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The Macroeconomics of Education

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General Introduction

Background

One year after its major Enlargement to 10 new Member States, Europe is facing several challenges. It has known a relatively long period of slow growth, with one or two percentage points below the United States in the last decade; at the same time, consecutive to its Enlargement to 10 new Member States, it has to face a huge redistribution of political and economic powers, both internally and vis-à-vis its partners; finally, Europe is facing an ever growing integration of international trade and most notably the emergence of the two low-wage giants, China and India, sometimes presented as the "world suppliers" of labour intensive goods and services.

Its success with respect to these challenges is mixed: Europe remains one of the wealthiest areas in the world; new Members grow at a fast rate; however, Europe still faces several structural problems. Most big countries in Europe, including France, Germany, Italy and Poland have inefficient labour markets, plagued with high unemployment rates and low participation rates in particular among the less educated workers. In a rapidly evolving

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macroeconomic context, the preservation of living standards and the welfare state requires more adaptability of individuals and institutions.

In particular, as this report will show, Europe has to invest more than ever in its comparative advantage: human capital. However, the answer cannot be simply quantitative: more money injected in the system may not be a solution in the absence of a serious reflection on the nature of education, on its macroeconomic and labour market impact and on the various imperfections it attenuates or on the contrary it reinforces. The report does not intend to provide such an exhaustive analysis. Instead, it aims at taking stock of the large economic literature on the subject, and at providing some hopefully useful policy guidelines.

Summary of the report

We will in particular emphasize that Europe has invested massively in the past decades in secondary education and along some dimensions, prevented a too large increase in wage and income inequality. Since the 1960's, the average number of years of education of the working age population has risen by 3.5 years, and half of the gap with the US has been filled. Recent cohorts of young graduates in Europe are more mobile than low skilled workers, and the over-education problem, meaning young graduate delaying ever and ever the entrance in the labour market, probably need to be more cautiously analysed: it appears that over-education is often the "wrong" name given to something else we believe to be one of Europe's main problem: skill mismatch and inadequacy of education and training to provide the right skills.

On the negative side, we indeed see several manifestations of an inadequacy between demand and supply of skills and workers. Europe has very low geographical mobility of labour even for the most educated ones, especially compared to the US; there is a very large share of European workers reporting they don't have the right skills for the job; more generally, labour market institutions promote longevity of jobs and thus favour specific skills, while at the same time demand for labour is increasingly volatile and would require general skills instead; finally, Europe faces difficulties to attract the most skilled and talented workers, with potentially large adverse consequences on long-run growth.

As argued above, more investments in education are required, but they must come with well-thought provisions of incentives: first, incentives to do well must be imposed on the supplier of skills (secondary schools and tertiary establishments); and second, incentives to

follow the right curriculum must be brought to the consumers of education (students and trainees). It is only if these conditions are fulfilled that Europe can simultaneously reach the dual objective of promoting equality and generating growth. Investing in secondary education is probably a good way to promote equality. Instilling a greater element of incentives is necessary if Europe wants to garnish universities with the same worldwide prestige and attractiveness as Harvard, Princeton or MIT and ultimately develop a knowledge-based economy.

The importance of education

On the last point, it has for long been recognized that education, notably tertiary education, is an important vehicle for growth and aggregate economic performance. Thus education has a subsequent impact on individuals' life in a broad sense: their income, occupation, and health as well as longevity are all affected. This occurs through a very large number of channels, including socio-economic mechanisms, but also cultural and political ones: democracy and equality of opportunities only emerge in educated societies.

The European Union is a potentially formidable economic power with highly educated labour force, excellent scientific and technological potentials and some of the most brilliant minds on earth. In spite of this during the nineties and ever since then the gap vis-à-vis the United States in terms of scientific and technological advancement and its impact on productivity growth appears to be deepening (see Daveri, 2002). Certainly, many EU countries are late in adopting the recent information technologies and bio-technologies, and in the field of applied sciences, the US lead does not seem to be narrowing (see Gordon, 2004).

Regarding the second of European priorities, suitably targeted educational policies are also instrumental in promoting equality. Indeed, some observers argue that, e.g., improving individuals' access to financing educational investments will promote the dual objective of reducing inequality and increasing efficiency (Okun, 1975). Thus, certain educational policies create a win-win situation where the usual trade-off between equality and efficiency is absent.

Europe, like all modern economies, invests large amounts in education: educational spending is about 5% of GDP in OECD countries, with a large upward trend over the past century. In the most recent cohorts, most individuals spend as much as 12 years into initial education: a large majority starts at the age of 6 in primary education and fully completes secondary education at the age of 18. In 1999 in the OECD, 78% of the 25-34 year old

population had at least upper secondary education.[2] The corresponding fraction for the 55-64 year old population was only 45%, which indicates that the education sector has expanded a lot during the last three decades.

If on average OECD countries have consistently raised their effort of education provision, there are still large cross-country differences in the origin of funds (public or private). According to the OECD Education at a Glance, the OECD countries on average spent 5.23% of GDP in 1998. This aggregate number may be decomposed into: 3.64% of GDP in primary and secondary education (3.28% public and 0.37% private) and 1.59% in tertiary education (0.93 public and 0.67 private). Interestingly, in two very different countries – the US and France – public expenditure in tertiary education as a fraction of GDP is exactly the same, 1% of GDP. But in total, the US spent 2.29% of its GDP in tertiary education while France spent only 1.13%; all the difference between the two countries actually came from private money. Spain, Italy and Germany are very close to France in that private money is marginal, resulting in under-funding of tertiary education.

In a European context, these issues are made more complex by the fact that labour markets are characterized by employment protection and social insurance policies. These features, designated as "labour market institutions", have potentially pros and cons. On the one hand, they promote the stability of employment relationships and accordingly raise incentives to acquire sector or job specific skills, either in initial education or in training programs. On the other hand, in rapidly changing environments, labour markets institutions may affect mobility incentives, by both raising costs and reducing returns.[3] It is all the more important since in Europe, the context of the Enlargement will precisely require from workers an increased adaptability given the likely patterns of country specialization predicted by trade theory. Further, the European population is ageing: the median age in Western and Eastern Europe is now around 40 years, 10 years more than twenty years ago. The ability of societies to deal with aggregate and distributional changes is thus likely to be lower than in the past, making it even more important to design relevant institutions and notably education institutions to cope with these transformations.

[2] The average is calculated including Turkey and Mexico, where this share was only 25 and 26% respectively.
[3] See Bertola and Ichino (1995), Bertola and Rogerson (1997) and Blanchard and Wolfers (2000) on the interaction between shocks and institutions.

Detailed plan

This is the context Europe is facing with. This report will first deepen the analysis of facts presented above in providing a set of descriptive statistics; then it proceeds to analyse the determinants of demand and supply of education; and finally it derives a series of policy conclusions in terms of reforms and public spending.

As economists, we attempt to detail the various links between human capital investments - notably education- and economic performance. We stratify the analysis in using our familiar concepts, namely the supply of education, the demand for education and the market interaction between the two. As stated above, the macroeconomic environment is characterized notably by the rising demand for skills from the private and public sectors, the rising demand for adaptability due to volatility in the demand for goods and the waves of labour reallocation across sectors and industries, and the need to develop an economy of knowledge where human and immaterial investments matter as much, if not more, than physical investments.

Our report is organized as follows. In a first part (Sections 1-3), we investigate the supply of education and the role of labour market institutions and other imperfections. In a second part (Sections 4-5), we emphasize the interactions between the supply and demand for education in imperfect labour markets. In a last part (Section 6), we investigate the pure demand component, and notably the ability of the highest skilled workers to generate new knowledge and subsequent growth.

In the first part, **Section 1** surveys evidence on the intensity of educational investments in Europe (EU15) with a comparison with non-European countries such as the United States of America or Canada. We examine various types of education as classified by UNESCO with ISCED-1997 (International Standard Classification of Education) and their supply in several OECD countries. We then look at stylized facts about the relation between wages and education, unemployment and education and mobility and education. We also survey the financing of education (as a fraction of GDP, per pupil/student and by origin, i.e. public or private). **Section 2** looks more closely the quality of schooling by cohort, in several OECD countries, in exploiting the International Adult Literacy Survey (IALS) data. The IALS contains test score data for the adult population in almost 30 countries. We use these data to examine how skills have evolved for subsequent cohorts across countries. We show that skills have grown at a faster rate in Europe than in the US. Indeed, the level of skills in Europe is higher than in the US for the most recent cohort in the data (born in 1970). This

section then attempts to examine the consequences of such differential trends on the returns to skills and relative wages. **Section 3** deals with the interaction between labour market institutions and the incentives to accumulate various skills. It starts with a brief theoretical survey on human capital, in relation with the efficiency of credit markets and labour markets. We then show how various institutions play different roles in human capital accumulation. Notably, the nature of skill investments is itself shaped by the nature of institutions. Employment protection may well increase the duration of employment and raise the returns to job specific skills, and may raise the duration of unemployment. This in turn reduces the returns to general skills. We then explore the impact of labour reallocation in the presence of specific human capital and show the existence of wage losses of displaced workers in new Member States, as well as large flows of workers out of the labour force.

In the second part explicitly devoted to interactions between demand and supply, **Section 4** investigates the links between education and within-country mobility and notably on how costs and returns to mobility are affected by workers of different educational levels. The higher the level of education, the higher the mobility of workers within country, the larger the likelihood to move for a job-related reason and the higher the likelihood to move outside the current area of residence. In that section, we base our claims on data from the European Community Household Panel. **Section 5** deals with over-education and skill mismatch, using data from the European Community Household Panel and from the Polish Labour Survey. In several European countries, we find strong evidence that skill mismatch (i.e. skills not suited for the current job) are a large scale phenomenon, and that over-education is has no longer any strong effect on wages once skill mismatch is taken into account, except perhaps Spain. In Poland, like in Spain, over-education seem to play an important role, but evidence also suggest that over-educated/under-educated individuals are more likely to move to another job and that over-education is associated with skill mismatch. **Section 6** will deal with between-country mobility and education, and notably the determinants of international immigration and out-migration of highly skilled foreign-born workers. Census data will be used to investigate this question. We point out that the EU do not attract highly skilled workers ("talents") to the same extent as the US and show that the mobility of skilled workers across countries within the EU is low. Wage dispersion does not seem to be a strong determinant of mobility for highly skilled workers, whereas R&D spending plays a strong role. **Section 7** develops the various policy implications of the analysis and concludes.

Section 1. Facts section

European countries, as well as other OECD countries, have drastically increased their effort to improve educational attainments. In this section, we review the trends in the supply of education, the financing issues and exhibit some gross statistics on employment, unemployment, wages and mobility rates by education levels. We start with a rapid description of the methodology to compare educational outputs across countries, such as developed by the United Nations Educational, Scientific and Cultural Organization (UNESCO).

1.1. Classification of education

To describe the educational attainments and their evolution, we will use the well-known ISCED-97 classification designed by UNESCO. As stated in the operational manual (UNESCO, 1999), *"The world's education systems differ considerably not only in respect to their structures but also in respect to their educational contents. In consequence, it is often difficult for national educational policy-makers to compare their own education systems with those of other countries and to draw useful lessons from the educational experiences of other countries. For this reason, UNESCO has been concerned since the Organization's earliest days with the design of a standard classification system for education that would facilitate comparisons of education statistics and indicators of different countries on the basis of uniform and internationally agreed definitions for the different levels and fields of education.*"

The number of years of schooling is rather well captured by the 6 following levels of education:

Level 0 – Pre-primary education;

Level 1 – Primary education or First stage of basic education;

Level 2 – Lower secondary or Second stage of basic education;

Level 3 – Upper secondary education;

Level 4 – Post-secondary non-tertiary education;

Level 5 – First stage of tertiary education (not leading directly to an advanced research qualification); and

Level 6 – Second stage of tertiary education (leading to an advanced research qualification).

which, roughly speaking, would correspond respectively to: less than 5 years, 5-7 years, 8-10 years, 10-12 years, 12-14 years, 14+ years and 16+ years of education, with some overlap across levels and large cross-country differences (up to +/- 2 years).

In addition, ISCED-97 characterizes the type of education with three letters (A, B and C), corresponding to the destination of pupils/students: C usually means that the completion of the degree is associated with the entry to the labour market and would typically refers to entirely vocational types of skills, B means access to the next educational level with likely termination and/or short duration (i.e. a type C program in the next level) and typically refers to program with a mix of general and pre-vocational skills; A means access to any of the next levels and typically refers to predominantly general education, although it also includes some purely vocational skills leading to longer duration programs in the next stage (e.g. engineering). See Figure 1.1 for the transition pattern.

For economists, the adequacy between the thin subdivisions of this classification and the theoretical concepts derived from human capital theory they may want to use is good, but not perfect. On the positive side, the number of years of schooling can be fitted reasonably well, even though there is an obvious measurement problem due to the diversity of schooling systems across countries. On the negative side, the letters A, B and C imperfectly match the degree of specificity of the training. As explained above, A – although dominantly general in that is gives an access to all superior levels – is also consistent with vocational skills. C typically refers to vocational skills but formally is actually meant to capture a curriculum leading straight away to the labour market. More generally, these letters are a measure of the expected duration of education in the next stage rather than of the nature of skills provided in the curriculum. Economists interested in knowing the degree of sectoral or occupational specialization of workers, and hereby, their adaptability in a world of labour reallocation across sectors, cannot use these classifications with certainty. Given the importance of skill mismatch and the needs of adaptability of the labour force in modern economies which we consistently point out in this report, it would certainly be interesting to develop a new classification harmonizing the degree of specialization of educational attainments instead of limiting the classification to the main destination after the completion of the diploma.

