. Indeed, the size of the relevant cohort might have a different impact on earnings depending on the degree of substitutability between age and education groups (see Stapleton and Young, 1988). The Northern versus Southern Europe divide is even more interesting, because of the differences both in the size of the demographic / educational shifts experienced during the 1990s and in labor market institutions. In particular, Southern European labor markets are characterized by higher employment protection, and we uncover in the paper a positive correlation between employment protection and the responsiveness of earnings to changes in cohort size.

The paper is organized as follows. We start by discussing the concept and measurement of cohort size (Section 1). Next, we introduce the data (Section 2) and present our empirical strategy (Section 3). Our results are shown and discussed in Section 4. Conclusions follow.

1. The definition of cohort size

We intend to study how the relative size of the cohort an individual belongs to affects her earnings. The relevant cohort is the population group with which the individual competes in the labor market. Following most of the literature, we restrict competition to workers with a similar level of experience, proxied by age, and a similar level of education. Suppose that the population N consists of age cohorts a and education groups e and let N_a and N_e be the number of individuals belonging to each age cohort and to education e respectively. Finally, let the number of individuals with education e in the age group a be N_{ae}.

In the literature (e.g. Welch, 1979, Card and Lemieux, 2002), cohort size is defined as the share of the selected age group in the total population with the same education attainment. Therefore

$$CS_{ae} = \frac{N_{ae}}{N_e} \tag{1}$$

and the empirical exercise consists of studying the impact of this variable on w_{ae}, the real hourly earnings of the selected age-education group, conditional on other controls. A feature of definition (1) is that an increase in N_{ae} and thus in CS_{ae} might result either from an increase in the size of the age group – a pure demographic effect - or from an increase in the relative share of the education group within the same age group – a relative education effect. Hence , the estimated effect of CS_{ae} on earnings captures both the effect of demographics and the impact of educational shifts across cohorts.

A way to disentangle demographic from relative education effects is to express cohort size as

$$CS_{ae} = \frac{N_{ae}}{N_e}. = \frac{N_a}{N}.\frac{N_{ae}}{N_a}.\frac{N}{N_e} = CS_a \frac{ES_{ae}}{ES_e} \tag{2}$$

where

$CS_a = N_a / N$ = share of age group a in the whole population

$ES_{ae} = N_{ae} / N_a$ = share of education group e in the relevant age group

$ES_e = N_e / N$ = share of education group e in the whole population.

Since CS_a is independent of educational attainment, it captures a pure demographic effect[3]. On the other hand, the ratio ES_{ae}/ES_e measures whether the proportion of individuals with education e is higher (ratio above 1) or lower (ratio below 1) in age group a than in the whole population. Taking logs and time derivatives of (2) yields

[3] Wright, 1991, uses only this measure in his study of the UK labor market.

$$\partial \ln CS_{ae} = \partial \ln CS_a + \partial \ln \frac{ES_{ae}}{ES_e} \quad (3)$$

The change in cohort size CS_{ae} over time can be decomposed into a demographic and an educational shift. For instance, an increase in the cohort size of the young and less educated can be generated either by a demographic shift, which increases the share of the young in the population, or by an educational shift, which increases the share of the less educated among the young, relative to the population share, or by both.

If the purpose is to evaluate the impact of demographic shifts on earnings, it is necessary to net out from the observed variation of cohort size CS_{ae} the variation induced by changes in the educational attainment of each cohort, relative to the population. One way to do this is to replace cohort size CS_{ae} in earnings regressions with the demographic effect CS_a and the relative education effect ES_{ae}/ES_e.

In practice, it is overly restrictive to limit labor market competition to individuals of the very same age, and it is more reasonable to assume that people compete with individuals of *approximately* the same age, i.e. a bit younger or older. Therefore, as in Welch, 1979, and Berger, 1984, we compute the size of the relevant age group as a moving average around the age of the individual concerned:

$$\overline{N}_{ae} = \frac{1}{9}N_{(a-2)e} + \frac{2}{9}N_{(a-1)e} + \frac{3}{9}N_{ae} + \frac{2}{9}N_{(a+1)e} + \frac{1}{9}N_{(a+2)e} \quad (4)$$

In words, the size of the relevant age group is measured by a weighted average of the size of age – education cohort *ae* in the selected group, N_{ae}, and of the size of the two adjacent age cohorts with the same education, both younger and older, with weights declining with distance from the current cohort. The idea is that the relevant age-education group is composed of individuals within a 5–years age range, with the age of reference having the highest weight and the adjacent ages having weights that decline with the distance from the age of reference. Next, we define

$$\overline{N}_a = \frac{1}{9}N_{(a-2)} + \frac{2}{9}N_{(a-1)} + \frac{3}{9}N_a + \frac{2}{9}N_{(a+1)} + \frac{1}{9}N_{(a+2)} \qquad (5)$$

as the weighted average of the size of age cohorts *a*, after aggregating across education groups. The empirical definition of cohort size used in the paper is then $CS_{ae} = \frac{\overline{N}_{ae}}{N_e}$. Similarly, $CS_a = \frac{\overline{N}_a}{N}$ and $\frac{ES_{ae}}{ES_e} = \frac{\overline{N}_{ae}}{\overline{N}_a}\frac{N}{N_e}$.

