3. EDUCATION, EARNINGS GROWTH AND COHORTS [1]

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3.1 Education and earnings growth

Does the slope of experience–earnings profiles vary with educational attainment? An answer to this question is important for the evaluation of the economic returns to education. For instance, the estimate of the internal rate of return to education, such as that computed by the OECD (1999) for a number of affiliated countries, requires information both on the costs and on the returns that individuals can expect over their working life as a consequence of their investment in education. When experience profiles by education are not parallel, information on their slope is necessary to compute expected lifetime earnings by educational attainment. The available empirical evidence suggests that participation in job-related training programmes is correlated with educational attainment (OECD 1997). Suppose that, because of the better access to training, earnings grow faster with experience for the more educated. In this case, education provides not only an initial labour market advantage, but also an advantage that cumulates over the working life.

According to Mincer (1974) the experience profiles of weekly earnings by education are parallel, suggesting that the relative "skill" differentials in wage rates do not change with years of experience. From then on a large body of literature has provided evidence that the relationship between wage and education is not affected by experience.

Psacharopoulos and Layard (1979) showed that experience profiles are steeper for individuals with higher education. They interpreted their results in light of the human capital model as evidence that education and training are complements: since training

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[1] This chapter summarises the main findings from two separate PURE studies: *Education and Earnings Growth. Evidence from 11 European Countries* by Giorgio Brunello and Simona Comi, and *The College Wage Gap in 10 European Countries: Evidence from Two Cohorts* by Giorgio Brunello, Simona Comi and Claudio Lucifora. Both papers are available at the PURE web-site www.etla.fi/PURE.

increases productivity and individuals with higher education are more likely to receive additional training over their working life, experience profiles are steeper for the more educated.

While higher education can be conducive to more training during working life, Neuman and Weiss (1995) argue that schooling-specific obsolescence of human capital is faster for the highly educated. They use this argument to explain their findings that wage differentials by education decrease with labour market experience. Converging experience profiles can also be explained by the screening hypothesis: if higher education is a signal and firms learn about the (time-invariant) ability of their employees over time, then the partial effect of education on earnings is bound to fall with experience (Layard and Psacharopoulos 1974).[2]

Most studies that have estimated a classical Mincerian earnings function with cross-section data have found hump-shaped experience profiles. It is well known that a hump-shaped profile can be generated by cohort effects, that is, by the contemporaneous presence in the same cross-section of cohorts of individuals that have entered the labour market at different earnings levels. Typically, younger cohorts receive a higher entry wage. There are two main alternatives to cross-section data: longitudinal data of individuals and pseudo panels of cohorts, where successive surveys are used to follow each cohort over time by looking at cohort members that are randomly selected into each survey.

We use the second alternative and collect cohort data from 11 PURE countries. We focus on two cohorts, the former including individuals born between 1940 and 1949, who started school just after the Second World War, and the latter including individuals born between 1950 and 1959, which is often called “the baby boom generation”. For each cohort, we allocate individuals into three school levels: compulsory education, upper secondary education and tertiary education. For most countries, our data cover the 1980s and the first half of the 1990s.