1.2. The supply of education and its trends

The basic supply of education is displayed in Table 1.1 for 14 European countries (EU-15 except Luxemburg), their population-weighted average and the United States and Canada. The average number of years of education of the 25-64 years old population is around 11.6 in Europe, with rather large differences across countries: Southern European countries have a less educated population (8.0 years in Portugal, 9.4 years in Italy, 10.3 in Spain), Nordic countries have a more educated population (13.3 in Denmark, 12.4 in Sweden and Finland). The population in the US and in Canada has completed on average one more year of education than in Europe (12.7 and 12.9 respectively). On average, in our sample of Western European countries (hereafter denoted by EU14), workers have completed 11.6 years of education, i.e. 1.3 years below the US.

It is interesting to understand the nature of the gap, i.e. in which educational categories the difference is the largest between Europe and North America. Inspection of Table 1 suggests that it can be equally attributed to a lack of tertiary education in Europe and of upper general secondary education (ISCED 3A). Further, the difference in tertiary education can mostly be attributed to the lack of supply of general and advanced research programs: the EU average reaches 14.2% of the population, while it is 29% in the US. Interestingly, if one imputed a value of 5 in both columns 7 and 8 to Italy to get rid of the missing value here, one would obtain that the EU14 average for column 7 is very close to the US one, 8.5% as compared to 9% in the US, the share of population in type A of tertiary education in the EU14 - column 8 - being then imputed to 13.5% in the EU14.

Where does the gap Europe-US in type A-tertiary education comes from? Additional unreported statistics allow for a gender decomposition of educational attainments. When computing the average of column 8 for males, one obtains 30% in the US, and 15% for Europe, suggesting that a part only of the gap is due to insufficient access of females to tertiary education. One may also think that the main part of the gap between Europe – or more precisely, Southern Europe – and North America is due to a catching up effect, as the US may have invested earlier into higher education. Table 1.2 shows that the answer is partly no. In this table, we present the attainment in tertiary education of various age categories. Comparison of the EU average with the US indicates that the gap between Europe and the US as regards to tertiary (type A) education is larger for older cohorts (merely 9.4% of those aged 55-64 have tertiary type-A education), while the corresponding number is 26% in the US: the difference is thus 16.6 percentage points between Europe and the US. Now, it is interesting to

observe that for cohorts aged 25-34, the gap is about the same magnitude, 16.9% in Europe and 31% in the US, i.e. a difference of 14.1. This means that in the last 40 years, Europe has not been able to catch–up more than 2.7 of the 17-percentage points difference.

We now investigate the trends, going back to the 1960's. In Table 1.3 we provide indicators of educational attainment for the population aged 25-64 in some countries. The sample includes now some of the new EU Member States.[4] There are broadly three facts emerging from it. First, between 1960 and 2002, *most of the difference between Europe and the US in the share of less skilled workers in total population has been absorbed*: in 1960, 76% of European workers had less than secondary education, while this number was 48%, i.e. 28 percentage points less, in the US. In 1980 and 1990 (unreported numbers), the gap was still around 30 percentage points. In 2002, the fraction was 34% in Europe and 13% in the US, i.e. a 21-percentage points difference. In other words, about one third of the gap has been filled in a decade, which is a relatively good performance. A related observation is that Europe had a much lower share with upper-secondary schooling than the US but by 2002, the gap between Europe and the US has been more or less closed at the upper-secondary level.

Second, interestingly, there was not such a big difference at the tertiary level in 1960, the difference being only of 3 percentage points (8% in the US, 5% in Europe). However, in 2002, the difference had reached 16 percentage points (38 vs. 22). Thus, over the 40 years spanned by these data *the EU-US gap in attainment has moved from the upper secondary level to the tertiary level*. The gap has actually stabilized in the last decade: in 1991 (unreported), the difference was by 15 percentage points (30% vs. 15%).

Third, combining the two trends, there appears to be a general catch-up in terms of the average number of years of education. To see this, Table 1.3 also provides estimates of the number of years of schooling.[5] In 1960, the average European had completed 8 years of schooling, while the average American had 10.2 years of education. By 2002, this gap had

[4] The educational attainment data for 2002 come from OECD (2004a). To obtain estimates for 1960 and 1980 we combine OECD data with estimates of the changes in educational attainment in the data compiled by De la Fuente and Domenech (2001). It is well-known that human capital measures in changes are plagued by measurement errors to a great extent. However, Serrano (2003) shows that the reliability of the De la Fuente and Domenech (2001) data, in changes, is much better than in the data derived by Barro and Lee (2001) that are most commonly used.

[5] The average years of schooling is then imputed using the attainment data and information on the typical length of schooling corresponding to each attainment level. In general, we use the "mapping" between educational attainment and years of schooling provided by De la Fuente and Domenech (2001). There are two exceptions and those pertain to years of schooling at the primary level in Switzerland and the United States. This is most likely an upward biased estimate of the actual number of years of schooling in the population. Nevertheless, they contain very interesting information about the broad picture of the evolution of the human capital stock since 1960. Notice also that we have used a finer division into different attainment levels when predicting years of schooling; furthermore, we use the same mapping for all years.

been reduced by almost a year. The reduction of the gap comes mostly from the educational expansion in Southern European and some continental European countries having started out from very low levels in 1960. Thus, *there is convergence in the distribution of educational attainment across countries within Europe, and between Europe and the US.*

1.3. Financing and quality

We now investigate how Europe and other countries have done in terms of financing in the different types of education. Due to variations in the principles of reporting resource investments across countries, there are some difficulties in interpreting the cross-country variation in expenditures. Nevertheless, the figures we present contains some useful information, in particular changes over time are informative. Further, with the aid of these data, we will discuss whether individual countries primarily target education at the primary, secondary, or tertiary level.

Table 1.4 presents total expenditure as a fraction of GDP along with expenditure per student as a fraction of GDP per capita for the EU14. These numbers are reported at two points in time, in 1991 and 2001. It is noteworthy that expenditures increased in the US over the ten years cov.ered by these data. In Europe, on the other hand, resource inputs have actually decreased over the same time period.

By normalizing the total expenditure data with respect to the relative size of the student population we obtain the last two columns reported in Table 1.4 In the US, expenditure per student, relative to GDP per capita, did not change between 1991 and 2001. We record a minor decline in the European countries. For some individual countries the decline is rather radical, however. In particular, in the Nordic countries and in the UK expenditure per student has declined substantially. The most radical decline can be observed in Sweden, a country that was the most ambitious in 1991 and went back to the European average in 2001.

In Table 1.5 we look at the allocation of the overall education budget at the various levels. The first number in each country/year cell reports the allocation of expenditure; the second number (given in italics) is the enrolment share; and the third number (given in bold face) is the ratio of expenditure and enrolment shares. In all countries investment per student is increasing with the educational level, but the allocation across levels differ markedly between the US and Europe: *the European countries allocate more resources per student* (for

given level of overall expenditures) *to the secondary level while the US favours the tertiary level* (see the bold face numbers). With respect to the changes over time in the allocation of expenditures per student, there are no major changes in Europe. In the US, however, there appears to have been a redirection of investment per student from the primary and secondary levels towards the pre-primary level.

Table 1.6 reports the share of total educational expenditure that comes from private sources. The main message of the table is well known and was already discussed in our general introduction: *the private share of total expenditure is far greater in the US than in Europe*. The EU average is some 20-percentage points lower than in the US and the private share of expenditure for no single European country surpasses that of the US.

Figure 1.2 presents long-run expenditure patterns. The reported numbers pertain to public expenditure on education as a percentage of GDP. The solid line shows public expenditure for the US. The dashed line labelled "EU 6" reports the population weighted average for six EU countries (Austria, Germany, Ireland, the Netherlands, Sweden, and the UK) where such data are available starting in 1970, while the line labelled "EU total" pertains to the EU-15 countries (excluding Luxembourg). As shown by the figure, public expenditure has been fairly similar in the US and Europe over the past thirty years. But remember that the US have a much higher share of private expenditure in overall expenditure, so in terms of total expenditure the US appears to be more ambitious than the EU-15 as a whole.

1.4. Returns to education: unemployment, wages, mobility

1.4.1. Wage returns to education

How does the Europe compare to the United States when it comes to the wage returns associated with education? Table 1.7 provides some information on this question by reporting relative earnings by educational attainment, gender and country. The earnings of upper-secondary graduates are normalized to 100. For most countries, earnings are gross of individual income taxes and reported on an annual or monthly basis. Thus, relative earnings will capture hours as well as wage variation across educational categories.

The main message conveyed by Table 1.7 is well-known: the earnings distributions of the European countries are in general much more compressed than in the United States. The main exception from this rule is Portugal where earnings inequality appears to be on par with

the US. We also see from the table that vocational tertiary education (type B) has a lower pay-off than general tertiary education (type A). Interestingly, the relative earnings of type B graduates are very similar in the US and in the EU. The relative earnings for those with less than university education are not too different in the EU and the US either. It is primarily at the top end of the earnings distribution where Europe and the US differ. In the relative sense, individuals with the highest educational level are paid much more in the US than in Europe.

Of course, gross earnings are not the sole determinants of the return to higher education. Taxes, employment probabilities, as well as study grants and subsidized student loans are also of some importance. The OECD (2004) has calculated returns that take taxes and employment probabilities into account for a small sub-set of the countries in Table 1.7.[6] In Table 1.8 we reproduce some of these estimates. The numbers in the table refer to the internal (private) rate of return associated with proceeding from upper-secondary to tertiary education. They are presented for tertiary education as a whole (there is thus no distinction between type A and B programs). Further, the calculations are conducted for an individual who proceeds to tertiary education at the normal time immediately upon completion of upper-secondary education.

The returns reported in Table 1.8 are fairly similar across countries. The EU average return is slightly lower than the US counterpart for males; for females, however, the EU average return exceeds that of the US.[7] Presumably, it is the adjustment for differences in employment probabilities that makes the male returns in the EU countries more similar to the US. counterparts. Adjusting for taxes should have increased the spread between Europe and the US, since European tax systems tend to be more progressive that the American one. The low return for American females is slightly surprising, but it may reflect the fact that they proceed to tertiary type B education to a greater extent than American males.

1.4.2. Employment and unemployment

Education has a strong impact on the relative economic performance of individuals in the labour market. We review some well know facts here. First, Table 1.9 describes the employment rate by education group in 14 European countries, and their average, vis-à-vis

[6] It is not clear whether the rate of returns calculation take the availability of subsidized study grants and loans into account.

[7] One should probably be slightly careful here since the UK is much more influential in the EU average in Table 1.8 than in Table 1.7. But this cannot be the entire story; compare, for instance, the estimated returns in Sweden and Finland with that of the US.

employment rates in the United States and Canada. The employment rate is the fraction of the population in working age actually contributing to production. It is therefore a useful index of the ability of an economy in mobilizing its human resources in production. The comparison of the EU average with US and Canada shows that differences in employment rates (by education and in aggregate) are not very large among males, while they are much larger among females and reach 7 percentage points all educational level together: the EU clearly lags behind (both the US and Canada) in terms of female employment rates.

Two regularities characterize the relationship between employment rates and schooling. First, in each country, higher education is associated with higher employment rates for both men and women. In some cases the differences are very pronounced (see for instance Italy or Belgium for female employment rates). Second, the gap between women's employment rates and male rates decreases as educational attainments grow. In the group with lower secondary education the average women employment rate in Europe, 2002, was 49%, 26% lower than for males (75%). For the group with tertiary education such difference was only 8% (83% employment rate for women vis-à-vis 91% for men). The higher participation of women and the higher levels of education in the North American country explain most of the overall differences in employment rates with the EU.

As usual the average EU values mask large differences between "southern" European countries (such as Spain and Italy) exhibiting very low employment rates for women (44-46%) and "northern" European countries (such as Finland or Denmark) boasting very large participation rates (72-79%), in fact above those of US and Canada. These differences across EU countries, however, are much more pronounced when we look at the groups with low schooling than when we consider those with high schooling (especially tertiary education).

Table 1.10 presents a similar picture, using unemployment ratios (unemployed persons as percentage of the population in working age) across educational groups and countries. Again, the aggregate unemployment ratio for Europe as a whole is significantly larger than for the US or Canada only for the female group. The unemployment ratio is also inversely related, in each country, to the level of education of a group. Increased education is likely to make the skills of a worker more valuable to production (increasing their employment rate) and may also increase the efficiency of the matching process (highly educated workers are more mobile and have a broader range of search) decreasing the unemployment rate.

1.4.3. Geographical mobility

Geographical mobility has two dimensions. The first one is the mobility between residential areas or between regions within countries. The second one is mobility between countries. Both are relevant for our analysis. We first investigate residential mobility within countries and present summary statistics in Tables 1.11 and 1.12, based on computation of the ECHP in 15 European countries between 1995 and 2001[8].

Table 1.11 reports substantial heterogeneity between European countries: high mobility countries are Denmark, the Netherlands, France, the UK, Finland, Germany, Sweden and Luxembourg, with 20% or more of individuals having moved from one dwelling to another. Ireland, Italy, Spain, Portugal, Austria and Greece all report a mobility rate below 12%. Table 1.11 also reports the frequency of reasons for move, conditional on mobility, country by country. Job-related reason given mobility in the last three years is higher in Denmark, the UK, Finland and France, is lowest in Ireland, Belgium, Portugal, Spain and Italy. This ranking is similar to the overall mobility ranking, but one exception, Germany, which has a relatively low job-mobility rate in this table.