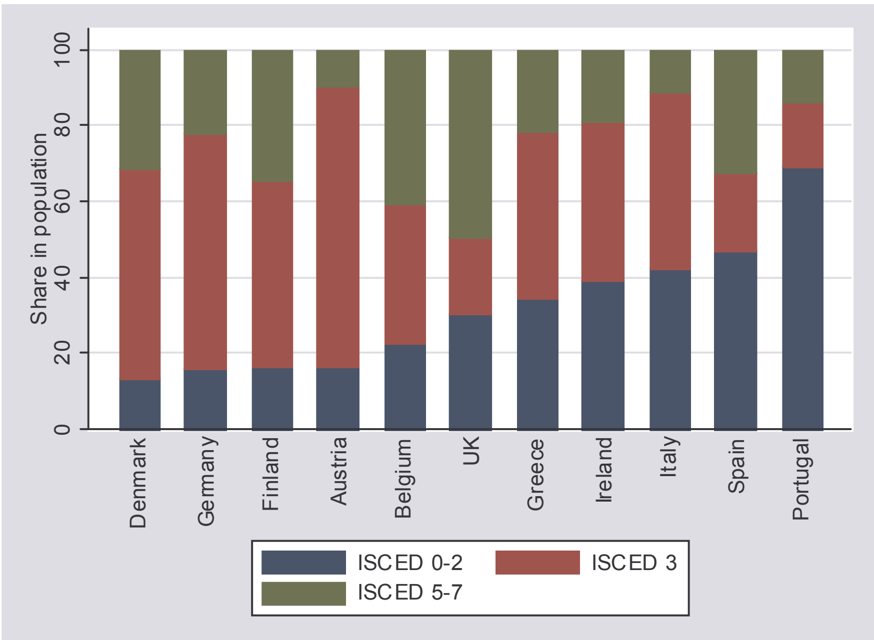
2. The Data

Our data are drawn from the December 2003 release of the *European Community Household Panel* (ECHP), a longitudinal survey modelled on the US Panel Study of Income Dynamics (PSID). This survey provides a wide range of information on individual income and socio-economic characteristics for all EU countries and aims to be representative both in cross-sections and longitudinally. Due to the common questionnaire, the information contained in the ECHP is, in principle, comparable across countries, which is its main strength. The ECHP data collection is made at the national level by National Data Collection Units (NDUs), while Eurostat provides centralized support and coordination.

The ECHP data cover the period 1994-2001 for each country belonging to EU-15. Austria joined in 1995 and Finland in 1996. Unit non-responses and attrition rates in the ECHP are comparable with those of other longitudinal household surveys (see Peracchi, 2002).

Nevertheless, due to small entry rates, attrition results in a reduction of the sample size that is increasing with time, and is highest in the transition from the first to the second wave (see Bassanini and Brunello, 2004). Because of this, we exclude the first wave. We also exclude from our sample Sweden, which has no wage data. Since cohort size CS varies by educational attainment, we need information on age and completed education. The ECHP uses the ISCED classification and distinguishes between three levels of attainment: primary and lower secondary (ISCED 0-2), upper secondary (ISCED 3) and tertiary (ISCED 5-7). Because the quality of the information on education is rather poor for France and The Netherlands, we omit these two countries from our final sample[4]. Figure 1 shows the substantial heterogeneity within EU11 in educational attainment, with Northern countries having a very low share of poorly educated individuals, compared to the South of Europe.

Figure 1. Population by educational attainment (ES_e) and country, 2001

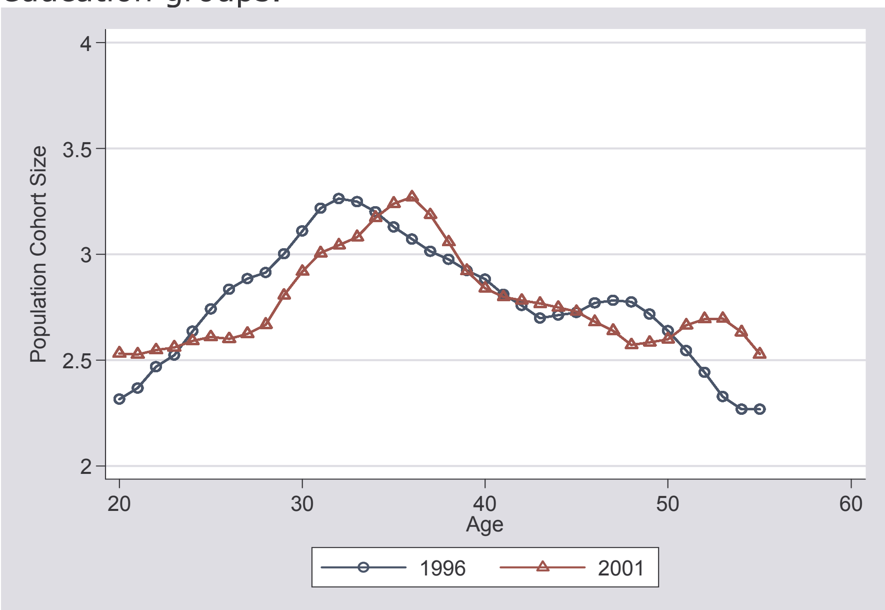


[4] Our sample includes Germany, Denmark, Belgium, the UK, Ireland, Italy, Greece, Spain, Portugal, Austria and Finland.

We select individuals – both employed and unemployed – aged between 20 and 55 and identify cohort with age as explained in the previous section. Therefore, there are 36 age cohorts for each level of education[5]. We exclude individuals still at school and those who report having changed their educational attainment during the sample period. Furthermore, we restrict the age sample for those with tertiary education to individuals aged 25 to 55. We compute the number of individuals in each cell – defined by year, country, education and age – by using the ECHP cross-section weights of interviewed persons and by applying the country-specific inflation factors, given by the ratio of the country population to the actual sample size[6].

Figure 2 shows the average size of age cohorts for the 11 European countries (EU11) considered in this study and for the years 1996 and 2001. In spite of the relatively short span of time, the figure clearly shows the demographic shift away from the younger and toward the older cohorts.

Figure 2. Cohort Size (CS_a), average EU-11, 1996 and 2001. All education groups.