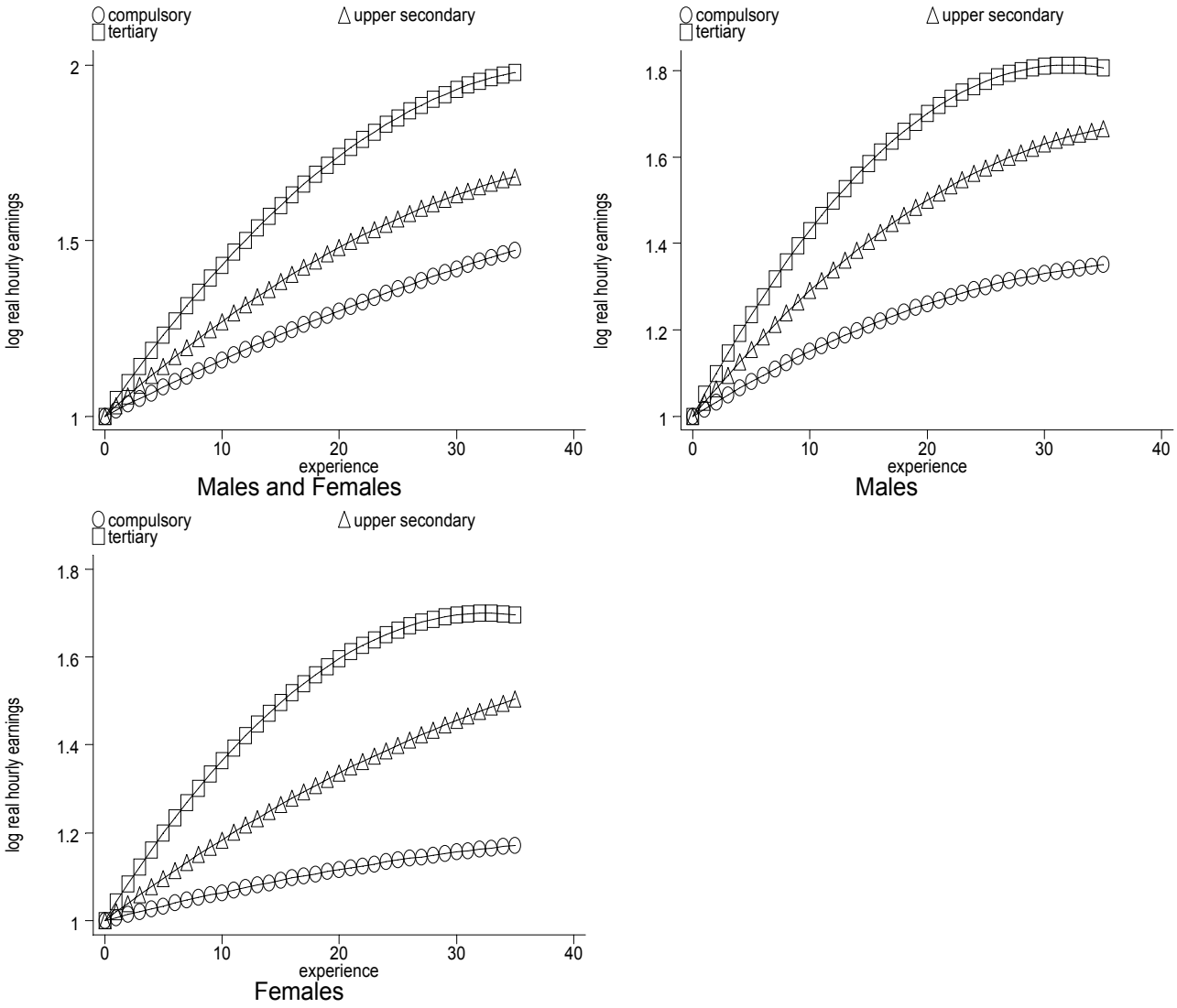
We pool all the available information and estimate a standard equation of accumulation of human capital using the fixed effects estimator, which captures time-invariant effects with a set of dummies that controls for time-invariant differences induced by the

[2] For PURE evidence on the screening hypothesis, see Chapter 4 of this volume.

country, the period of birth and educational attainment. One pitfall of this method is that it does not allow us to identify the relationship between real hourly earnings and educational attainment. Given that the focus of the analysis is on the relationship between education and earnings growth, however, this is of secondary importance.

The evidence suggests that experience profiles are not parallel but steeper for higher attained education. Figure 3.1 plots the simulated profiles obtained by letting potential experience *x* vary from 0 to 35 years and by assigning to each profile the same starting value, equal to 1. Note that experience profiles are generally steeper for males, independently of the level of attained education. On the other hand, the earnings growth gap between college graduates and high-school graduates is larger for females.

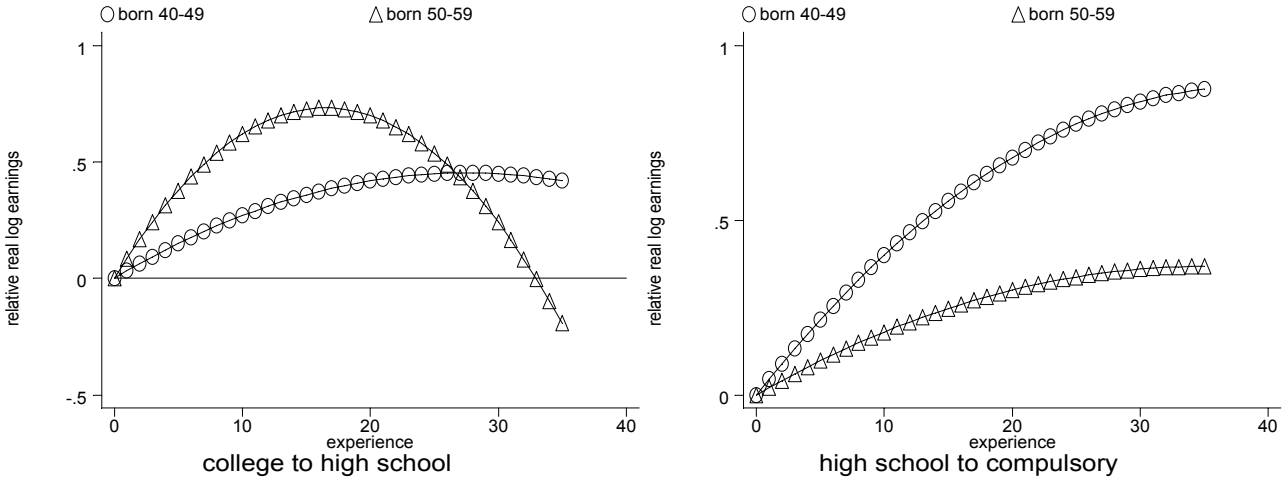
Figure3.1. Earnings growth by educational attainment and gender