Restricting the sample to heads of households (to identify the level of education) in the labour force, table 1.12 reports that on average, 14.5% of individuals have moved from one place to another in the last three years (any reason). It also indicates a substantial heterogeneity across education levels. Among individuals with primary education, this rate is 11.2%, while it reaches 15.4% for those with secondary education and 20.5% for those with tertiary education. The fraction of heads of households reporting geographical mobility in the last three years with the main reason being related to job is on average 8.3%, but it is merely 5.5% for workers with primary education, 8.0 for workers with secondary education and 11.4% for workers with tertiary education.

These few figures raise a couple of interesting points. First, *overall, mobility and notably job-related mobility is pretty low in Europe*. Second, mobility outside the residential area is even lower. Third, *there are significant cross-country differences*: the UK, Finland, Denmark and France having relatively high job mobility rate while countries in Southern Europe and Germany are lagging behind. Finally, *less educated individuals are the less mobile workers, even though they are most affected by unemployment*. We will come back on the links between education and mobility in Section 4.

[8] See Section 4 for a definition of mobility in the ECHP.

We now investigate the second facet, mobility between states or countries. Table 1.13 summarizes some statistics on long-run mobility of labour into the European Union (immigration from outside) and within it (and here by within we shall mean between countries). As way of comparison, the Table also reports the measures relative to immigration into the US and to mobility of US workers across states within the country. We capture long-run immigration into the EU (US) as the percentage of the labour force in the EU (US) that is born outside it. Similarly we capture the extent of internal mobility as the percentage of people in the labour force working in a country of the EU (state of the US) and born in a different EU country (US state).

The data, based on US Census and European Labour Force Data compare the very early nineties (1990 in the US and 1992 in the EU) with the year 2000. Two facts emerge clearly at a first glance to the data. First, the US had a much larger share of foreign-born immigrant workers than the EU already at the beginning of the considered period (1990) and increased such lead by attracting more foreign-born workers during the nineties. *By year 2000 one worker in eight was foreign born in the US while only one in 20 in the EU was born outside the Union*. Second the degree of internal mobility of US citizens is more than ten times larger than the internal mobility of EU citizens between different countries of the Union. *Less than 3% of the labour force in Europe works in a country different from the country of birth, while in the US more than 35% of the labour force moved out of the state of birth to work in a different one*. The comparison is somehow forced since US states are more homogenous than EU countries, but the difference is still strikingly large. As a matter of fact, *the degree of cross-country mobility has not changed at all between 1992 (Maastricht Treaty) and 2000*, after nearly a decade of potential (*de jure*) freedom of movement of workers in the Union. This trend may appear as a source of concern.

These statistics, which we will develop in greater detail in section 6, illustrate a substantially smaller capacity of the EU to attract and absorb foreign workers, as well as to promote mobility within its boundaries when compared to the US. Our work will address the issue of between country (between state) mobility and skills in Section 6.

Section 2. The Supply of General Skills in Europe

2.1. Introduction

In this chapter we examine what the schooling systems across Europe have produced. We focus primarily on primary and secondary schooling and thus the analysis presumably has more implications for inequality than growth. Important questions asked in this chapter are: What do the European countries get for their resource investments, i.e., what skills are provided by these schooling systems? How have these general skills evolved over time? What is the implication of the evolution of skills for wage inequality? Throughout we use the US as a benchmark and present data for a selection of European countries. The actual selection of European countries is mostly determined by the availability of data. As a measure of skills in the adult population we use data from the International Adult Literacy Survey (IALS); see OECD and Statistics Canada (1995). The IALS data impose the major restriction on the number of European countries included.[9]

We start by analysing skills in the oldest cohort and then proceed to successively younger cohorts. Section 2.2 examines basic skills brought to the labour market by successive cohorts born from 1935 until 1970. In section 2.3, we look at skills for those still in schools. Section 2.4 examines the consequences of educational such choices on wage inequality across countries. Section 2.5 offers concluding remarks.

2.2. Schooling and skills by cohort: a long-run perspective

We begin by describing the evolution of years of schooling and skills across cohorts within countries. To provide more details on the evolution of general skills, we utilize data from the International Adult Literacy Survey (IALS). The great virtue of the IALS data is that it provides an internationally comparable measure of skills in the adult population.

[9] For instance, Spain did not participate in the survey and France elected to opt out of the survey.

2.2.1. Data description

The IALS data were collected during in 1994, 1996, and 1998.[10] The IALS test consisted of three domains: prose, document, and quantitative literacy. It is mainly a test of basic skills. It is thus primarily designed to detect variations in skills at the lower end of the skill distribution; it is presumably less apt to fully detect variations in skill at the top end of the distribution.

Table 2.1 reports a basic set of statistics obtained using these data with different samples. The measure of skills used is the IALS score obtained by averaging over the three domains. The first two columns show the mean and the standard deviation (SD) for the target populations (aged 16-65). The country obtaining the highest score on this literacy test is Sweden, while Poland has the lowest score. The US is slightly above average and has the highest variance in skills. The average score in the US target population is almost identical to the EU average reported in the table. That average skills are so similar in the US compared to the EU is perhaps surprising given the large attainment differences in Table 1.3. To some extent this lack of a difference is driven by the fact that EU countries that did not participate in the IALS tend to be those with low levels of human capital (e.g. Greece, Spain, and Portugal). But this is not the entire story as can be seen by comparing EU countries with similar educational attainment as in the US. The European countries do better on a comparison of basic literacy skills than they do when examining formal attainment.

We decided to exclude immigrants from the analysis that follow, as it is not clear if they went to school in the host country. The columns headed "Natives" report the mean and standard deviation in skills when immigrants are excluded.[11] The final three columns reports summary measures of skills for the sample that comes closest to our analysis sample. The sample is restricted to those aged 25-64 to eliminate those who have not yet finished their educational careers from the data. As can be seen, this sample restriction has a minor effect on

[10] The data for Germany, Ireland, the Netherlands, Poland, Sweden, Switzerland (French and German-speaking regions), and the United States were collected in 1994. Data for the Flemish community in Belgium and Great Britain were collected in 1996, and data for the Czech Republic, Denmark, Finland, Hungary, Italy, and Norway in 1998. The target populations were individuals aged 16-65 and the sample sizes were around 3,000 per country. A potential drawback of these data is thus that the samples are small. Small sample error is therefore likely to be an issue, in particular at the cohort level.

[11] Natives are defined as those who responded "yes" to the question of whether they were born in the country of the interview. This sample restriction has a big effect on the reported mean and variance in the US – the mean increases, and the standard deviation falls, substantially. The European numbers are only affected to a minor extent. This mainly has to do with the immigrant population being much greater in the US, but a greater fraction of sample non-response to the question on nativity is probably also an issue. With only those reporting that they were born in the country in question included in the sample, the sample size is reduced by 22 percent in the US. but only by 5 percent in Europe.

measured mean skills, although it is slightly surprising to see that mean skills increases in the US. In the final analysis sample, the variation in skills is comparable for the US and Europe and the average native-born American perform slightly better on the test than the average native-born European.

2.2.2. Schooling and skills by cohort

The IALS also report educational attainment, as measured by years of schooling. In this Section, we will thus use both measures; still we will focus on test scores as they provide a better measurement of the quality of the education than years of schooling.

Figure 2.1 shows years of schooling by cohort for the Anglo-Saxon countries along with the EU average.[12] It conveys a similar message as Table 1.3. The educational expansion in the US preceded that of the EU. For the cohorts observed in the data there is in fact little increase in the US; the increase amounts 0.5 years from the cohort born in 1935 to the cohort born in 1970. For Europe, on the other hand, there is a substantial rise in attainment for successive cohorts. For the time period spanned by these cohorts the increase is 2.9 years. Note that the deceleration in growth rate of human capital in the US has been observed by others, e.g., DeLong et al. (2003).[13]

How is the increase in attainment translated into skills? Figure 2.2 examines this question by showing the evolution of skills (as measured by the sum of the scores in all three domains of the IALS) by cohort.[14] In looking at these estimates one should bear in mind that skill depreciation will affect the slope of these relationship. However, we do not expect the rate of skill depreciation to vary substantially across countries so this problem should not bias the cross-country comparison.[15]

There are a couple of interesting patterns in Figure 2.2. First, starting out from a much lower level in the 1935 cohort, the skills in the average European country have actually surpassed the skills in the US for the 1970 cohort. Second, skills are actually declining for those born during the 1960s in the US (this decline is statistically significant). Similarly, in the UK there is no increase in skills for those born after 1950. For those born in the 1960s, the

[12] To avoid the variability due to small samples we have fitted a smoothing linear spline with knots in 1950 and 1960 to the raw cohort data.

[13] The evolution of years of schooling for the US, according to the IALS is not quite consistent with the figures reported in DeLong et al. (2003). For the cohorts born before 1950, years of schooling is higher in the IALS than in the census data used by DeLong et al.

[14] Again, we have smoothed the data by fitting a spline to the cohort data.

[15] Moreover, Nathanelsson (2003) shows that skill depreciation is a minor issue using IALS panel data for Sweden collected in 1994 and 1998.

rate of increase in skills thus appears to be much lower in the Anglo-Saxon countries than in the average European country. This in particularly interesting given that it is in Anglo-Saxon countries that we have observed the greatest surge in wage inequality during the 1980s; we return to this issue in Section 2.4.

Figures 2.3 and 2.4 report years of schooling and skills by cohort for four continental European countries. Looking at Figure 2.3 we see that educational attainment is virtually identical in the Netherlands and Switzerland to start off with, but then grows at a faster rate in the Netherlands. The bilateral comparison between Belgium and Germany has an analogous feature. Educational attainment is very similar through the cohort born in 1950. But while years of schooling continued to grow in Belgium, this development was halted in Germany for those born in the 1950s. Again, we look at how the attainment differences are translated into skill differences in Figure 2.4. Comparing Figures 2.3 and 2.4 it seems that the increase in schooling has been translated into skill increases to a greater extent in Belgium than in the Netherlands.

Next we turn to the Nordic countries. Figures 2.5 and 2.6 report the evolution of years of schooling and skills for Denmark, Finland, Norway, and Sweden. These countries start out at fairly similar levels in the 1935 cohort. But then educational attainment almost seems to diverge among the Nordic countries. The country showing the most exceptional growth in attainment is Finland: It starts off having the lowest attainment level, but over the 35 years spanned by these birth cohorts, attainment in Finland surpasses the remaining three countries. If we instead look at the evolution of literacy skills, there seems to be convergence rather than divergence among the Nordic countries. The country ranking is fairly different when it comes to skills rather than attainment. In the skills dimension, Sweden manages to keep its early advantage throughout the period despite slipping down the ranking when it comes to investment in formal schooling. Skills are growing at the fastest rate in Finland, which largely mirrors the increase in educational attainment.

Finally, we consider four countries from Southern and Eastern Europe. Figure 2.7 shows years of schooling by cohort for the Czech Republic, Hungary, Italy, and Poland, while Figure 2.8 shows cohort skills for these countries. The development of formal schooling is similar in the three Eastern European countries. Educational attainment actually falls for the cohorts born during the 1960s, perhaps as a result of poor incentives to invest in schooling. In Italy, on the other hand, educational attainment increases precipitously starting from a very low level for the cohort born in the mid 1930s.

The evolution of cohort skills to some extent mirrors the development in educational attainment. The skill increase levels off in Hungary and Poland for those born in the 1960s. This does not appear to happen in the Czech Republic, however, where the test score increases throughout the period. Indeed, the skill evolution in the Czech Republic is roughly comparable to the development in the Netherlands, despite the fact that attainment evolves rather differently in these two countries.

Looking at Figures 2.1 through 2.8 it is clear that there is fairly close match between educational attainment and skills as measured by the test in the IALS. Still for some countries during some time periods they deviate from one another. To give a more systematic account of these differences, we estimate the relationship between skills and educational attainment using the cohort data for all countries.

$$s_{ic} = a_i + a_{50s} + a_{60s} + ße_{ic} + ?d_{e\geq 8}(e_{ic} - 8) + dd_{e\geq 10}(e_{ic} - 10) + ?d_{e\geq 12}(e_{ic} - 12) + ?_{ic} \quad (2.1)$$

where s_{ic} denotes skills in country i and cohort c and e_{ic} years of education. We include country fixed effects (a_i), time-period fixed effects (e.g., a_{50s} equals unity for the cohorts born during the 1950s), and allow the "effect" of schooling on skills to vary by years of schooling.[16] The break-points where the skills/schooling gradient may change slope are somewhat arbitrarily set 8, 10, and 12 years of education (thus, e.g., $d_{e\geq 8} = I(e_{ic} \geq 8)$). We think of the time variation in the deviation between actual skills and the prediction obtained from the regression equation as a measure of the time variation in the quality of the education provided by the schooling system of individual countries.

Table 2.2 reports the annual changes in residual skills relative to the standard deviation within country. Let us take a concrete example to illustrate what the table shows. According to Figures 2.1 and 2.2, skills are improving substantially in the UK between the cohorts born 1935 and 1950. At the same time, the average years of schooling rises. However, the increase in years of schooling is not sufficient to "justify" the substantial increase in skills. Hence, we have a positive coefficient during 1935-50 for the UK. The opposite is happening during the 1950s. Then there are no improvements in measured skills despite the fact that

[16] There are several arguments for estimating a non-linear relationship between formal attainment and skills. For one thing the IALS was not primarily designed to pick up skill variations at the top end of the skills distribution. Thus one should expect the "effect" of an additional year of schooling on measured skills to be lower for higher levels of formal attainment.

there is similar growth in educational attainment as during the earlier time period. Thus there is a negative coefficient during 1950-60.