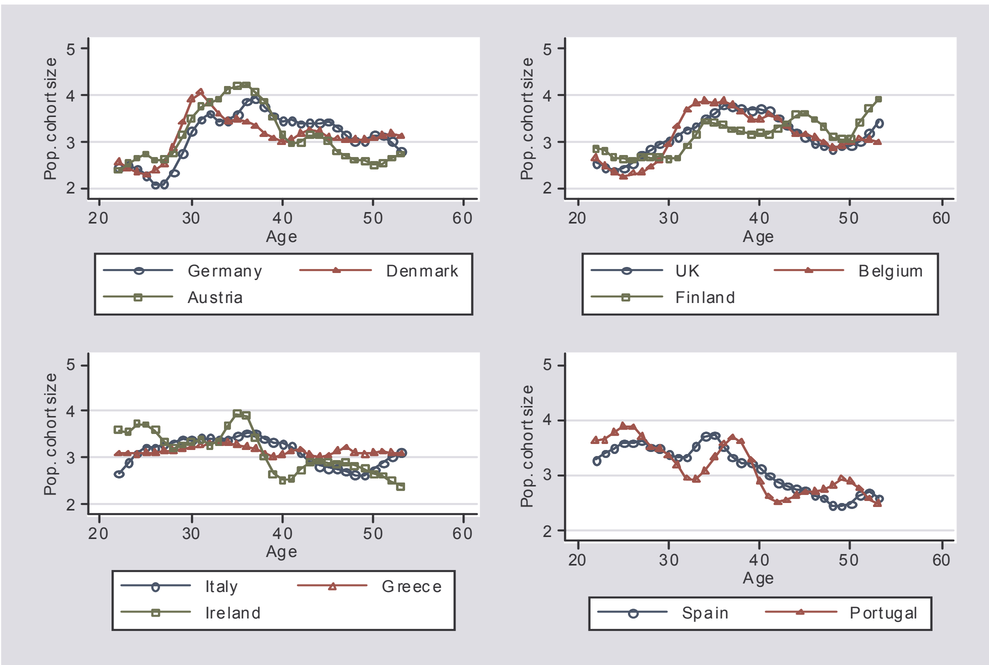


[5] In order to compute cohort size for the 36 age groups, we use data on individuals aged 18 to 57.

Figure 3 illustrates the substantial heterogeneity in the relative size of age cohorts across European countries in 2001, an important feature of our data given the limited time span available (see Korenman and Neumark, 2000, for a discussion of identification issues). We notice that the cohort size of individuals aged below 30 is significantly lower in Northern than in Southern Europe, with two noteworthy exceptions, Ireland and Italy. Figures A1, A2 and A3 in the Appendix provide further detail by showing the heterogeneity of changes in cohort size CS_a between 1996 and 2001 among European countries.

Figure 4 plots average EU11 cohort size CS_{ae} by educational attainment and shows that the reduction in the size of the younger cohorts is sharper for the less educated, suggesting that the negative demographic shift illustrated in Figure 2 has been amplified by a shift away of the young from lower education.

Figure 3: Cohort size (CS_a), by country, 2001. All education groups.



[6] See the file DOC.PAN 168 attached to the ECHP user data files for further details.

Figure 4: Cohort size (CS_{ae}), by country and education, 1996 and 2001.

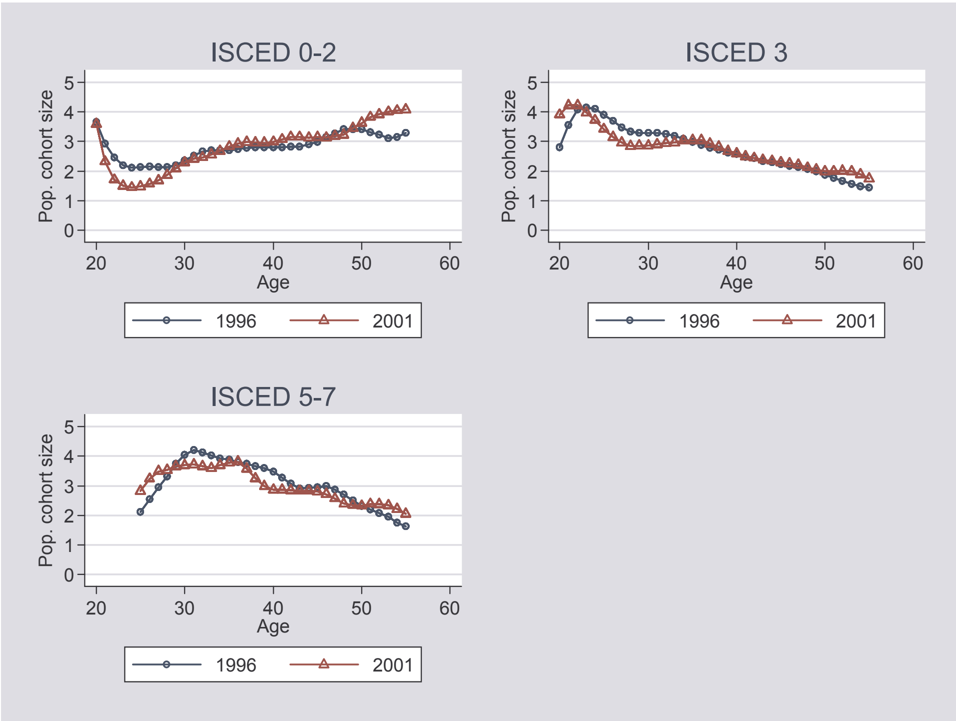


Figure 5 illustrates the relative education effect in the EU11. We notice for the young age groups the decline in the relative share of the low educated (Panel 1 in the figure) and the increase in the relative share of the high educated (Panel 3).