The findings in Figure 3.1 are based on the assumption that experience profiles do not vary by cohort of birth. We now relax this hypothesis and consider the two cohorts separately. In Figure 3.2 we plot both the experience profiles of college graduates relative to high-school graduates and the experience profiles of high-school graduates relative to employees with only compulsory education. In each panel of the figure, relative earnings at zero experience have been normalised at zero.

We find that the earnings differential between college and upper secondary school graduates increases faster with experience for the younger than for the older cohort during the first fifteen years of potential experience. For longer potential experience, however, the difference in relative earnings growth between the two cohorts declines and eventually relative earnings growth becomes smaller for the younger cohort. This observed pattern in the dynamics of relative earnings is consistent with college graduates of the younger cohort investing relatively more in human capital than college graduates of the older cohort during the former part of their working life and relatively less during the latter part.

Figure 3.2. Relative experience profiles by school level and cohort



The observed slowdown in relative net investment later in working life could also be attributed to faster depreciation of human capital. Following Card and Lemieux (2000), the higher rate of net investment by the younger cohort could be explained by the fact that younger cohorts of college-educated individuals have higher levels of computer skills. Because of their stronger complementarity with computer-intensive technologies, productivity and earnings grow faster for them, relative to high-school graduates, than for older college graduates.

It is an open question, however, why skills should grow at a slower rate or depreciate faster for college graduates of the younger cohort in the later part of working life. We try to answer this question in the next section. We also find that the earnings differential between upper secondary school graduates and individuals with only compulsory education grows faster for the older cohort. For this cohort, the experience profile of individuals with only compulsory education has a negative slope.

3.2 The college wage gap

The wage structures of several OECD countries experienced, over the last decades, significant changes. Overall wage inequality and wage differentials across different groups of workers showed a marked departure with respect to the trends that had characterised earlier periods. In this respect, various factors, both of economic and institutional source, contributed to re-shaping the distribution of wages. Major changes occurred in the distribution of the labour force by educational level and by labour market skills, partly driven by the educational choices of the “baby boom” generation and partly due to the changing structure of employment following the diffusion of computer technologies.

Two leading explanations have been offered to account for the observed changes in relative wages: one story has emphasised the role of market forces and the evolution of (relative) supply and demand; another story has stressed the role of labour market imperfections and institutional arrangements. The former approach focuses mainly on demographic changes, adverse shifts in supply and demand for products, skill-biased technological change, and the increased globalisation of trade. The latter approach advocates the importance of trade unions, collective bargaining practices, and product and labour market regulations.

Changes have had different impact on younger and older cohorts. Card and Lemieux (2000), for instance, use data on workers of different age groups to show that in the USA much of the rise in the college–high-school wage gap can be attributed to changes in the relative earnings of younger college-educated workers. They also show that this shift in the structure of returns to college graduates shares a common pattern in the UK and Canada, where educational wage differentials have risen for younger men while remaining stable or even declining for older men.

While there is an extensive literature investigating the evolution of the college wage gap in the North American and British experiences, relatively little is known about the (continental) European experience. We believe that a better understanding of the European case is interesting not only in itself, but also because the PURE countries show a relatively high degree of variation in the evolution of relative prices and quantities for different skills and also exhibit significant institutional diversity.

Figures 3.3 and 3.4 compare, for each selected cohort, the college wage gap at the beginning and at the end of the sample period and highlight the significant heterogeneity in the behaviour of the gap across cohorts and countries. In Austria and the Netherlands, for instance, the college wage gap was lower at the end of the sample period for the older cohort and higher for the younger one. Interestingly, the increase in the college wage gap between the end and the start of the sample period has been higher for the younger generation in half of the countries in our sample (Austria, Denmark, Netherlands, Switzerland, UK) and higher for the older generation in rest of the sample countries (Finland, France, Germany, Italy, Portugal).