According to Table 2.2, almost half of the countries saw an increase in residual skills for the cohorts born during the 1940s (and earlier). This may reflect an increase in the ambition of educational authorities, such that they expanded the resources invested per student at each level of attainment. The table also shows that the EU as a whole did worse than expected for the cohorts born during the 1950s. The negative coefficient for the United States during the 1960s may also indicate that the quality of the education provided to children born during this decade has deteriorated. In passing note that this also implies that skills deteriorated within educational groups in the US. Indeed, for the US, the measured skills for those born in the 1960s are lower for the university-educated as well as for those with less than upper-secondary education than in the previous cohorts; see Björklund et al (2005).

2.3. The skills among those still in school

We now focus on the most recent cohorts and investigate the skills of children still in school. We look at mean student performance (Section 2.4.1), the variation in student/teacher ratios (Section 2.4.2) as well as the variance in student achievement (Section 2.4.3)

2.3.1. Mean student performance

The first column of Table 2.3 gives a snap-shot picture of mean performance by reporting a sub-set of the latest PISA results. The tests in PISA are taken at age 15 in math, science, and reading literacy. We report the scores in Reading Literacy and Math according to PISA 2003 along with estimated changes in reading literacy and math since 1991 and 1995 respectively. The data for the earlier time points are taken from the Reading Literacy Study and the TIMSS (these two studies tested students at age 14).[17] The top performers in the PISA study are the students in Finland. This is true for all three domains tested by PISA; indeed, country rankings are rather similar across the three domains. The EU as a whole does as well as US students in reading but better in math.

[17] TIMSS is short for Third International Math and Science Study. Beaton et al. (1996) report results for TIMSS while the results for the Reading Literacy Study are contained in Elley (1992).

The last two columns attempt to examine the changes in performance during the 1990s. Rather than presenting the changes in the actual scores we present the changes of the rank order of countries.[18] It seems that students in Ireland, and the Netherlands improved substantially in reading, while students in France and Hungary moved down the rank order. In mathematics the big improvers are the UK and Denmark while losses are recorded in Austria and Hungary.

An obvious observation is that it is difficult to make strong inference about within-country changes in performance, because PISA and TIMSS are different studies. Further, differences in the cross-country variation in the age of testing may have a substantial impact on estimated changes in the rank-order. In the TIMSS, however, there are attempts to look at the trends in achievement for a small sub-set of countries. According to these estimates, there were significant losses in math achievement in Belgium, Sweden, and Norway while students in the US improved significantly. For reading literacy, there are also some trends estimates pertaining to 10 year-olds. According to the International Reading Literacy Study, there is a significant reduction of the reading performance of Swedish students.[19]

2.3.2. Student/teacher ratios

The next question we raise is what accounts for the variation in student performance over time. The most natural place to start looking for an answer to this question is by examining the variation in resources, in general, and the variation in class size in particular. Table 2.4 shows the number of students per teacher – the student/teacher ratio – in 1992 and 2002. The most useful information in Table 2.5 pertains to the changes over the 1990s.[20] Since the early 1990s, the number of students per teacher has been reduced in the US while it appears to have been constant in Europe. There is a good deal of variation behind this constant average. Some countries have expanded a lot (i.e. reduced student/teacher ratios): the reduction of the number of students per teacher is roughly 25 percent in Ireland and the Netherlands. Other countries have moved in the opposite direction: for instance, in Austria and Norway the student/teacher ratio increased by 27 and 21 percent respectively.

[18] The reason for focusing on the rank order is that the scores are relative in nature; the scores are set such that the average student among all participating countries gets a score of 500. Therefore, the scoring depends on which countries participated in the study.

[19] There is also a significant gain for Hungarian students. But it is difficult to place much emphasis on this gain given that the average age at testing increased by almost half a year.

[20] This is one of the cases where the cross-sectional variation is probably not informative. Differing reporting principles presumably drive the difference between e.g. Portugal (9.3) and the UK (17.6) to a large extent.

The interesting question is, of course, whether and how much students gain by being in a smaller class. This is one of the most controversial issues in the economics of education. The disagreement is so profound that not even the quantitative reviews of the literature are in agreement. Some reviews (e.g., Hedges, et al. 1994 and Krueger, 2003) find positive impacts of smaller classes on student outcomes, while others (most prominently, Hanushek, 1997) find no beneficial effects of smaller classes.

Our reading of the voluminous literature on class size is that the students gain by reductions in class size; the gains are particularly apparent for disadvantaged students. We come to this conclusion by placing more weight on studies that are based on an experimental or quasi-experimental design (e.g., Angrist and Lavy, 1999, and Krueger, 1999), that is, studies that have a credible source of variation to identify the causal effects. On this reading of the literature, US students should have gained from the resource development during the 1990s.

Is there any support for the conclusion that students benefit from reductions in class size in the data presented in Tables 2.3 and 2.4? There is some support when it comes to reading literacy. A regression of the change in the rank order across countries on the change in the log student/teacher ratio produces a coefficient with the expected (negative) sign with a t-ratio of 1.64.[21] Of course, one should not place too much emphasis on this estimate, given that there are only 12 observations. Moreover, we find no systematic relationship between performance and the student/teacher ratio when it comes to math and science.

2.3.3. Equality

A potentially important policy concern is the variation in skills across students and schools. The individual variation in skill during adolescence will eventually contribute to the observed variation in market outcomes. The between-school variation in student performance is related to issues concerning segregation and equality of opportunity. With a high share of the overall variance being explicable by the schools that students attend, this may signal variations in the quality of schooling that the students get.

Table 2.5 reports various dimensions of cross-sectional inequality among students and how these have evolved over time. The variance measures are derived from the Math test in

[21] If we use the actual change in performance (with an adjustment of the means such that the scores are comparable), the coefficient has a t-ratio of 1.97.

PISA since this is the only test where the between-school variance is reported in OECD (2004b). The development of cross-sectional inequality is obtained by comparing the PISA results to those obtained in TIMSS 1995. The total variation across students appears to be similar across all countries. In all countries, apart from Ireland, the variation has risen but the increases seem to be rather minor (apart from possibly Belgium, France, and Portugal). The variation across students has increased more in Europe than in the US.

There is considerably more variation between schools. The between-school variance is particularly low in the Nordic countries. It is considerably higher in continental Europe and the Eastern European countries. The US is in between these two extremes. Interestingly, the between school variance seems to move in opposite directions when the US is compared to Europe. In the US, the share of the variance that can be attributed to schools has declined since 1995, while in Europe it has increased on average. The opposite changes in the between school variance begs the question of why this has occurred. According to OECD (2004a), decision-making in most European countries became more decentralized between 1998 and 2003. Thus, decentralization of authority to the school level in one potential explanation; however, there is not sufficient data to back-up this statement, so this is bound to be a speculative conjecture.

2.4. Implications for wage inequality

At this stage, it is of course tempting to try to relate the changes in skills (described in section 2.2) to the changes in the wage distribution. Can the supply of skills account for the variation in wage inequality observed across countries? By now, there is a fairly substantial literature revolving around this issue.[22] It is well known that the greatest increases in wage inequality during the 1980s were observed in the US and the UK (e.g. Katz and Autor, 1999). In the 1980s, cohorts born during the 1960s entered the labour market. It is interesting to note

[22] See, e.g., Gottschalk and Joyce, 1998, Blau and Kahn, 2001, Devroye and Freeman, 2002, Acemoglu, 2003, and Leuven et al., 2004. One strand of the literature (Blau and Kahn, 2001, Devroye and Freeman, 2002, and Leuven et al., 2004) uses the spread in the IALS test score to examine if the (cross-sectional) variance of skills can account for the (cross-sectional) variation in wage inequality. Another strand of the literature (e.g., Gottschalk and Joyce, 1998, and Acemoglu, 2003) examines whether changes in the relative supply of, e.g., educated labour can account for the changes in wage inequality across countries. In Gottschalk and Joyce (1998) the answer is affirmative: they conclude that changes in relative supplies can explain much of the changes in returns to skills (education and age).

that the US and the UK are among the countries with the weakest increases in skills. Indeed, the US stands out as the country with the most marked *decrease* in the inflow of skills.

Skill dispersion will affect wage dispersion for two reasons. First, there is the obvious direct effect: for given price of skills, countries with high skill dispersion will have more wage dispersion. Second, there is an indirect effect working through the price of skills: increases in the net supply of skills will lower the price of skills. The papers by Blau and Kahn (2001) and Devroye and Freeman (2002) look only at the direct effect. The evidence suggests that the direct effect of skill dispersion on wage dispersion may be fairly small. Devroye and Freeman (2002) present a simple variance decomposition exercise that suggests that only a small part of the cross-country differences in wage inequality is driven by differences in skill dispersion (given the US price of skills). They therefore conclude that the differences in wage inequality between the US and European countries are mainly driven by different wage setting institutions. Similar evidence is reported by Blau and Kahn (2001). In contrast to Devroye and Freeman (2002), however, they allow for different effects of skills at different parts of the wage distribution. An interesting aspect of their results is that the contribution of measured characteristics (including skills) to wages is higher at the lower end of the wage distribution. Comparing two extreme countries when it comes to wage inequality – the US and Sweden – they find that differences in age, schooling, and skills account for 26 percent of the 50-10 log wage differential between the US. The paper by Leuven et al. (2004) is interesting as it attempts to include the indirect effect as well – the effect of the net supply of skills on the price of skills. Applying the methodology of Katz and Murphy (1992), they find much stronger effects of cross-country differences in skills. They find that about one third of the variation across countries in the relative wages of skill groups can be attributed to the net supply of skill groups. Their analysis does an even better job in explaining differences in relative wages in the lower parts of the wage distribution, where differences in skills account for about 60 percent of the variation. Taken at face value, their estimates then suggest that the relative supply of skills has a rather big impact on relative wages, in particular at the lower end of the wage distribution.

Coming back to the initial question, what should we expect about the evolution of wages, given the evolutions of the supply of skills shown in Figures 2.1-2.8? Our final purpose in this section is to examine this question. In particular we will demonstrate that the variation in skills and the quality of education has some importance on the labour market. We do that by running earnings regression at the cohort level. In particular, we estimate versions of the following simple regression using IALS data

$$y_{ic}^{q} = a_i + a_c + ßs_{ic} + ?e_{ic} + d(pop_{ic} / pop_i) + ?_{ic} \qquad (2.3)$$

where y_{ic}^{q} is the average male earnings quintile rank for cohort c in country i, a_i (a_c) is a country (cohort) fixed effect, s denotes skills, e years of education, and (pop_{ic} / pop_i) is the relative size of the cohort population. Notice that the quintile rank ranges from 1 to 5 and that the inclusion of the cohort fixed effects capture the age/earnings profile flexibly. We include relative cohort size in order to capture labour supply effects on earnings.

Table 2.6 presents the results. We begin with specifications that exclude skills; see columns 1, 3 and 5. The estimates suggest a "healthy" return to schooling. An increase of years of schooling by one year moves the cohort up in the earnings distribution by two percentile ranks. However, controlling for skills, schooling has no impact (and in some specifications the impact is even negative and significant). A standard deviation increase in the IALS score (c.f. Table 2.2) yields an increase of roughly 20 percentile ranks. Controlling for skills, we also find evidence suggesting that the relative size of the cohort has a negative effect on the earnings rank. The bottom line of these estimates is that what matters for relative wages is the quality of schooling that the education system produces. Increases in attainment without a concomitant increase in skills have little value on the labour market. In short, what schools produce, and changes in the quality of the education provided, feed onto labour market outcomes.

2.5. Concluding remarks

1. US educational expansion much preceded the European one: there was a substantial gap in attainment some 40 years ago.
2. Some of this gap has now been closed, but there still exists a marked difference in attainment, particularly at the tertiary level; see section 1.2.
3. Despite the gap in attainment, Europe appears to have closed the gap in terms of basic skills. The basic skills that individuals bring to the labour market have grown at a faster rate in Europe. In the latest cohort in our data (born in 1970) skills in the average EU country has surpassed that of the US.

4. According to the latest PISA results European (lower secondary) students do as well (reading) or slightly better (math) than their American counterparts. It is difficult to get an idea about how student performance has changed during the 1990s, but the available data suggest that there have been no major changes in the position of Europe relative to the US.
5. Looking at the resource data it seems that the US have invested more heavily in education during the 1990s. For instance, student/teacher ratios at the lower secondary level have been reduced in the US but have stayed largely constant in Europe.
6. Moreover, there is evidence suggesting an increase in heterogeneity of outcomes in Europe. In particular, the between-school variance in outcomes appears to have increased in Europe while it has been reduced in the US.
7. Finally, we documented that the basic skills that individuals bring to the market are important determinants of their for labour earnings. Moreover, the variation in skills across countries can account for a substantial fraction of the variation in wage inequality across countries, in particular inequality at the lower end of the wage distribution. Thus the quality of the skills provided by the education systems has important repercussions on the labour market.

Section 3. Institutions and Skill Investments

3.1. Introduction

Various labour market institutions (minimum wage, collective wage bargaining, employment protection, passive and active labour market policies) are known to have a large impact on unemployment, with various interpretations on their relative impact. Layard and Nickell (1999) argue in their handbook survey that unions and unemployment compensation have the most adverse effects, while the impact of the other components of institutions is not that evident, and can even be ambiguous. Labour market institutions also have a large impact on worker's incentives and effort (Ichino and Riphan 2004) and on the fluidity of labour markets, notably regional mobility and labour reallocation (see Bertola and Ichino, 1995 and Bertola and Rogerson 1997).