What is the contribution of the demographic and the relative education effects to the average change in the cohort size of the young and the old between 1996 and 2001? To answer this question, we define the young as the individuals aged less than 35 and the old as the individuals aged more than 34 and compute average changes of cohort size over time for the EU11. Table 2 reports the results. We notice that the average decline in cohort size is highest (-17.9 percent) among the young and less educated, mainly because of the negative shift in relative education (-15.4 percent). On the other hand, the average small increase in the cohort size of the young with college education is driven by the positive shift in relative education, which more than compensates the negative demographic shift[7].

Figure 5: Relative education effect, by age (ES_{ae}/ ES_e) and education, 1996 and 2001.

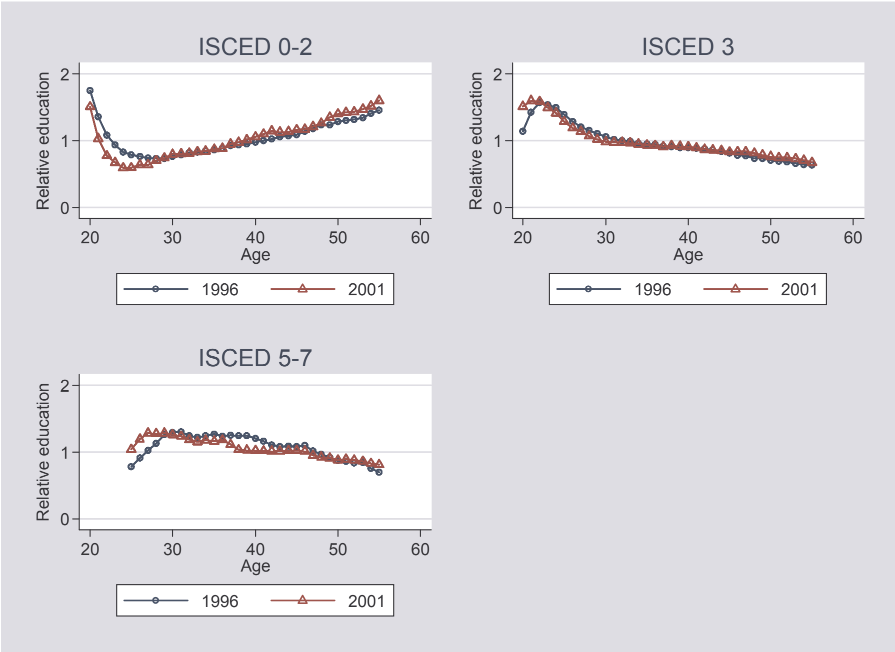


Table 2. Average change in cohort size and decomposition of the change. 1996 to 2001. EU11. Percentage changes. Source:ECHP.

	ISCED 0-2 Young	ISCED 3 Young	ISCED 5-7 Young	ISCED 0-2 Old	ISCED 3 Old	ISCED 5-7 Old
$\partial \ln CS_{ae}$	-17.94	-3.54	1.86	7.91	8.20	-2.60
$\partial \ln CS_{a}$	-2.53	-2.53	-6.93	2.42	2.42	2.42
$\partial \ln \frac{ES_{ae}}{ES_e}$	-15.41	-1.01	8.79	5.49	5.78	-0.18

Overall, these figures show two facts: a) the observed changes in cohort size in EU11 over the second half of the 1990s have been

[7] Notice that the data in Tables 1 and 2 are from different sources, the Eurostat Labor Force Survey for Table 1 and the ECHP for Table 2.

driven both by demographic shifts and by shifts in relative education, and the latter effect has been particularly important for the less educated; b) there is substantial heterogeneity in the level and dynamics of cohort size across European countries.

3. Estimation strategy

With comparable panel micro-data for 11 European countries we can study the relationship between cohort size *CS* and earnings *w* by controlling for observed and unobserved individual heterogeneity, which includes non random selection into paid employment. Following Card and Krueger, 1992, we use a two step approach. In the first step we estimate for each country and level of education the relationship between individual earnings and time by age effects using the fixed effects estimator, after controlling for other individual factors. In the second step we pool the time by age effects of each country and education level together and regress them on a number of controls and on cohort size. This method has two advantages: first, it provides a convenient reduction of the data (Card and Krueger, 1992); second, the dependent variable in the second stage and the key explanatory variable, cohort size, are at the same level of aggregation, and clustering problems are avoided[8].

Starting from the first step, we estimate, for each country and level of education, the following empirical earnings function

$$\ln w_{it} = \alpha + \beta X_{it} + \gamma_{at} + u_i + \varepsilon_{it} \qquad (6)$$

[8] Adjustment of standard errors for clustering is still required, however, when we replace cohort size with the demographic and the relative education effect, because the former is at a higher level of aggregation than the dependent variable.

where *w* is the gross hourly earnings, *X* is a vector of individual controls, which include firm size dummies, tenure and tenure squared, marital status, number of children younger than 12, health status, type of contract, and sector of employment (public versus private), *u* is a time invariant individual effect, ε is a random error, *i* stands for the individual and *t* for the year, and γ_{at} is the time by age effect, which includes both aggregate macroeconomic effects and changes in the demographics.

We estimate (6) using the fixed–effects estimator. This estimation strategy is motivated both by the presence of unobserved and time invariant individual effects *u* and by the fact that both employment and selection of education are non-random. The fixed–effects estimator takes care of both problems if we are prepared to assume that the selectivity into paid employment and educational attainment depends mainly on time invariant individual effects, such as ability.

In the second step we pool together the estimated values of γ_{at} for all countries and education levels, retrieve the associated standard errors and estimate the following equation

$$\bar{\gamma}_{atce} = \gamma_e + \gamma_c + \lambda A + \phi T + \mu Y + \sigma \ln CS_{atce} + \rho W + \eta_{atce} \qquad (7)$$

where $\bar{\gamma}$ is the estimated time by age effect, *a* is the subscript for age, *c* for country and *e* for educational attainment, γ_e and γ_c are education and country effects, *A* is age, *T* is a linear time trend, *Y* is a vector which includes both the unemployment rate, which varies by age, country and year, and the Katz and Murphy[9] index of relative demand shifts, which varies by country, year and educational attainment, and

[9] See Katz and Murphy, 1992. The index measures relative changes in employment growth across industries.