In practice, the college–high-school wage gap can be decomposed into two parts: the first part varies by country and cohort only (time invariant); the second part varies by country, cohort and time (time variant). Using a linear trend to capture time effects and pooling the available data, we adopt the following empirical specification:

$$r_{cjt} = \sum_c \alpha_c D_c + \beta\, C + \sum_c \gamma_c C * D_c + \delta\, t + \sum_c \xi_c D_c * t + \sum_c \theta_c D_c * C * t$$

where D are country dummies, C a cohort dummy, and t a linear time trend. We allow for two sets of interactions, one involving time and country dummies and the other time, cohort and country dummies. Whilst the former set captures differences in the linear trend across countries, the latter picks up further differences between cohorts.

Figure 3.3. College wage gap, cohort born 1940–49

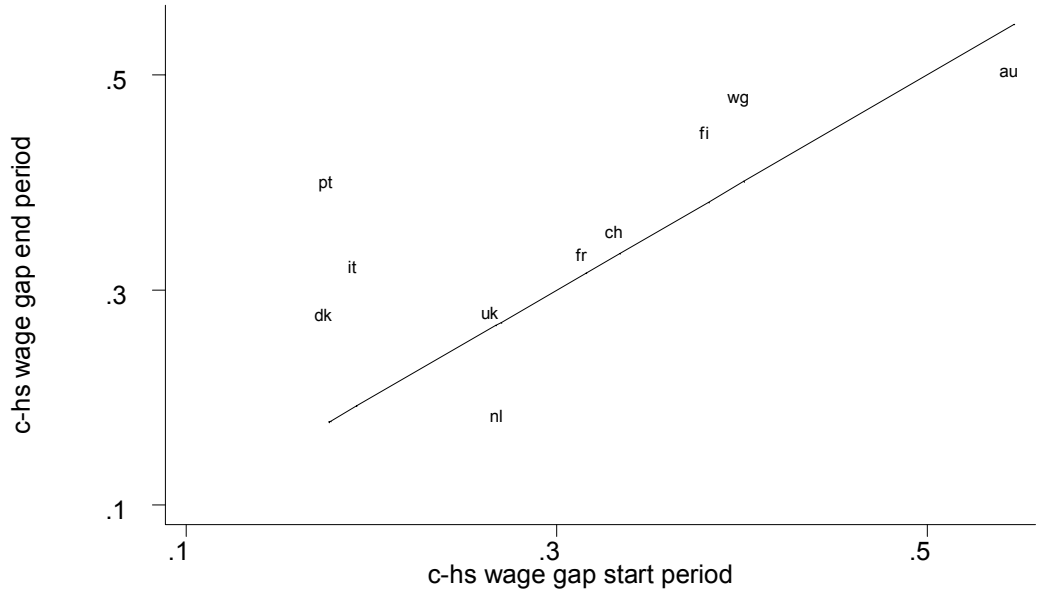
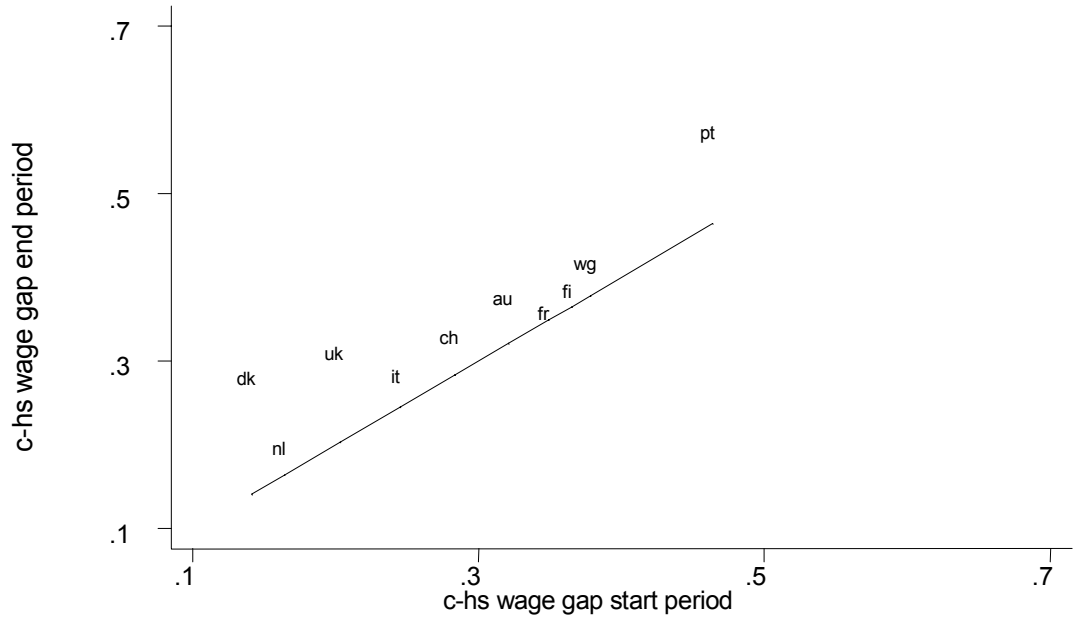