In this section, we focus on the direct or indirect effects of both institutions and market imperfections on workers' supply of skills. We notably focus on the way labour market institutions affect the nature of education and more generally the type of skills. Later on, in Section 5, we will investigate another dimension of the interaction of institutions and education, in examining the general theme of over-qualification and skill mismatch.

3.2. Theory

3.2.1. Perfect financial markets

In this part, we develop the common theoretical framework to analyze the nature of investments in skills, to draw implications in the next part. The concept of human capital has been widely used in the last 40-50 years, since pioneering works by T.W. Schultz, Gary Becker and Jacob Mincer. Human capital typically refers to a set of knowledge, skills and know-how sharing three characteristics. First, they are costly to acquire, both because of direct financial cost and because of time and effort. Second, they increase potential earnings through the life-cycle: like a financial investment, their return is differed to the future. Finally, they are embedded into an individual: skills cannot be sold or transferred from one individual to another: only their service can be rented.

Note that human capital is similar to physical capital in the first two characteristics, but differs in the third one. Despite this difference, Becker (1964) established in the context of perfect markets, notably financial markets, that the internal rate of return on education, defined as the discount rate equalizing costs and returns on investments, had to be equal to the interest rate. This means that individuals should invest into education and possibly borrow to finance their investment, up to a point where the rate of returns on education is no longer larger than the interest rate.

All individuals stop studying at one point or another, suggesting decreasing returns to years of schooling after some point. Under this assumption of decreasing returns, the first implication of human capital theory is that the higher the rate of interest, the lower the chosen number of years of education. Alternatively, the higher the return on education at a given interest rate, the higher the number of years of schooling. Figure 3.1 illustrates: *i* denotes the interest rate, *s* the number of years of schooling and *s** the chosen level of schooling.

A second implication of this analysis is that decentralization of education choices to the market is efficient: individuals chose optimal investments when they pay for education. Of course, in reality, there are several market imperfections, discussed below, leading to drastically different policy conclusions. The general consensus of economists is indeed that education should not be entirely financed by households or individuals. There is another consensus that education should not be entirely free, as many free-goods tend to be over-consumed. Where to draw the line between public and private funding is actually difficult and beyond the scope of this report. Among other things, it importantly depends on the magnitude of market imperfections we intend to describe now.

3.2.2. Financial imperfections

First, what happens in the presence of financial imperfections, such as borrowing constraints? One can easily reinterpret Becker's results as follows. The internal rate of return on education has to be equal to the interest rate faced by borrowing individuals, i.e. a number typically larger than the riskless interest rate. If an individual has no access at all to financial markets, one can replace the interest rate by the (risk-neutral) individual's rate of pure time preference, a typically very high rate.

Still under the assumption of decreasing marginal returns to education, differences in the level of education across individuals can be due to differences in the access to financial markets: the higher the interest rate faced by an individual, the lower the investment in

education he/she will afford. Figure 3.2 illustrates the schooling choices made by two individuals: individuals 1 has a poor access to capital markets and chooses a low level of schooling, while individual 2 has a good access to capital markets and chooses a higher level of schooling. Note that, in the total absence of capital markets, individual 1 would be interpreted as an impatient individual, while individual 2 would be interpreted has more patient.

This analysis is mostly static, but Benabou (2000, 2005) has very well summarized the dynamic trade-off in a world of imperfect information, as illustrated in Figure 3.3. On the one hand, less redistribution leads, dynamically, to a less efficient transmission of human capital across generations, and thus more inequality as poorer families remain unskilled. This is the downward sloping curve 1 (in blue), which depends heavily on the failure of financial markets. On the other hand, median voters would normally tend to choose more redistribution as inequality increases which is the upward sloping part in curve 2 (in red). Unfortunately, there is also a downward sloping part to that curve: more inequality distorts democratic decisions through lobbying or influence, resulting into less redistribution when there is more inequality. The outcome is a multiplicity of equilibria, where the European case (more redistribution, less inequality) may be represented by the first intersection to the left between the two curves, and the US case can be represented by the third intersection with the opposite characteristics (more inequality, less redistribution).

3.2.3. Life-cycle and on-the-job investments

Ben-Porath (1967) has analyzed human capital decisions in a dynamic context and shown that the optimal time allocated to learning should decrease monotonically with age. Full-time education is optimal in the beginning of individual's life, part-time learning, meaning being trained part-time and working the rest of the time, is optimal afterwards, and no learning at all should be optimal as the retirement age is getting closer and closer, as returns to learning eventually become null. Blinder and Weiss (1976) have extended the analysis to labour supply decisions: hours supplied and time spent to learn are two control variables of individuals: the same pattern of human capital investments emerge.

It is implicit in the analysis described above that the nature of initial education and, say, *on-carreer* learning is similar: they apply to any job held, without any distinction. However, as noted earlier on by Becker (1964), on-the-job skills should be usefully separated in two broad categories: skills that are useful in any job, that can be called general human

capital, and skills that are specific to a job, which are called specific human capital. One can then easily extend the distinction to "sector-specific" skills or "occupation specific skills".

A drastic difference between general and specific skills is that purely general skills are theoretically paid by employees: they accept a lower wage today in order to be more productive and hence more paid tomorrow. The reason is that general skills raise productivity in all possible jobs: it is therefore possible for a worker evolving in a perfect labour market, to obtain a wage increase as soon as he/she becomes more productive. In contrast, specific skills cannot be transferred to other jobs: they simply generate a surplus or quasi-rent that can be shared between the employer and the employee. In other words, depending on the relative bargaining power of workers vis-à-vis employers, the cost of specific skills is shared between the bargaining partners.

3.2.4. Labour market frictions

In terms of returns to education, factors leading to wage compression may reduce the propensity to invest in all types of skills. In addition, in imperfect labour markets, private returns to education are increased by the existence of longer spells of unemployment and lower job durations for the less skilled workers. Thus, private incentives to schooling are increased. See for instance Charlot (2003) for the distinction between wage return and return to employability.

In terms of on-the-job skills, Acemoglu and Pischke (1999a and b) have shown that to a large extent, employers tend to pay for general human capital. Their interpretation is that one must relax the assumption of frictionless labour market: indeed, this assumption implies that employers are unable to appropriate the return on general skills. In fact, in the presence of market frictions such as search frictions, workers incur a loss when they leave their employer, even if they were able to find a job elsewhere, in the same occupation with the same general skills. Search frictions imply that it will take some time and some resources to the worker before being employed again. Frictions thus create a specificity of the employer-employee relationship, in the sense developed by Caballero and Hammour (1998). Interestingly, specific skills and search frictions have similar features: they create the specificity of relations, a surplus of the relationship and lead to a natural solution to share the surplus, bargaining over the surplus.

Wasmer (2002) has investigated the relation between another market imperfection, employment protection and the type of skills chosen by individuals. When employees are

protected by layoff costs, they anticipate a higher duration in the current job: being fired is simply too costly for employers to react to small shock, and they thus prefer to retain workers even temporarily unproductive. In partial equilibrium, this raises the relative return to specific skills with respect to general skills, as workers obtain a reward to their skills over a longer time horizon. This mix of highly-specific skills and long-duration jobs has several implications: it is conducive to low turnover in the labour market (as workers with specific skills have no incentive to quit and lose their skills) ; it makes the cost of displacement extremely high (as workers having over-invested in specific skills and under-invested in general skills require huge re-training). Interestingly, *ceteris paribus,* employers tend to prefer workers with specific skills and low mobility, as long as they remain productive, because such workers are attached to the firm and have low outside options. On the other hand, workers with too specific skills are more likely to demand more employment protection (precisely because their outside options are typically low) and are more likely to unionize (as their only option to improve wages is through bargaining over the surplus, not by raising outside options).

3.2.5. Conclusion of the theory part

This brief review of the theoretical literature brings a few points worth emphasizing, and that are useful in the next sections and for the policy conclusion.

1. Human capital is costly to acquire but raise individual perspectives (wages, employability, careers).
2. Individual incentives to learn decrease over time.
3. Financial market imperfections lead to under-investment in human capital.
4. In the absence of labour market imperfections, employees pay for general skills and the costs of specific skills are shared.
5. With labour market imperfections, employers are partly willing to finance on-the-job general skills.
6. Employment protection raises the return to specific skills.
7. Investing in specific skills rather than in general skills raises the individual cost of displacement.

A contrario, we have not made any statement on whether education and more generally on-the-job training should be publicly or privately financed. Pure gratuity is probably conducive to waste, while fully private funding is probably conducive to inequality and inefficiency in the presence of market imperfections and externality.

3.3. Application of theory to the measurement of specific skills in an Enlarged Europe

3.3.1. Labour reallocation in Europe

Kumar and Kruger (2003 and 2004) have developed the view that in Europe, the education system provides a relatively more specialized curriculum, as compared to the US. They argue that this is a source a growth-differential between the two areas, as the US are able to cope with new technologies in a more reactive way. Wasmer (2002) makes a similar point related to on-the-job skills: as institutions in the labour market tend to raise the relative returns of specific skills, workers over-invest in such skills. They are thus very productive on-the-job, but reallocation of labour is more costly, individually and in terms of aggregate welfare. An implication is that, in a stable macroeconomic environment, the European model with specific skills is rather efficient. In periods of turbulence, when large aggregate and reallocative shocks occur, the European model with specific skills may have troubles because of its lower ability to deal with rapid changes. The picture presented by Kumar and Kruger and Wasmer is highly consistent with Blanchard and Wolfers's (2000) view that shocks interact with institutions.

We now present evidence of the large labour reallocation Europe has faced or is currently facing, both in the Eastern and Western part. We first present empirical evidence that workers in Central and Eastern European Countries (CEEC) were and still are concentrated in agriculture and industry. Table 3.1 shows how specific countries (Eastern Germany, Czechoslovakia, Hungary and Poland) compare to various OECD countries. Here, OECD countries are ranked per quantiles of the income per capita distribution.[23] CEEC's and East Germany still have a very large industry compared to the richest OECD countries. The situation is somehow different from the previous enlargements to Southern Europe, where the share of agriculture was dominant, and only Poland can be compared to Southern Europe in

[23] The bottom third corresponds broadly speaking to Southern European Countries such as Spain, Portugal, Greece, and Ireland, the fourth of the 'Cohesion Fund Countries'.

terms of the sectoral composition of employment. See Wasmer (2005) for a longer discussion of these issues.

Let us now focus on two selected Eastern European countries, Poland, and Estonia, and investigate the effect of such macroeconomic shocks (the transition to the market economy in the early 1990's and the Enlargement in the late 1990's). Both countries have formally joined the European Union in 2004, but the process was initiated years before, first in the early 1990's when the negotiation for adhesion started with the definition of the so-called Copenhagen criteria, and second, when an Accession Partnership was adopted and published in the Official Journal of European Communities in March 1998, after the Luxembourg European Council had adopted the agenda of the Enlargement process.

Figures 3.4 and 3.5 give a good illustration of what can be meant by obsolescence of specific skills. Right after the fall of Berlin Wall and the conversion of Poland to market economy, the inflow of early-retirement peaked drastically, around 160 000 workers, while the subsequent, steady-state inflows is around 40 000 workers a year. In the years preceding the Enlargement, Poland has still a massive recourse to early-retirement allowances: Figure 3.5 indicates that the stock of workers under such scheme is around 800 000, for a stock of unemployed workers of more than 3 millions, which in 2001 represented almost 20% of the labour force. In Estonia, given a very active labour market in which job creations exceed considerably job destructions, the job separations started to increase after 1997, as well as the sum of hiring and separations (a measure of labour reallocation). The point we are making here is the twofold: first, the Enlargement, as well as any large transition shock, is associated with more labour turnover. And second, labour being not infinitely mobile across sectors, in some cases labour turnover implies an increase in the inflows into early inactivity. This is an indication that the nature and specificity of skills matter a lot for individual characteristics, and even more so in periods of reallocation of labour.

3.3.2. Measurement of specific skills

We have discussed above the importance for any theoretical analysis of labour markets to take into consideration the existence of specific skills in the cross-section of labour market participants: their existence makes labour adjustment more costly, and slower. A natural question, at this stage, is the empirical relevance of such theoretical ideas at the micro level.

The most direct evidence can be obtained by a careful investigation of returns to seniority. In an older paper, Hashimoto and Raisian (1985) had provocatively demonstrated that Japanese and American workers deeply diverged in terms of number of jobs occupied throughout their career. For instance, in the late 70's, they showed that in the US, 15% of male workers aged 40-49 had more than 20 years of tenure, while this was the case of 31% of Japanese workers. At the age 65, US workers had occupied in average slightly more than 10 jobs, while the average Japanese workers had occupied only four jobs. Perhaps as a cause, perhaps as a consequence, they found that, in large firms, returns to tenure were 7% a year (with a quadratic term of -0.03%) in Japan, and only 1.2% a year in the US (with an identical quadratic coefficient), controlling for total experience, schooling and several interaction terms. This has been a much controversial result: subsequent studies for the US oscillated between larger and significant returns to tenure (Topel 1991, Kletzer 1989, see also Kletzer's survey 1998 based on US displaced workers) and zero returns (Abraham and Farber 1987, Altonji and Shakotko 1987), while for Japan, Clark and Ogawa (1992) indicated that strong returns to tenure were less true in the mid 1980's, due to changes in the demographic structure of Japan. In France, Lefranc (2003) found evidence of large wage losses after displacement, but not as large as in the US. Interestingly, he argues that wages losses in France are a loss of accumulated human capital while in the US this is mostly due to downgrading of occupation. Loewenstein and Spletzer (1999) investigated the content of firms' sponsored training and argue that it is mostly general in the US.