W is a vector of interactions, which includes time by education, country by education, age by education and time by education by country effects. The coefficient σ measures the effect of cohort size on earnings in the relevant cell – defined by age, year, country and education, because

$$\frac{\partial \ln w}{\partial \ln CS} = \frac{\partial \ln w}{\partial \gamma_{atce}} \frac{\partial \gamma_{atce}}{\partial \ln CS} = \sigma \tag{8}$$

Since $\bar{\gamma}$ is a generated regressor, we follow Card and Krueger, 1992, and weight the second step estimates with the first step variances of estimated $\bar{\gamma}$.

An alternative specification of (7) consists of replacing $\ln CS_{atce}$ with the demographic effect $\ln CS_{atc}$ and the relative education effect $\ln \frac{ES_{atce}}{ES_{tce}}$. By so doing, we are able to identify the impact on earnings of demographic changes, net of changes in relative educational attainment. The specification of the second step (7) is guided by the idea that earnings are determined in imperfect labor markets by the interaction of demand and supply. Since in imperfect labor markets with wage bargaining we can have positive unemployment, we capture supply effects with cohort size and the unemployment rate, as in Nickell and Bell, 1995. Demand effects are proxied with a linear trend, which is allowed to be country and education specific, and with the measure of relative demand shifts developed by Katz and Murphy, 1992, and extensively used in the literature on skill biased technical change (see Card and DiNardo, 2002).

4. Results

The first row of Table 3 reports the estimated effect of cohort size on earnings for the full sample and by educational attainment, and the next two rows report the separate effects of the relative education and the demographic components[10]. In these baseline second step estimates we pool all countries together and exploit the variability of cohort size both over time and across countries to identify the cohort size effect. Due to the specification of the model (see section 3), the numbers in this and in the next tables are elasticities.

Table 3. Estimated effect of different measures of cohort size on log earnings. All countries (EU-11).

	All	*ISCED 0 to 2*	*ISCED 3*	*ISCED 5 to 7*
$\ln CS_{ae}$	-0.015	-0.077***	0.010	0.017
	(0.012)	(0.023)	(0.025)	(0.016)
$\ln \frac{ES_{ae}}{ES_e}$	-0.013	-0.078***	0.066*	0.024
	(0.012)	(0.025)	(0.036)	(0.033)
$\ln CS_a$	-0.017	-0.010	-0.048	0.013
	(0.026)	(0.037)	(0.034)	(0.018)
Nobs	6104	2163	2069	1872

Note: standard errors in parentheses with p<0.10=*, p<0.05 = **, p<0.01 = ***. Each regression includes age, a linear trend, the unemployment rate by age, the Katz–Murphy index of relative demand shifts, education and country dummies and interaction terms.

When we consider all education levels – first column of the table - the estimated relationship between cohort size and earnings is negative, small and statistically insignificant. The demographic and relative education effects are also negative but imprecisely estimated. The mild and imprecise effect of cohort size on earnings could be due to the implicit assumption in the first column of Table 3 that the relationship between cohort size and earnings does not vary by education, age group and group of countries.

We start examining the implications of removing this assumption by estimating separate second-step regressions for each level of educational attainment. The last three columns of Table 3 present the

[10] The details of the full regression are reported in the Appendix (Table A.1).

results of these estimates and show that the relationship between cohort size and earnings is negative and statistically significant only for the less educated. Furthermore, the decomposition of the cohort size effect for this group shows that this result is driven by the relative education component, which attracts a negative and statistically significant coefficient.

Next, we aggregate the available age cohorts in two groups, the "young"– aged 20 to 34 – and the "old"– aged from 35 to 54, and estimate (7) separately for each group[11]. The results reported in Table 4 show that the estimated cohort size effect is negative and larger in absolute value for the old than for the young, and statistically significant only for the old. The decomposition of cohort size in the demographic and relative education components shows that both factors have a negative and statistically significant impact on the earnings of the old, but that the demographic effect is much stronger.

Table 4. Estimated effect of different measures of cohort size on log earnings. All countries (EU-11). By age group.

	Young	Old
$\ln CS_{ae}$	-0.001	-0.050***
	(0.018)	(0.014)
$\ln \frac{ES_{ae}}{ES_e}$	-0.003	-0.029*
	(0.017)	(0.014)
$\ln CS_a$	-0.006	-0.100***
	(0.053)	(0.029)
Nobs	2389	3715

Note: see Table 1.

We further disaggregate our results and estimate (7) separately by age group and educational attainment. Our findings reported in Table 5 suggest that a negative and statistically significant relationship

[11] We only retain college graduates aged 25 to 55.

between cohort size and earnings exists for the young and poorly educated and for the old. An interesting pattern in the table is that the impact on earnings of the demographic effect tends to be stronger for the old than for the young, while the opposite occurs for the relative education effect.

We can use the results in Table 5 to ask whether a decline in the cohort size of the younger age group affects the relative wage of the young relatively more for the better educated, as suggested by Stapleton and Young, 1988. These authors have argued that, if young workers are poorer substitutes for old workers in jobs requiring college education than in careers requiring less education, a reduction in the number of young workers because of a baby bust should increase the wages of young workers relative to old workers in college careers more than in non college careers.