Figure 3.4. College wage gap, cohort born 1950–59



Estimating the above equation we find that:

- the cohort effect is relatively high in Austria and Germany for the cohort born between 1940 and 1949;

- the cohort effect is significantly lower for the cohort born between 1950 and 1959 in Austria, Denmark and the Netherlands, and significantly higher in France and Portugal;

- the older cohort has experienced a positive trend in the college wage gap in all countries but the Netherlands; this trend has been particularly pronounced in Finland, Italy and Portugal;

- the estimated rate of growth in the college wage gap is higher for the younger cohort in Austria, Denmark, the Netherlands, Switzerland and the UK (see Figure 3.5), albeit the difference to the older cohort is not statistically significant in the last two countries, and lower in the rest of the sample countries.

We stress two results in particular. First, and contrary to the evidence presented by Card and Lemieux (2000) on three Anglo-Saxon countries, the growth in the college wage gap has not been restricted to the younger cohort. Second, in a number of PURE countries the college wage gap has risen faster for the older than for the younger cohort.

We also find that there is a negative correlation (–0.356) between the estimated time-invariant country-by-cohort effect (intercept) and the time-varying country-by-cohort aggregate effect (trend) (see Figure 3.6). This suggests that countries that started with relatively high college wage gaps have also experienced a slower growth in the gap during the sample period.

The observed heterogeneity in the behaviour of the college wage gap among countries, between cohorts and over time begs the question whether these differences can be associated to differences in the levels and changes of relative supply, relative demand and institutional set-ups.

Figure 3.5. Estimated growth in the gap for the two cohorts

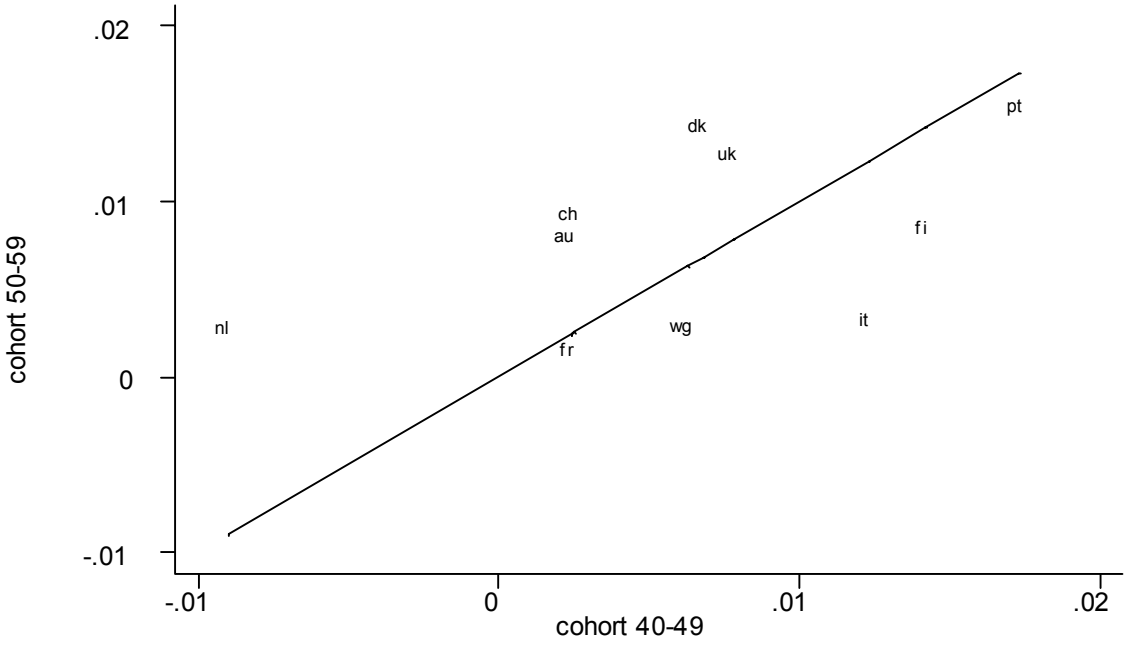
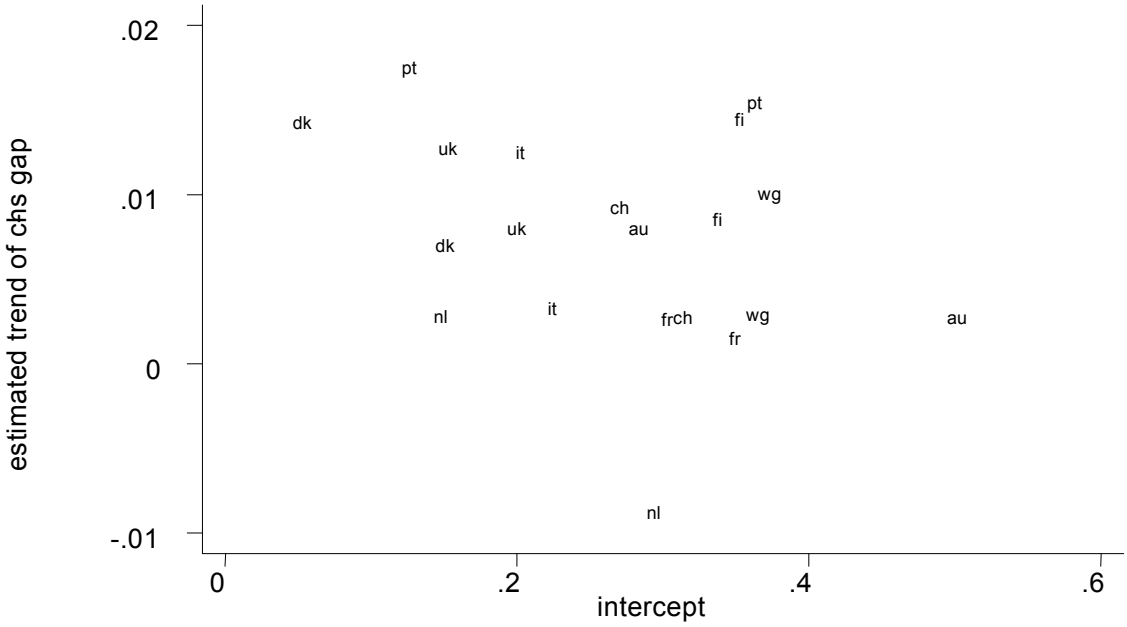