There is also a large literature on workers' displacement, attempting to precisely investigate the wage loss incurred by workers a few quarters after they were displaced from their previous job.[24] Bender et al. (2002) for instance measured the wage profile of workers before and after plant closure in Germany and France by carrying out standard wage regressions with a full set of dummy variables covering the wage of movers before and after displacement. The comparison group in all the regressions is the group of stayers on the job. Contrary to US studies, they do not find important wage losses after displacement. Lamo et al. (2005) extend the approach in Bender et al. (2002) by allowing for different wage profiles for workers with different educational attainment. The key idea is to interact the "before move" and "after move" dummies with the degree of specificity of skills, such as measured by the ISCED-1997 classification.

[24] See the compendium of papers included in Kuhn (2001) for a recent study of the issue in different countries.

3.3.3. Am application to two accession countries, Poland and Estonia

We borrow from Lamo et al. (2005) and simplify the presentation of their results. In what follows, we attempt to measure the degree of specificity of skills in an economy in investigating the wage profile of workers having moved from one job to another (movers throughout this section). Bender et al.'s (2002) method is applied to two countries having faced the large reallocation episodes discussed above: Poland and Estonia. The main data sources are the Polish and Estonian labour force surveys. These are quarterly surveys to a large extent homogenized with the LFS carried out in the EU-15. The longitudinal nature of the survey allows observing individuals for a maximum of four quarters within a 1.5 years period.[25] The period of analysis is 1997-2003 covering to a great extent the anticipation of the reallocation shock imposed by the EU Enlargement. Our data set does not allow distinguishing voluntary from involuntary mobility. Thus, we do not have *a priori* expectations on the wage consequences of mobility. However, our theoretical discussion suggests that movers with more specific skills should benefit less (or suffer more) from mobility. We distinguish 4 educational categories: tertiary, secondary vocational, secondary general and less than secondary. If skill specificity is an important limitation to mobility we should observe workers holding a vocational qualification to suffer higher wage losses (or lower wage gains) than similar workers with more general human capital (secondary general). This will be our main hypothesis to be tested.

Table 3.2 presents the main results from the wage regressions in Poland and Estonia. The wage regressions pool information for movers and stayers, and include a full set of covariates typically used in this type of analysis. Four dummy variables take value 1 for movers at different moments in time before and after mobility. Our coefficients of interest are these wage profiles for movers with general secondary education and secondary vocational (thus, the interaction terms between the dummy variables of mobility and the educational dummies). Results for Estonia confirm the predictions of our theoretical insights. Wages of movers with secondary general educations before and after mobility are on average 8 percent lower than wages of stayers. Therefore, there is no difference before and after mobility for movers with general education. Instead, wages of movers with a vocational degree are 4 percent lower than wages of stayers before mobility, i.e. they are in jobs with better paid than movers with general skills, although they are less paid than stayers. Now, the important

[25] For a longer discussion of the main characteristics of the Polish LFS see Section 5 in this report.

difference is that the gap after the move is large: wages decrease by 7 percent compared to stayers in the first quarters after move to reach a -10 percent one year after mobility. These sizable differences between both types of workers suggest that human capital specificity can be an important limitation in periods of rapid structural change.

The evidence for Poland, although pointing towards a similar direction, is less clear-cut. In this case, movers with secondary general education benefit from mobility. The 7 percent gap in wages with respect to stayers before mobility is reduced to -2 in the immediate quarters after mobility. This wage gain is somewhat reduced a year after mobility, but not enough to reach the level preceding the job change. Instead, the wages of movers with secondary vocational education do not vary significantly before and after mobility. The massive recourse to early-retirement in Poland may explain why we see smaller differences between workers of different education among those who remained in the labour force. Subsequent work will try to address the issue of selection in the pool of labour market participants.

3.4. Conclusion

1. In the European macroeconomic context of the Enlargement and more generally volatility of demand, one can expect large workers' reallocation flows
2. Education must provide skills to ease transition between sectors
3. In an ageing Europe, such transitions may be costly, especially since labour market institutions, notably employment protection, do not encourage the acquisition of general skills.

Section 4. Mobility and Education

4.1. Introduction

The purpose of this Section is to investigate the determinants of geographical mobility in Europe and in particular to assess the role of education. In Section 1.4, we already explored preliminary links between education and mobility and showed that more educated workers are more mobile. If unemployment in Europe is partly due to a lack of mobility of workers as suggested by many (e.g., Bertola and Ichino, 1995), a natural question to ask here is *what is the role of human capital in determining mobility,* and more precisely, why is the impact of education of mobility so large and common in all countries?

In theory, education may affect the migration decision for two reasons: it may raise gross returns to mobility; and it may reduce the costs to mobility. The first effect is rather obvious: education has an effect on earnings. Suppose workers receive job offers in a log-normal wage distribution. Workers with a higher level of education have access to proportionally better paid jobs than uneducated workers. Some of these job offers imply a geographical move. If mobility costs are independent of education, educated workers will therefore be more likely to move.

The second mechanism is usually disregarded, but is not necessarily less important. Higher education is associated with general skills, adaptability of individuals and, in the case of higher education, some experience of studying in another city or region. Many studies report that, conditional on many observable characteristics, the migration probability increases with previous mobility experience (e.g., Axelsson and Westerlund, 1998). Individuals with higher education are more likely to have studied elsewhere, they were confronted with classmates from other sub-regions or areas, raising the ability to exchange and communicate. Overall, higher education may reduce psychological costs to mobility.

The effect of education on both costs and returns produce the same observable effects as the ones displayed in Tables 1.11 and 1.12: education and mobility are positively associated. This Section will first provide multivariate analysis of the links between mobility and education with no strong claims on causality. We then make a rough attempt to disentangle the two effects (costs vs. returns). If we find that education seems to reduce

mobility cost, the general increase in educational attainment in Europe may be beneficial to geographical mobility.

One could argue that it is difficult, both empirically and theoretically to dissociate costs from returns.[26] This is true, and we try to make modest claims about how to disentangle the two aspects. Nevertheless, the effect of education on returns and costs is important in normative terms. If education affects mobility positively because of higher wages, education should be privately financed, or at least not more publicly financed. If however education reduces mobility costs and is not internalised by students, or it acts through an external effect (e.g., if my mate is mobile, I am mobile too), then there is an additional rationale for the large recent increase in general education that is not always present in labour market analysis.

4.2. Data: ECHP and geographical mobility

The European Community Household Panel (ECHP) is a household survey collected from all EU-15 countries that includes detailed information about individual and household characteristics. We will use this survey here and in Section 5 on over-education and mismatch. The longitudinal nature of the ECHP allows following individuals over time throughout the seven years covered in the survey (1994-2001). Moreover, the data also includes supplementary information at the country level such as PPP exchange rates, CPI national deflators and aggregate population information. Throughout this chapter we use the cross-sectional weights provided by the ECHP. Education is defined as a categorical variable (primary, secondary or tertiary) in descriptive tables, and in years of schooling in regression analysis. See the Appendix to Sections 4 and 5 for details.

Defining mobility with ECHP is relatively straightforward. The household files contain information of the year of the move into the current dwelling (left-truncated in 1979). For recent moves, the month of the move is also declared in most cases. Knowing the year and month of the interview, one can easily estimate the number of months elapsed since the last move for all household members and thus define a 'recent mobility variable'. For all 15 countries in the ECHP and for all years but 1994 (due to lack of reliability), we construct two variables defining a recent episode of mobility if the household has moved within 12 and 36

[26] For instance, in a compensating wage differential approach, wages may reflect moving costs. Here, we have in mind a take-it-or-leave-it model of wage offers where firms face an elastic supply of labour and thus have ex-post the monopoly power.

months preceding the interview. We also know the main reason for the move for 13 of the 15 countries of the ECHP (Luxembourg and Sweden being the exceptions). The reasons fall into three categories: mainly job-related, mainly house-related, or personal reasons. The last possibility corresponds to marriage or divorce or death of a relative, while the second one corresponds to a situation in which the current dwelling is inappropriate. Drawing the line between these two possibilities is not necessarily easy, but house-related mobility is typically associated with either the dwelling being too small or too expensive. We finally know whether the move was within the city/area, from outside the city/area or from another country. See Appendix A4 for the definition of related variables.[27]

4.3. More descriptive statistics on mobility

Here we present additional descriptive statistics on mobility for the sample of heads of households (reference person) in the active population. In the survey, the reason for mobility can be due to any person in the household. To relate the decision of moving to personal characteristics, the best we can do is to select the reference person, presumably the one for which the reason for move applies most. The head of household could not be defined for Luxembourg as the PID (personal identification number) of the reference person is missing; further this information is missing for Finland in 1997.

In what follows, all statistics are computed using survey weights. Tables 4.1 to 4.3 report summary statistics on the relation between mobility rates and various variables related to the skill level and employment status of the head of household. Here we focus on mobility for any reason and refine the analysis later on. Table 4.1 indicates that mobility rates for the unemployed are substantially greater than for employed workers: the mobility rate of the unemployment in the last 36 months is 3.5 percentage points above the rate for the employed workers (21.3% compared with 17.8%). Table 4.2 reports mobility rates by occupation. The relatively more skilled occupations (professionals, technicians) and service workers tend to

[27] There are now many studies on mobility based on ECHP. Two recent works, Barcelo (2002), and Tatsiramos (2004), use a definition of geographical mobility similar to the one used here, in that it is not based on the change in the macro-region of residence to define mobility. The main reason is that, in several countries, macro-regions (which are a group of regions, corresponding to the geographical level NUTS1) are so large that geographical mobility would be strongly underestimated.

have higher mobility rates than less skilled occupations and occupations specific to industry or agriculture.[28]

Figure 4.1 reports the measured mobility rate of heads of households for a job-related reason, outside the area/city in which they lived. For all countries, this mobility rate is higher, the higher the level of education. On average in Europe, this rate is 2.1% for workers with tertiary education, 0.8% for workers with secondary education, and 0.4% for workers with primary education. Tables 4.3 and 4.4 examine mobility outside the residential area/city. Table 4.3 shows that the UK, Denmark and Finland exhibit the highest mobility rates outside the (previous) area of residence. Other countries, notably Belgium and Southern European countries, have low or very low mobility outside the current residential area. France and Germany are in intermediate positions in this table. The last column in table 4.3 restricts mobility to job-related moves. This roughly corresponds to the observations to the right side in Figure 4.1, except that in this table, international mobility is excluded while it was included in Figure 4.1. Finally, going back to our initial question, Table 4.4 shows that *the mobility rate outside the area is more than 3 times higher for workers with higher education* (4.4% of households have experienced a move outside the area in the last 3 years) *than for workers with primary education* (merely 1.4%).

4.4. Theory

We now present a simple model of migration. For simplicity we abstract from complex intra-household decisions and treat households and individuals interchangeably. The presentation draws on Axelsson and Westerlund (1998) with some adaptations. Typical migration models go as follows: each household i has access to J possible places indexed by j. Households derive random utility U_{ij} from being located in j and chose the optimal location j^* as:

$$j^* = \text{Armax}\,(U_{ij})$$

[28] Other unreported statistics indicates that self-employed and workers in family enterprises are much less mobile than the regular employees, themselves less mobiles than workers in training and apprenticeship. There is clearly an age effect here, as younger workers are at the same time more likely to be geographically mobile and more likely to be in a training or apprenticeship status. We did not find any clear trend in the data: mobility rates simply show a peak in 1997 and 1998 and subsequently decline.

Now introduce time variability. Denote by $l=j^*(t-1)$ the optimal location last period. At time t, if $j^*(t)$ differs from l, the household moves. One can thus estimate a migration model such as:

$$M=1 \text{ (or 0)} \qquad \text{if } M^*=Wg+w>0 \text{ (or=0)} \qquad (4.1)$$

where W is a vector of households characteristics, g a vector of coefficients, and ω a random error term, assumed to be normally distributed with zero mean and variance $(s_w)^2$. This approach implicitly focuses on returns to migration and ignores costs: the fact that education and mobility are positively correlated in the cross-section is taken as an indication that returns to migration are higher, the higher the level of human capital.

To disentangle returns and costs to education, one can adapt the model as follows:

$$j^*(t) = \text{Armax}\,(U_{ij} - C_{ilj}) \qquad (4.2)$$

where now, the optimal location depends on the current location and C_{ilj} is the cost for household i to move from place l to place j, with $C_{ill}=0$.

Estimation of equation (4.1) is however not going to help, as the determinants of the returns to moving W are now the determinants of *net* gains from migration, thus still mixing up costs and gross returns. We need to adapt the existing empirical strategies to attempt to decompose the effects of education on costs and returns to mobility. Here, we will propose two alternative strategies. A first one can be thought of as a reduced-form empirical strategy. The second one is a more structural approach.

4.5. First strategy: comparing job-related mobility and mobility for other reasons

Here we exploit an interesting feature of the ECHP: individuals report the main reason for having moved in the current dwelling. As discussed above, the reason can be either primarily job-related, house-related or for personal reasons. The main idea in our empirical strategy is as follows. The effect of human capital on returns to mobility is presumably stronger for job-related moves than for moves induced by other reasons. Denote again by Wg the determinants of mobility with $Wg=Rg_r-Cg_c$ with R a set of variables affecting returns

to mobility, and X a set of variables affecting costs to mobility. Estimating a multinomial logit model of migration, where the categorical variable takes values 0 if no recent move, 1 if job-related move, 2 if house-related move and 3 for personal reasons, one has an estimate of γ per type of mobility. We use the mobility rate in the last three years instead on the last year to obtain more mobility events and thus have a better identification of parameters of interest.