Table 5. Estimated effect of different measures of cohort size on log earnings. All countries. By age group and education

	ISCED 0-2 Young	*ISCED 0-2 Old*	*ISCED 3 Young*	*ISCED 3 Old*	*ISCED 5-7 Young*	*ISCED 5-7 Old*
$\ln CS_{ae}$	-0.117**	-0.051*	0.088**	-0.061*	-0.042	-0.066**
	(0.038)	(0.027)	(0.034)	(0.034)	(0.041)	(0.025)
$\ln \frac{ES_{ae}}{ES_e}$	-0.114***	-0.021	0.183***	-0.023	-0.065*	-0.066**
	(0.042)	(0.037)	(0.048)	(0.045)	(0.029)	(0.029)
$\ln CS_a$	-0.025	-0.079*	-0.103	-0.081*	-0.094**	-0.095**
	(0.031)	(0.046)	(0.091)	(0.049)	(0.047)	(0.047)
Nobs	896	1267	888	1181	605	1267

Note: see Table 1.

We compute the percentage change in the relative wage of the young relative to the old induced by a 1 percent variation in the cohort size of the young as follows

$$\frac{\partial \ln \frac{w_Y}{w_O}}{\partial \ln CS_Y} = \frac{\partial \ln w_Y}{\partial \ln CS_Y} - \frac{\partial \ln w_O}{\partial \ln CS_O}\frac{\partial \ln CS_O}{\partial \ln CS_Y} = \frac{\partial \ln w_Y}{\partial \ln CS_Y} + \frac{\partial \ln w_O}{\partial \ln CS_O}\frac{CS_Y}{CS_O}$$

Evaluated at the sample mean cohort sizes for each age group, this elasticity is equal to 0.043 percent for college graduates and to -0.076 for individuals with at most lower secondary education, corresponding to ISCED 0 to 2. In contrast with the predictions offered by Stapleton and Young, our estimates suggest that a baby bust which reduces the size of the younger cohort is expected to increase the relative wage of the young and less educated more than the relative earnings of the better educated, which actually fall. Notice, however, that the size of the change in the relative wage is small, since it takes more than a 10 percent variation in the cohort size of the young to generate a one percent variation in relative wages.

Does the responsiveness of wages to changes in cohort size vary across countries? A natural divide here is between Northern and Southern Europe. As Table 1 suggests, demographic changes during the 1990s have been larger in the former group. Labor market institutions also differ in a significant way between the North and the South, as discussed more in detail below, and so do labor market outcomes. The unemployment rate of the young, for instance, is much higher in the South of Europe, independently of educational attainment.

We divide the full sample of countries into two sub-samples, one for Southern Europe (Italy, Greece, Spain and Portugal) and the other for Northern Europe – the rest, and estimate separate regressions for the two areas. The results are reported in Table 6. We find that the impact of cohort size on earnings is negative and much larger in absolute value in the South than in the North of Europe. Moreover, only in the former region is this impact statistically significant.

Table 6. Estimated effect of cohort size CS on log wages. All countries and by education. Northern and Southern Europe.

	Northern Europe	*Southern Europe*
$\ln CS_{ae}$	-0.002	-0.049***
	(0.017)	(0.020)
$\ln \frac{ES_{ae}}{ES_e}$	-0.0002	-0.047**
	(0.014)	(0.024)
$\ln CS_a$	-0.003	-0.067*
	(0.029)	(0.041)
Nobs	3758	2346

Note: see Table 1.

The decomposition of cohort size into a demographic and a relative education effect also shows that both components have a negative and statistically significant effect on Southern European real earnings, but no statistically significant effect on the wages of Northern Europe. Apparently, most of the action in the relationship between cohort size and wages in our sample is taking place near the Mediterranean sea.

We further investigate these differences by estimating (7) separately by area and age group ("young" versus "old"). As shown in Table 7, a negative and statistically significant relationship between earnings and cohort size holds only for the older age group in Southern Europe. Moreover, the difference in the responsiveness of earnings to changes in cohort size between the old in the South and the old in the North turns out to be much larger than the difference between the young in the two areas, in spite of the fact that the unemployment differential is much smaller (less than 1 percentage point for the old and close to 8 percentage point for the young). These results suggest that Southern European earnings are more flexible than in the rest of Europe in their response to demographic changes, especially among individuals aged 35 to 54.

Table 7. Estimated effect of cohort size CS on log wages. Northern and Southern Europe, young and old

	North Young	North Old	South Young	South Old
$\ln CS_{ae}$	0.010	0.005	-0.045	-0.106***
	(0.025)	(0.018)	(0.037)	(0.025)
$\ln \frac{ES_{ae}}{ES_e}$	0.020	0.037*	-0.062	-0.091***
	(0.018)	(0.022)	(0.045)	(0.027)
$\ln CS_a$	-0.024	-0.048	-0.051	-0.165***
	(0.066)	(0.037)	(0.042)	(0.048)
Nobs	1468	2290	921	1425

Note: see Table 1.

Why is it so? Since domestic labor is not mobile within Europe, a natural explanation is that Southern European countries have different labor market institutions than the rest of Europe, and that these institutions affect in a significant way the responsiveness of earnings to supply shocks[12].

We focus on three such institutions, the minimum wage (MW), the degree of coordination of the wage bargain (CO) and employment protection (EP). The importance of these institutions for wage determination and inequality has been widely remarked in the literature – see for instance Blau and Kahn, 1996 and Kahn, 2000. We draw our data on institutions – for the year 1995 - from the comparative databank developed by Nickell and Nunziata, 2000. Unfortunately, their compiled indices do not include Greece, but for the rest of the sample it is quite clear that Southern European countries – Italy, Spain and Portugal – have all a higher index of employment protection than the rest of the countries in Northern Europe. On

[12] Institutions play an important role in the literature on skill biased technical change. See for instance DiNardo, Fortin, Lemieux, 1996.

average, the index is equal to 1.793 in the South and to 0.962 in the North of Europe.