Figure 3.6. Estimated intercept and trend in the college wage gap



A model that combines labour market competition with non-competitive rents implies that cross-country differences in the college wage gap should be correlated with differences in relative demand, relative supply and institutional set-ups. Correlation does not imply a causal relationship, however, because relative prices and quantities are jointly determined in competitive markets and institutions themselves could vary in response to price and quantity signals (see the discussion in Fortin and Lemieux (1997)).

In order to study this subject in more depth, we summarise the discovered differences in college wage gaps using two indicators: (1) the estimated coefficient of the country dummy (level), which varies between cohorts and captures time-invariant effects on the college wage gap; and (2) the estimated coefficient of the time trend (trend), which varies by country and cohort and captures aggregate time effects. Next we relate each indicator to measures of relative supply, relative demand and labour market institutions. We associate the former indicator to *levels* of relative supply, relative demand and institutional constraints affecting the wage gap. The latter indicator relates to *changes* in relative supply, demand and institutional constraints (since institutions vary over time, we distinguish, when possible, between institutional levels at the start of the sample period and institutional changes).[3]

Starting with levels, the first panel of Figure 3.7 shows the expected negative relation between the estimated level of the trend and the considered measure of relative supply, the relative cohort size.[4] As expected, the time-invariant country effect is negatively correlated also with the Kaitz index, defined as the ratio of the minimum wage to the average wage. In fact, a relatively high minimum wage can raise wages at the lower end of the wage distribution and thus affect the denominator of the gap. The third panel shows the positive relation existing between the estimated level of the gap and an index of the relative strictness of employment protection measures, for the early 1980s.[5] Finally, the positive correlation with age at start of the sample period is also as expected and suggests that college graduates have steeper earnings profile than high-school graduates, as already shown in section 3.1 above (see panel 4 of Figure 3.7).