A possible identifying assumption, denoted by (H_o), is that the coefficient of the variable education on returns to mobility (one coefficient of the array γ_r) is zero for house-related moves or personal reasons. In this case, we would obtain an estimate of the cost-effect of education (which is the corresponding coefficient of the γ_c). Nevertheless, this is a rather strong assumption. A refinement of the method is to run a higher-level multinomial logit model, making use of the distance of the move; individuals indeed declare whether the previous location was in the same area/city or outside. One can then create a categorical variable taking the following values (0 if no recent move, 11 if job-related move in the same area, 12 if job-related move to another area, 21 if house-related move to the same area, 22 if house-related move to another area, 31 if personal reason move to the same area and 32 if personal reason move to another area. One would expect the effect of education to be more important for house-related moves for a move outside the city, the same for moves motivated by a personal reason.

We restrict the analysis to a sample of active individuals who are the reference person in the household. A missing variable is attributed to the categorical variables when the reason for move or its origin is missing. We use data covering the time period 1995 to 2001 for 13 countries (Sweden and Luxembourg excluded because of data availability) and obtain a partition of the sample as described in Table 4.5. Missing observations represent 9%, no mobility 79%. The remainder is mobility mostly due to house-related moves, mostly in the same area. In contrast, job-related moves tend to be marginally more outside the area (0.83%) than within the area (0.67%).

Table 4.6 reports the results of the three-level multinomial logit where individual clustering is taken into account in the computation of the variance-covariance matrix. We present the relative risk ratios. As is clear, whatever the specification retained (with or without industry and occupation effects, with or without control for household total net real income or unemployment status), the effect of education is positive and significant for all types of moves. Unsurprisingly, the coefficient on education is larger for job-related mobility (8% in the first specification), but it remains positive and significant for house-related and moves out

of personal reasons (3.5% and 2.0% respectively). Under assumption (H_o) made above, *this would mean that mobility costs depend negatively on the level of education.*

Table 4.7 decomposes the multinomial analysis further using the information on the distance of the move. In the top table, we present the estimated coefficients both in level and in their exponential form, In the benchmark specification, one can observe that the coefficient of education in columns "Outside the area" is between two and three times larger than in columns "same area". The ratio is even about 4 for moves for personal reason. A similar finding emerges from alternative specifications in the bottom of the table. This means that, whatever the reason for the move, a higher level of education implies that individuals are two to three times more mobile outside the area than within the area, everything else controlled for. *Since psychological mobility costs are presumably larger when distance of the residential change is larger, we take these results as an additional indication that mobility costs are significantly reduced by education.*

We also explored the determinants of mobility for Germany, France, the UK and Italy. We don't report the results, but for job-related moves the results are consistent with those in Table 4.7: the marginal impact of an additional year of education on the probability of moving outside the current residential area is larger than for moves within the current residential area. On the other hand, the coefficient on education is not larger for "big" moves in Germany and the UK when it comes to moves that are not job-related. It is much larger in France and Italy, however.

4.6. Second strategy: estimating the income gain from migration

The migration decision specified in equation (4.1) is a reduced-form approach, where the explanatory variables are personal characteristics. A more structural approach would incorporate the income change due to migration. In our case, this would be very useful, because the effect of education net of income change would be good measure of the cost-reducing effect of education. Of course, the income change from migration is only observed for those having moved, a typical selection problem analogous to the problem of estimating wage equations when the wage of non-participants is not observed.

To deal with the problem, a second equation -- an income change equation -- is typically estimated. Suppose income is determined by

$$Y = Xb + aM + Zd + e \quad (4.3)$$

where X are observable characteristics affecting income, while Z is a set of time-independent variables such as education, and b and d are vectors of coefficients. The stochastic component e is assumed to be normally distributed variable with zero mean and variance $(s_e)^2$. The correlation between the two error terms e and w is given by r.

The method is the following: in a first step, equation (4.1) is estimated. In a second stage, equation (4.2) is estimated. In this second step, the correlation between e and w is taken into account by adding the variable *Inv.Mills* = $f(Wg) / F(Wg)$ if $M=1$ and $f(Wg) / (1 - F(Wg))$ if $M=0$. The estimated coefficient on this variable delivers the product $r s_e$.[29]

One thus obtains $E(Y|M=1)$, $E(Y|M=0)$ and their difference is thus the expected gain from migration, imputed notably to households for which no migration was observed. See the Appendix for the computation of these variables. Denote by

$$DY_{E,imp} = E(Y|M=1) - E(Y|M=0) \quad (4.4)$$

the imputed, expected gain from migration. One can thus in a third stage re-estimate a migration equation similar to (4.1), but with this variable as an additional explanatory variable. The effect of education, given the inclusion of this variable, is thus the effect of education net of the effect of the potential gain from migration. It is thus the effect on the cost.

In order to see why it is important to estimate the income equation for stayers and movers separately in this two-stage analysis, one can simply report gross statistics on the yearly income growth of household real income (PPP adjusted). It is on average 2.4 percent a year over the sample of 13 EU countries. Movers for job-related reasons have on average a 6.7% income growth. Movers for a job-related reason who moved outside the area further experience on average a 8.3% income growth.

We report in Table 4.8 the first stage (a probit equation for mobility) in the first column and the semi-structural mobility equation in the second column where the imputed income growth is added as a regressor. We also report the income model, corrected for

[29] Identification will come from housing tenure and "rent is a financial burden" variables in the mobility equation, and different functional forms (potential exp. vs. age dummies) in the income and mobility equations.

selection, for stayers and movers, respectively, in columns 3 and 4.[30] A few interesting results emerge. First, in the income growth equations, the product rs_e is positive and significant, contrary to Axelsson and Westerlund (1998) who find it to be insignificant. The main reason is that we estimated the income model in levels, while they estimate an income growth model. The impact of education on income is large, and larger, though marginally, for movers. Other variables playing the dominant role in this equation are family status and family size. Second, the imputed income growth variable has a large and significant coefficient in the mobility equation. Finally, the coefficient of education is about 0.033 in the reduced-form probit, and is not much smaller in the semi-structural approach: it falls to 0.030. We also undertook the same analysis by country for Germany, France, the UK and Italy, in retaining the same benchmark specification.

4.7. Conclusions

1. Geographical mobility is positively associated with the level of education unconditionally as well as conditional on other characteristics.
2. The effect of education is larger for job-related moves and for long-distance moves (outside the area of residence)
3. The results suggest that mobility costs, notably psychological costs, are reduced by higher levels of education.

[30] We also tried four different specifications, including additional variables: unemployment status and occupation and industry dummies but do not report these results, as they are very similar.

Section 5. Skill mismatch and over-qualification in the Enlarged Europe

5.1. Introduction

Every year, the European economy generates a large number of high school and college graduates that start searching for their first job. Regardless the search efforts by the newly incorporated to the labour market, the transition from school to work is often slow and associated with long spells of unemployment.[31] But at the same time, companies usually claim that their posted vacancies cannot be filled-in by the numerous jobseekers. This failure of the market to match unemployed individuals and vacancies can often be attributed to information asymmetries and high costs associated to mobility, but it is also often a sign that the jobseekers do not have the qualifications demanded by the firms. Even when young workers finally obtain a job, it is often the case that their qualifications are not necessarily related to the job contents. Sometimes workers find themselves over-qualified for the job. Alternatively, their qualifications acquired at school might be sufficient for the job, although the contents of their educational background might not be much related to the skills required by the job.

A recent empirical literature mainly focused in European countries studies the determinants and causes of the mismatches between the formal education of individuals and the educational requirements of their jobs. Following Freeman's (1976) seminal book this literature identifies workers as over or under educated and studies the consequences of these types of mismatches for wages and other labour market outcomes. One limitation in this literature is the lack of comparability of methods and data, which hinges cross-country comparisons. Groot and van den Brink (2000) present a meta-analysis of previous studies on the effects of over-education on wages, but their focus is on laying out cross-country regularities rather than identifying idiosyncratic features. Moreover, while looking at educational mismatches is interesting in itself and from a policy perspective, these mismatches might not necessarily imply an inefficient allocation of resources. Workers identified as over-educated might well be properly matched if their productivity is lower due to unobserved characteristics such as inner ability with respect to other workers with the same educational level. Similarly, under-educated workers might compensate this lack of education

[31] For a survey of the issue and recent international comparisons see OECD (1999).

with other forms of human capital such as firm specific training and be the best suited for their jobs.

There are two main perspectives in the interpretation of skill and educational mismatch. According to some views skill mismatch is a temporary phenomenon at the individual level. This phenomenon might be related to inefficiencies in the functioning of the labour market due to lack of perfect information and mobility (Jovanovic, 1979), or might instead reflect a desire from the part of workers to acquire skills that complement their qualification at early stages of their career (Sicherman and Galor, 1990). Over time, workers are expected to improve the matches either by mobility within or outside the firm. Instead, if formal education is used as a screening device by employers (Spence, 1973) skill mismatch can become a permanent phenomenon. Recently, Albrecht and Vroman (2002) and Dolado et al. (2004) have shown that mismatch can be a long-lasting phenomenon in matching models with jobs and worker heterogeneity, where high skilled workers can compete with low skilled workers for low skilled jobs. These structural mismatches can be attributed to supply forces such as rapid educational upgrading of the labour force, or demand forces such as skilled bias technological change. In both cases they imply a rapid change in the demand or supply of skills that cannot be easily matched by the other side of the market.

This chapter presents an overview of the labour market causes and consequences of skill and educational mismatch in selected European countries. When the data allows, it goes beyond previous definitions of over-education by concentrating on the broader concept of skills rather than formal education. The chapter is divided in two parts. First, we study the causes and consequences of skill mismatch in the EU-15 using recent data from the European Community Household Panel (ECHP). The data allow us to characterize the phenomenon of skill mismatch and over-qualification on a consistent basis across countries and time, based on workers self-assessments on the relationship between their skills and those required by their jobs. After presenting a short overview of the phenomenon of skill mismatch in the EU-15 economies, the analysis concentrates on the five largest EU-15 countries.

The second part complements the analysis by focusing on Poland, a country that like nine others of the new enlarged Europe has recently gone through a process of structural change and transition to a market economy while its educational system was tailored to the needs of a regulated economy. Over/under education (or education mismatch) in these countries has not been studied, and it is a potentially relevant phenomenon.

Unfortunately, the definition of educational mismatch available for Poland is not directly comparable to the definition used for the other EU countries. The data source used for

the analysis is the Polish Labour Force Survey (PLFS) for the period 1997-2003, which allows us to look at formal education mismatches (both, under and over education) but does not allow to directly characterizing the broader phenomenon of skill mismatch. This partially prevents us from comparing measures and trends of education mismatch in Poland and the other large countries of the European Union. Therefore, the second part of this chapter offers new empirical evidence of the labour market consequences of over/under education in Poland, and when possible draws some tentative lines of comparison with the other EU countries.

Part A. Skill mismatch and over-qualification in the EU-15

Our analysis starts characterizing the phenomenon of skill mismatch and over-qualification. We start with a fact-finding section where we analyse the main personal and firm characteristics associated to skill mismatch. Thus, we relate several measures of skill mismatch to a set of personal characteristics including education, previous unemployment experience, potential experience in the labour market and tenure on the job and firm characteristics such sector of operation. Next, we analyse the consequences of over-qualification and skill mismatch for the determination of wages. Our augmented Mincerian regressions single out the types of skill mismatch that are penalized by the market.

5.2. The data

As in Section 4, we use the ECHP. We concentrate the analysis on the five largest countries of the EU-15; namely, France, Germany, Italy, Spain and the UK, but we will present summary statistics for all EU-15 countries in an attempt to provide a full picture of the skill mismatch phenomenon[32]. Hourly wages net of taxes are calculated from the ECHP. Hourly wages are derived by dividing the monthly net wage provided by the questionnaire by monthly hours worked. In order to facilitate cross-country comparisons we use the PPP exchange rates provided with the ECHP to convert wages into 2001 PPP units and then deflate them by using the National Consumer Price Indices. More details on the ECHP data can be found in the Appendix and in Peracchi (2002).

[32] Sweden and the Netherlands are excluded from the sample since questions on skill mismatch are not available.

Over-qualified individuals can be identified in the ECHP as those individuals answering affirmatively the following question:

- Do you feel that you have skills or qualifications to do a more demanding job than the one you have now?

Unfortunately, this question is only formulated in the common independent questionnaire of the ECHP. This limits data availability in the cases of Germany and the UK to the first three waves (1994-1997). Some aspects are worth noting regarding the formulation of the question above. First note that the question refers to skills or qualifications rather than educational levels. In this respect the information provided will be more ample than in previous studies that focused on over-education. For instance, an experienced individual with the right educational level for a given job might feel over-qualified when she compares herself with a younger worker with the same educational attainment employed for the same job. One drawback of this measure is that it does not allow us to distinguish by how much the phenomenon of over-qualification occurs. As an illustration think about two individuals working as a waiter, but one holding a high school degree and another with a collage graduate certificate. It is very likely that in this case both individuals feel over-qualified for the job, but we will not be able to distinguish by how much each of them exceeds the required educational level of a waiter with the right education for the job.

A second question in the ECHP questionnaire allows us to go a bit further in the classification of skill and educational mismatch:

- Have you had formal training or education that has given you skills needed for your present type of work?

Crossing the information contained in both questions we can construct four types of individual classes according to their type of match:

- Type 1. “Non-over-qualified and well matched” (NOWM), if non-over-qualified and education and training is suited for their job.
- Type 2. "Non-over-qualified and mismatched" (NOBM), if non-over-qualified but education and training is not suited for their job.

- Type 3. "Over-qualified but correctly matched" (OWM), if over-qualified but education and training are suited for their job.
- Type 4. "Over-qualified and mismatched" (OBM), if over-qualified and education and training are not suited for job.