This clear-cut ranking does not apply to wage coordination and the minimum wage. Southern European countries have an intermediate degree of coordination, lower than Austria, Finland and Germany but higher than the UK. Similarly, Italy has the highest value of the Kaitz index, defined as the ratio of the minimum wage to the average wage, and Spain the lowest.

We estimate (7) by augmenting the list of explanatory variables with the interactions between log cohort size and the index of employment protection, the Kaitz index and the degree of coordination in the wage bargain[13]. As shown by Table 8, the interaction of cohort size with employment protection exhibits a negative and statistically significant sign, both for the young and for the old age group. On the other hand, the interactions with the Kaitz index and the degree of coordination of the wage bargain are positive and statistically significant – at the 10 and 5 percent level of confidence – only for the young and for the old respectively.

Therefore, we conclude that – ceteris paribus – real earnings decline more when cohort size increases in countries with higher employment protection. These countries in our sample are located in Southern Europe. This decline is less pronounced either when wage bargaining institutions have a higher degree of coordination – for the older cohorts – or when the minimum wage is higher – for the younger cohorts.

The strongest result is clearly the positive correlation between employment protection and the sensitivity of earnings to changes in cohort size – in absolute value. How do we explain this positive correlation? On the one hand, strong employment protection can generate an insider–outsider mechanism, and shelter the earnings of insiders from the competition of outsiders. This should reduce the sensitivity of insiders' wages to supply shocks.

Table 8. Labor market institutions and the elasticity of wages to cohort size

	Young	Old
$\ln CS_{ae}$	0.004	-0.029*
	(0.018)	(0.015)
$\ln CS_{ae}$ *EP	-0.066*	-0.061**
	(0.036)	(0.026)
$\ln CS_{ae}$ * CO	0.011	0.051**
	(0.039)	(0.025)
$\ln CS_{ae}$ * MW	0.330*	-0.131
	(0.177)	(0.089)
Nobs	2158	3355

Note: see Table 1

On the other hand, protection generates two-tier systems, which combine a protected with a flexible area, where earnings are quite sensitive to economic conditions. It is interesting to notice that the average percentage of employees with a temporary contract in our data is equal to 10.74 percent in Northern European countries and to 21.51 percent in Southern European countries. The gap is there both for the young (15.05 versus 30.89 percent) and for the old (7.8 versus 13.8 percent). Furthermore, Southern Europe has a significantly higher share of small firms with less than 20 employees (54.8 versus 37.7), which are more likely to belong to the flexible tier[14]. Therefore, European countries with higher employment protection are likely to have a relatively smaller protected sector, with low wage flexibility, and a relatively larger flexible sector, with high wage flexibility. The higher overall responsiveness of earnings to cohort size in Southern Europe suggests that the impact on the larger flexible sector prevails in the aggregate.

[13] These indices are computed as deviations from sample means.
[14] In Italy and Spain employment protection rules vary with firm size. See Boeri and Jimeno, 2003.

Conclusions

We have exploited the cross–country variation in cohort size in Eu-11 to study how demographic changes affect real earnings. The bottom line is that the effect varies significantly by age, education and group of countries. The average effect obtained by pooling all countries, education and age groups is negative, modest and measured imprecisely.

When we allow the response of earnings to cohort size to differ by group of countries, education and age, we find that

a) the response is negative and significantly higher in Southern Europe. We relate this to institutional factors such as the degree of employment protection, the minimum wage and the coordination of the wage bargain and argue that economies with higher protection have relatively large unprotected sectors, where earnings are more flexible;
b) the response is also significantly larger among the older age groups, and there is no evidence in support of the view that a baby bust should increase the earnings of the young relative to the old more for college graduates, as it was found to happen in the US. If anything, the opposite occurs.

Overall, the impact of changes in demographic trends on real earnings is modest. The share of individuals aged 20 to 34 in the population aged 20 to 54 has declined in the Eu-11 countries by 10.20 percent between 1991 and 2001. At the same time, the percentage of individuals aged 35 to 54 has increased by 9.32 percent. Our estimates suggest that, as a consequence of these significant changes and conditional on the relative education effect, the real earnings of the younger cohort have increased by a tiny 0.06 percent (-10.20*-0.006), while the earnings of the older cohort have fallen by a modest 0.93 percent (9.32*-0.100). Clearly, the baby bust under way in Eu-11 has flattened the wage–age profile. The size of this effect, however, has been small.

The available data offer scope for further research. We have ignored the gender dimension, which raises important policy issues, and the impact of cohort size on employment. The analysis of the effects of changes in cohort size on the probability of employment is an obvious complement to the study conducted out in this paper. We plan to carry out such analysis in future work.

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Appendix

Figure A1. Cohort Size (CS_a), 1996 and 2001, by coun try. All education groups.

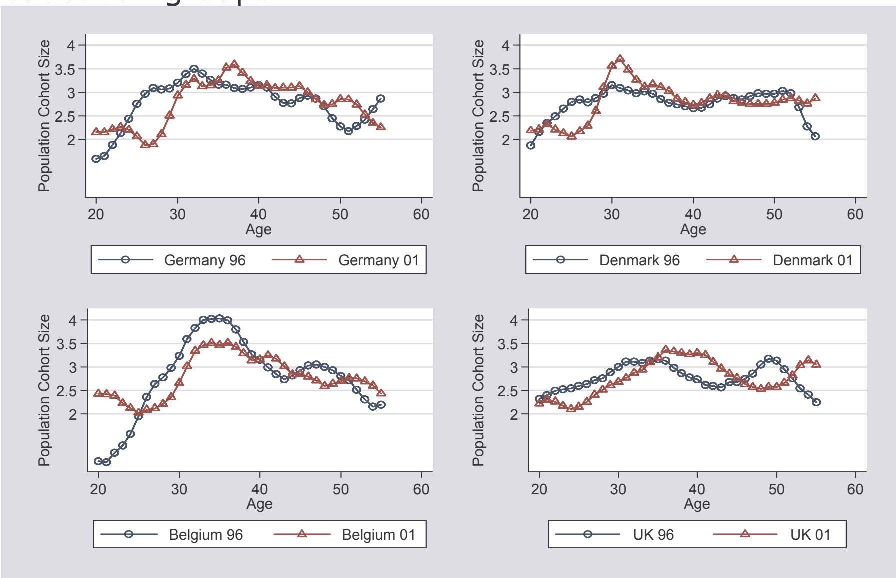

Figure A2. Cohort Size (CS_a), 1996 and 2001, by coun try. All education groups.