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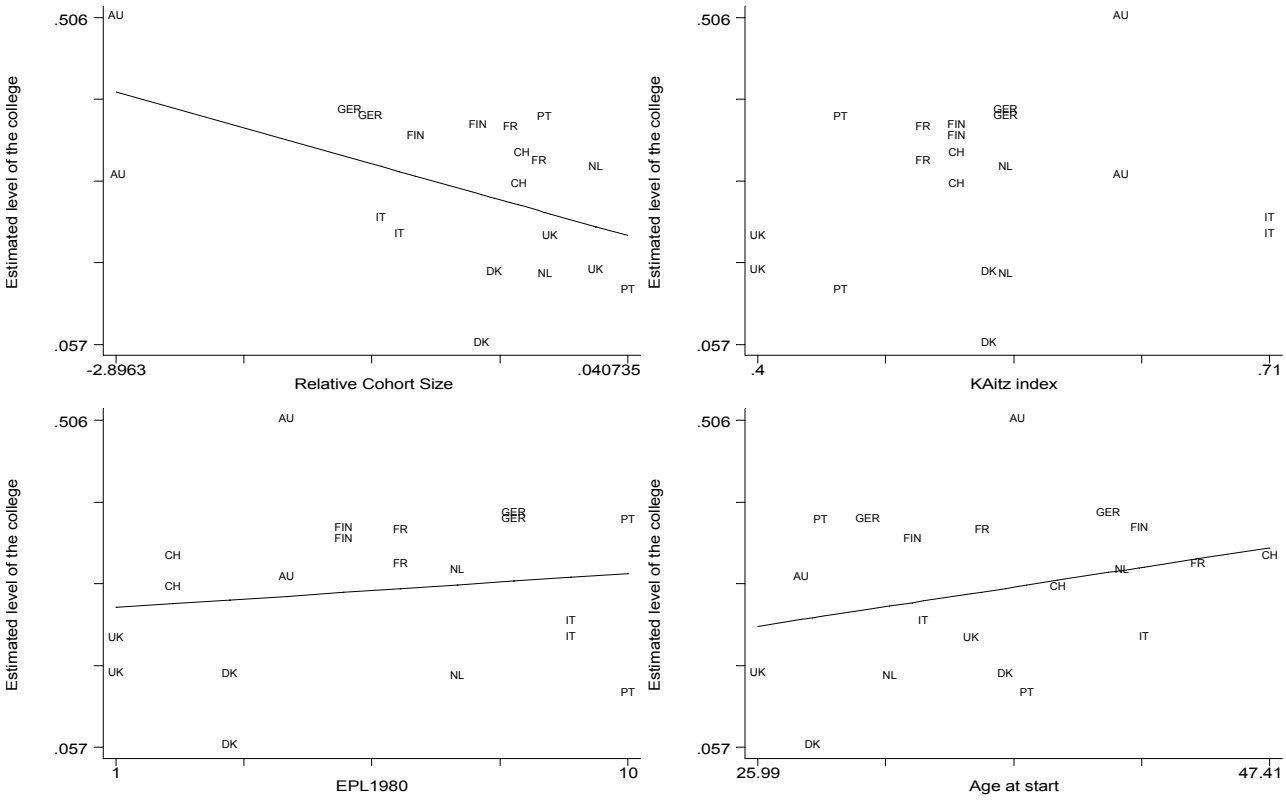
[3] See Brunello et al. (2000) for a more detailed and technical analysis and for a more extensive description of the variables considered.

[4] For a more detailed description of these indexes, see Brunello et al. (2000).

[5] For a more detailed analysis, see Brunello et al. (2000).

Figure 3.7. Relations between the estimated level of the gap and selected variables

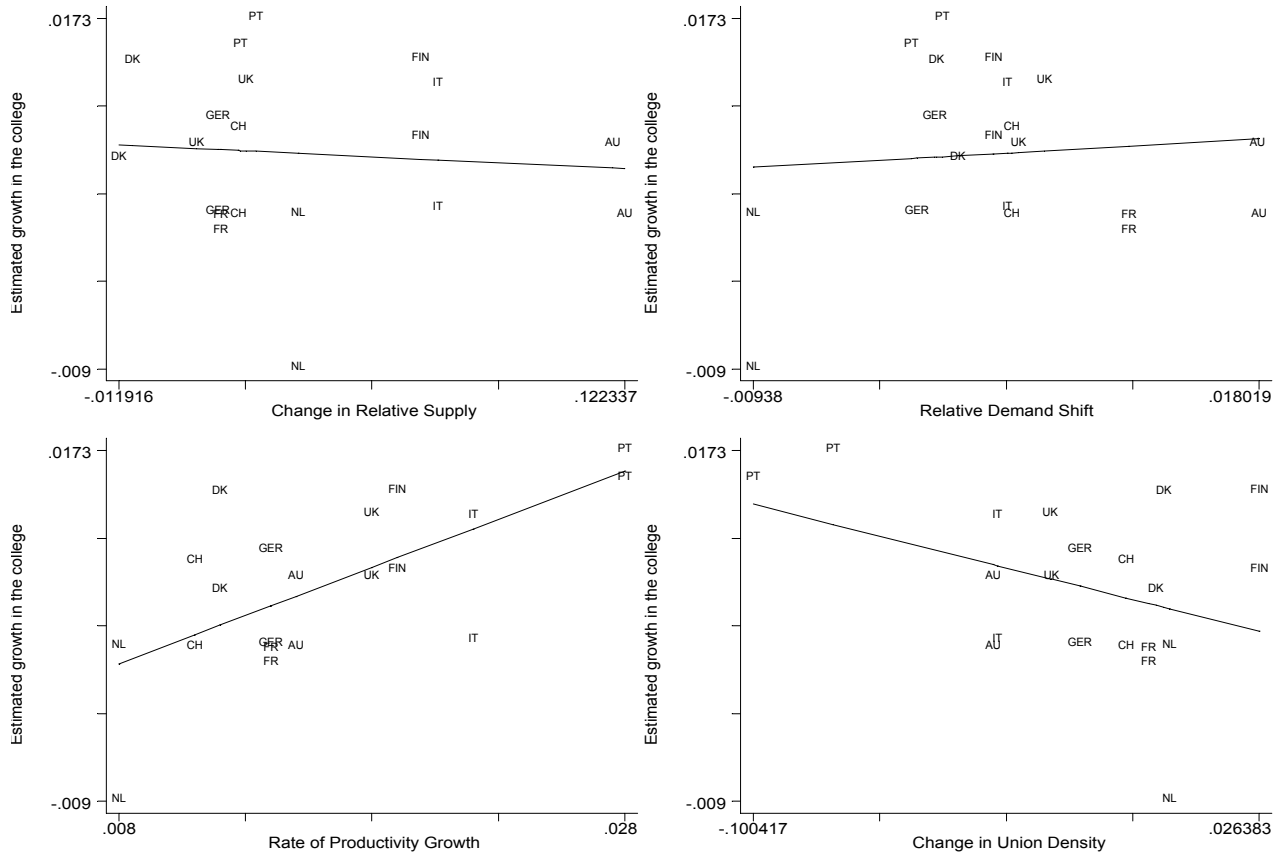


Turning to the estimated growth of the college gap, in Figure 3.8 we illustrate the relationship between the estimated value of the trend for each cohort and the changes in relative supply, relative demand, productivity growth and union density. We measure changes in relative supply using the average annual rates of change in relative attainment of the population. This measure turns out to be negatively correlated with the growth of the gap (see panel one of Figure 3.8). In the literature, the standard measure of relative demand shifts is based on Katz and Murphy (1992), and from a simple inspection this index is positively correlated with the growth of the college gap (panel two of Figure 3.8).

It has been shown recently that relative wages by education and skills can be affected by the rate of technical progress. By introducing new vintages of techniques, technical progress has both a productivity effect and an erosion effect on skills and wages. Erosion occurs because accumulated skills depreciate with the introduction of new techniques and the progressive demise of old techniques. If the skills of high-school graduates depreciate faster than the skills of college graduates, the college wage gap increases when technical progress accelerates. As shown in panel three of the figure, in

our data there is a positive correlation between the growth in the gap and the rate of productivity growth. Finally, union density is a measure of union influence on relative wages. Traditionally, stronger unions have compressed wage differentials by skills and education and, as expected, this measure is negatively correlated with the time-variant component of the college wage gap (see the fourth panel of Figure 3.8).

Figure 3.8. Relations between the estimated trend of the gap and selected variables



3.3 Policy implications

We find evidence of significant cross-country differences in the level and growth of the college wage gap. There is also evidence that both the level and the growth of the college wage gap differ significantly between cohorts. Estimated growth turns out to be negatively correlated with changes in relative supply and positively correlated with an index of between-industry demand shocks as well as the long-run rate of labour

productivity growth. The latter finding is consistent with different demand-side explanations, including skill-biased technical change and capital–skill complementarity. Institutional changes matter as well. We find that countries having experienced a decline in union density, have also had a faster growth in the college wage gap.

Our results show the importance of education not only as securing a higher entry wage but also in affecting the life-cycle wage profile. Significant differences emerge across cohorts suggesting that different age groups experience different labour market patterns. Educational and labour market policies directed at specific age groups should take this into account.

Finally, there seems to be significant heterogeneity across countries both in the level and in the evolution of the college wage gap, stressing once more the role of institutions. Policy intervention should account for institutional variety in the educational as well as in the labour market.

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