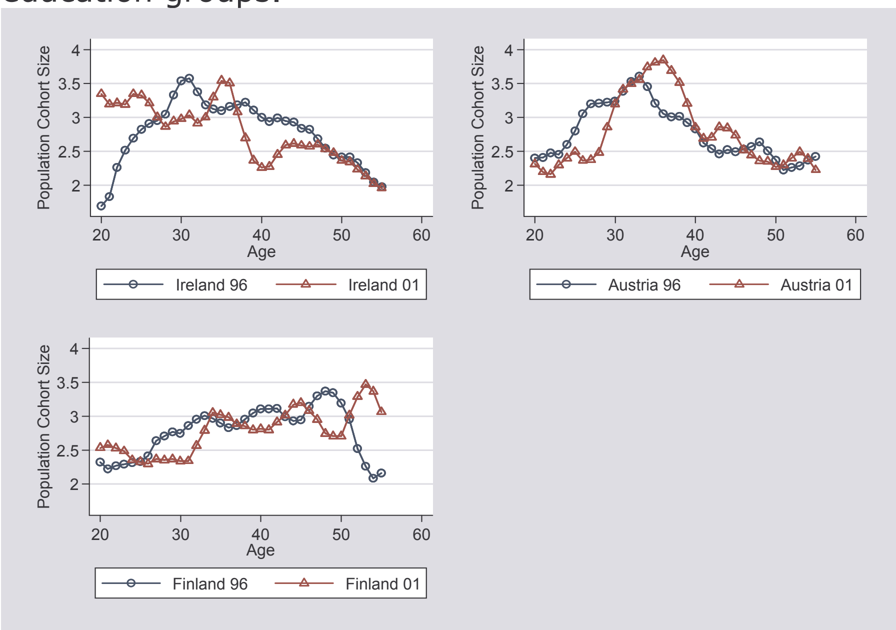

Figure A3. Cohort Size (CS_a), 1996 and 2001, by coun try. All education groups.

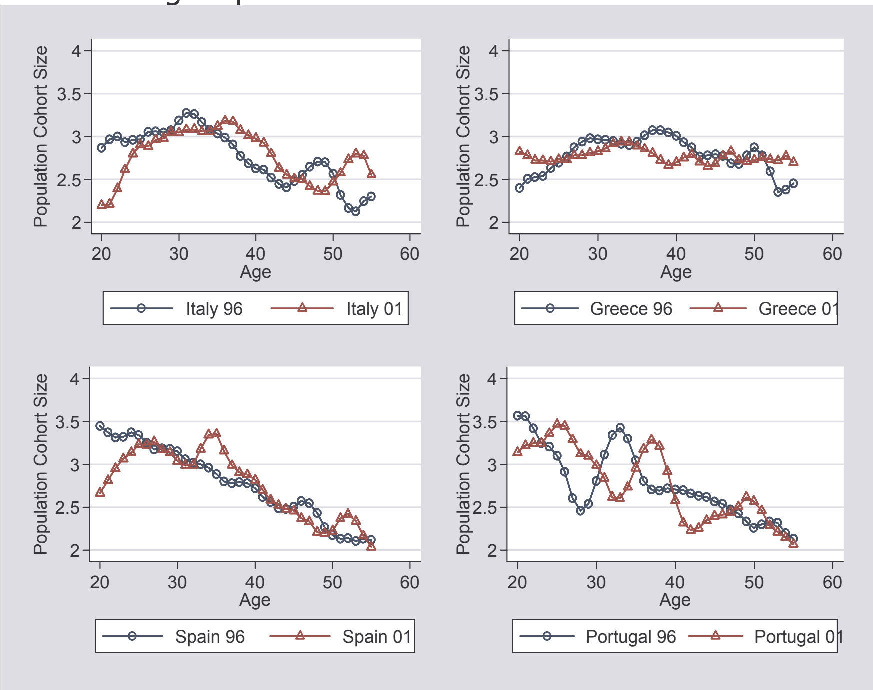

Table A.1. Extensive results for the regression in Table 3, column 1

# obs :	6104	6104
age	0.0039*	0.0038*
	(0.0008)	(0.0009)
e2age	-0.0022*	-0.0022*
	(0.0008)	(0.0007)
e1age	-0.0022*	-0.0021*
	(0.0007)	(0.0007)
trend	0.0352*	0.0351*
	(0.0017)	(0.0018)
e1t	-0.0074~	-0.0074~
	(0.0035)	(0.0036)
e2t	-0.0072	-0.0071
	(0.0047)	(0.0047)
km	-0.0021	-0.0020
	(0.0618)	(0.0637)
unemp	-0.0748*	-0.0754*
	(0.0115)	(0.0116)
lnsize	-0.0147	
	(0.0126)	
lncoh		-0.0173
		(0.0251)
lnedra		-0.0132
		(0.0113)
R-sq	0.381	0.381

Note: standard errors in parentheses with p<0.05 = ~, p<0.01 = *; e1age= age*highest education; e2age=age*intermediate education; e1t= trend by highest education; e2t: trend by intermediate education; **lnsize** is $\ln CS_{ae}$, **lncoh** is $\ln CS_a$ and **lnedra** is $\ln(ES_{ae} / ES_e)$.