An example can help to illustrate the differences between the four types of individuals. An individual with a PhD in mathematics working as a university professor will be classified as NOWM. Instead, if this individual is employed as a research assistant she will probably classify herself as OWM, since she has the right training to do the job but would be suitable for a more qualified set of tasks. Imagine instead that she is appointed as the CEO of a multinational firm. In this case, her formal qualification would not be well suited for the job although she is certainly not over-qualified (NOBM). Finally, if she worked as an electrician she would certainly feel over-qualified and with an education not suited for the job (OBM). It is important to note that strictly speaking only workers in category 1 are properly matched. OWM, although having the training demanded by the job could be assigned to more demanding tasks according to their qualifications. Thus, we label them as "correctly matched" in the sense that their formal training is directly related to their job, although their actual (either formal or acquired on the job) qualifications would allow them to do a more demanding job.

Table 5.1 presents the results from the cross-tabulations of type of match pooling all countries and years where information is available. We restrict the sample throughout the chapter to full time employees in the working age (15-64) population. The total number of workers in the sample is 279,655. According to these tabulations about 54 percent of the population considers to have skills for a more demanding job than the one they hold at the moment of the interview. Among the four categories described above, OWM workers are the most common, accounting for 33 percent of the total number of employees. Instead, the number of workers correctly matched (NOWM) is the lowest among the four categories (21.2 percent).

Summary statistics (not presented in the text) of the three categories of skill mismatch and their relationship with personal characteristics for each country (pooling all the years available) revealed that although cross-country differences are apparent, there are some common features in the incidence of skill mismatch across countries. With the exception of a slightly larger incidence of NOWM among female workers, there are no large differences across gender in the incidence of the three types of skill mismatch. A similar pattern emerges

regarding marital status.[33] As expected, the incidence of NOWM increases with age. The other side of this pattern is a higher incidence of over-qualification among younger workers, with OBM exhibiting a mode in the [16,25) age bracket and OWM being more concentrated in the next age category [25,35). NOWM are less common within individuals holding a tertiary degree in all countries, while NOBM is more common within labour market participants holding a primary degree. Interestingly, the incidence of over-qualification within educational groups differs significantly depending on the nature of the skill match. While OWM is more common among individuals with tertiary diploma OBM is more concentrated on the other tier of the skill distribution. Regarding the evolution of each category of mismatch with tenure on the firm an interesting pattern emerges. While OBM diminishes with tenure, NOBM and OWM appear as relatively permanent phenomena, without a clear relationship with tenure on the job.

Figure 5.1 shows the evolution of the different categories of skill match during the period of analysis for the European average. During the 7 years of study, the incidence of skill mismatch has remained relatively stable with a mild decline of OWM coupled with a raise of properly matched individuals. In spite of the common features across countries mentioned, there are important cross-country differences in the incidence of the different categories of skill mismatch. Figure 5.2 shows the incidence of the four types of match in the thirteen European countries for which information is available. In all countries with the exception of Portugal, Italy and Greece the modal category is OWM, involving almost 50 percent of the employees in Germany, Belgium, Finland and the UK. In southern Europe, there is instead a relatively higher incidence of mismatch, either coupled with over-qualification in the cases of Italy and Greece or in the form of pure mismatch in the cases of Portugal and France. These differences across countries can be attributed to a large number of factors. They could be caused by the design and efficiency of the different educational systems in providing the skills demanded by the market. Alternatively, they might be related to the interplay of institutions, educational choices and the functioning of the labour market in matching the supply and demand of skills.

Regarding the later, firing costs are expected to reduce labour flows with ambiguous effects on average employment, but unambiguous effects regarding efficiency, since they prevent workers to be employed where more needed at each point in time.[34] Moreover, they are expected to play a significant role in segmenting the labour market, by insulating insiders

[33] Note that the survey started in 1995 in Austria and Finland.
[34] See Bertola (1999) and the references therein for a detailed analysis.

from employment fluctuations at the cost of a lower (higher) employment (unemployment) rate of outsiders (typically younger and female workers). Bertola et al (2005) find support for this hypothesis using a time varying indicator of Employment protection legislation (EPL) for a panel of 17 OECD countries, showing that more stringent EPL the higher the relative unemployment rate of younger workers with respect to adults. It might be argued then that in countries where reallocation of labour is costly and finding a first job is difficult due to the presence of employment protection the incidence of skill mismatched might be larger. At the same time, mismatched individuals will remain for longer spells on the job due to stringent firing restrictions. This presumption seems to be supported by the data. Figure 5.3 shows the rank correlations between the different categories of skill match and a ranking of EPL.[35] In line with the previous arguments, we find that there is a positive association between skill mismatch and the stringency of EPL. However, there are not significant differences between the different categories of skill mismatch regardless whether individuals are over-qualified for their jobs or not (NOBM and OBM).

5.3. Who is over-qualified or mismatched?

In this section we examine the individual and job characteristics most typically associated with the different categories of skill mismatch outlined in the previous section for the largest countries in the EU-15. The analysis is divided into two parts. In the first part we follow most of the literature on over-education and study the personal characteristics associated with over-qualification regardless of the matching status of the individual. A probit model is estimated, where the dependent variable takes value 1 if the individual declares to be over-qualified. Control variables include personal (gender, marital status, size of household, years of education, potential experience and a set of previous unemployment experience dummies) and job (tenure, 10 industry and 10 occupational dummies) related characteristics. In the second part of this section we differentiate between the four categories of matching outlined above and estimate multinomial logit models of the different categories of skill mismatch. Before turning to the results, some clarifications must be in place regarding the construction of some of the covariates included in the analysis. The number of years of education is not directly observable from the ECHP and therefore was (see the Appendix

[35] The EPL ranking is constructed by averaging the OECD (2004) index of employment protection for the period 1994-2001.

A4.1). Another important variable for the analysis is tenure on the job. This information is reported in the survey as a continuous variable top coded at 15. In order to deal with this top coding we have constructed 4 categories of tenure as reported in the appendix. Regarding previous unemployment experience we include three dummy variables in the analysis, which take value 1 if the individual was ever unemployed in the last 5 years (unemp), more than once within the last 5 years (nunemp) and for more than 1 year within the last 5 years (ltunemp).

Table 5.2 presents marginal effects of the expected changes in the predicted probability of over-qualification evaluated at the mean of the covariates as a function of personal and job characteristics. Standard errors are robust to clustering at the individual level.[36] Columns 1 to 5 present the results for each individual country while Column 6 pools the information for all countries and years. A definition of the variables is presented in Table A5.4 in the Appendix. Some common features across countries stand out. Regarding personal characteristics, male workers tend to consider themselves over-qualified in greater proportion than female workers holding other characteristics constant such as years of education. With the sole exception of Germany, where the effect is positive but not statistically significant at standard levels, over-qualification increases with years of schooling. According to the average across countries, 10 additional years of education increase the probability of being over-qualified in 0.21. On the contrary, the probability of being over-qualified declines with labour market experience in all countries. This result goes in line with a transitory interpretation of the incidence of over-qualification. There are also some important differences across countries. We find further evidence of over-qualification being a temporary phenomenon in Italy and Spain, where workers with tenure exceeding 10 years have a significantly lower probability of being over-qualified. This is not the case in the rest of countries, where we do not find a significant difference in the incidence of over-qualification for workers with difference seniority on the job. On the other hand, in Germany and the UK we find a positive association between over-qualification and having experienced an unemployment spell during the last five years, suggesting that some workers might be willing to accept a job for which they are over-qualified to avoid unemployment. This last finding deserves further exploration, for instance by looking at the transitions from unemployment to work and their relationship with over-qualification. Lastly, note that the country dummies are all highly significant at standard confidence levels in column 6, suggesting that cross-country differences remain after

[36] Assuming that the individual heterogeneity is random and estimating the probit model by random effects yielded qualitatively similar results, which are therefore not reported.

controlling for a wide set of personal and job characteristics. According to this set of dummies, the likelihood of being overeducated is lower in Southern Europe, being highest in the UK and lowest in Italy.

Having analysed the determinants of over-qualification, we go one step further by studying the four categories of skill match outlined in the previous section. Table 5.3 presents results for multinomial logit regressions on the determinants of skill mismatch. The reference group are those individuals not over-qualified and well matched (NOWM). The first three columns present the coefficients, and should guide us regarding the sign of the effects, while the last three columns present the relative risk ratios, which help interpreting the effects of the covariates in the odds of being in each category with respect to the reference group. To simplify the presentation of the results, we include only the specifications polling all countries and years and including country and year dummies. Separate specifications for the 5 largest EU-15 countries are available upon request. The main differences between countries with respect to the pooled country results will be commented in the text.

The multinomial logit regressions confirm the higher incidence of over-qualification among male workers. However, no important gender differences are found between NOWM and NOBM. An interesting difference between the two classes of over-qualified workers emerges. While the incidence of correctly matched over-qualified (OWM) workers increases with respect to comparison group (NOWM) with years of education, OBM are more concentrated than NOWM among individuals with a lower educational background. This is consistent with a higher concentration of OBM workers than NOWM in elementary occupations such as clerks, service and trade workers and plant and machine operators, as observed by the occupational dummies included in the regressions (not shown in the text), and a lower concentration in more demanding occupations such as professionals and associate technicians.

The lower association between over-qualification and experience is maintained in the multinomial framework, and no substantial differences are observed between both types of over-qualified individuals. Surprisingly, experience increases the probability of being NOBM with respect to the reference group. This somewhat counter-intuitive result is maintained in Germany, France and Italy, while in Spain the expected pattern of lower likelihood of non over-qualification and mismatch with an increase in experience is observed. More than 10 years of tenure reduces the probability of being mismatched regardless of the over-qualification status (for NOBM and OBM), but it is only for the latter group that we observe a clear pattern of declining incidence with increasing tenure with respect to the reference group.

This pattern is common across countries, and it is only in the Spanish case that more than 10 years of experience reduces the likelihood of being OWM with respect to NOWM. Having an unemployment spell, or experiencing long term unemployment in the recent past increases the likelihood of being mismatched and over-qualified with respect to the baseline category, although these effects are not always statistically significant at the country level. As observed in the case of the simple probit estimates of the extent of over-education, country differences remain important after controlling for compositional effects. Interestingly, the lower likelihood of being over-qualified in Southern Europe noted above is explained by a difference incidence of over-qualification in the absence of skill mismatch (OWM).

The multinomial logit analysis uncovered important differences among the four classes of workers. We have performed Hausman type tests of the independence of irrelevant alternatives (IIA) hypotheses maintained by the multinomial logit. In most cases, the test did not reject the null of independence of alternative hypothesis. Similarly, we have tested whether we can pool the different categories for the aggregate and country models using standard Wald tests, and for all pair of combinations of outcome categories the null of equal coefficients was rejected. This evidence thus suggests that different categories of over-qualified workers differ significantly, depending on whether they are properly matched or not.

5.4. Over-qualification, skills mismatch and wages

Having established the main characteristics of the different classes of mismatched workers we move next to the analysis of the consequences of skill mismatch and over-qualification. In this section, we investigate the link between over-qualification, skill mismatch and wages. Although the previous analysis suggested that different types of over-qualified workers might actually have a very different behaviour, we start this section by estimating standard Mincer regressions augmented to include a dummy variable for over-qualification and in a second stage we differentiate between the different types of mismatched workers. A similar approach was first developed by Duncan and Hoffman (1981), who extended the Mincerian earnings regressions to include measures of over-education and under-education, thus establishing a first link between the supply side of the labour market and the demand side (ignored in the standard Mincer regressions).

This first set of regressions has the virtue of being to some extent comparable to the analysis of Poland carried out in the second part of this chapter. Table 5.4 presents the results

of augmented Mincer regressions including an over-qualification dummy[37]. The first 5 columns present the results for each of the countries separately and Column 6 presents the results pooling all countries. The other covariates included in the regression (not shown in the table) presented the expected signs, wages increasing with education, tenure and experience (albeit at a decreasing rate), and falling for singles and female workers as well as for those individuals who experienced an unemployment spell in the recent past or suffered a long term unemployment spell within the previous 5 years. In line with the rest of the literature, over-qualified workers have a wage penalty with respect to properly matched employees according to Column 6. However, the magnitude of the effect is relatively small (1 % lower wages). Moreover, the pooled results hide important differences across countries, since it is only in Spain where the wage penalty of over-qualified workers is negative and statistically significant.

Our second set of regressions extends the approach in the over-education literature by allowing distinguishing between the three different types of skill mismatch defined above. Are these differences translated in wage differentials among these three groups of workers and between mismatched and correctly matched individuals? Table 5.5 presents OLS standard Mincer regressions augmented to include three dummy variables that capture each of our mismatch categories of workers (NOWM is the reference group). The first 5 columns present the results for each of the countries separately and Column 6 presents the results pooling all countries.

Both categories of mismatched workers present a negative return in all countries. The effect is large, suggesting that on average NOBM and OBM workers earn about 11 percent less that properly matched individuals. Interestingly, with the exception of the Spanish case where being over-qualified and mismatched carries an extra negative premium with respect to being mismatched and correctly qualified, there are not substantial differences between the negative returns of NOBM and OBM. Hence, we can conclude that once the individual is mismatch there is no additional wage penalty from being over-qualified. If instead the individual has the skills required for the job (well matched) but is over-qualified (OWM), a wage penalty is found only in the cases of Spain and Italy. This fact together with the highest negative wage penalty for OBM workers in Spain is consistent with the view that the current expansion of tertiary education in this country has not been sufficiently accommodated by an increase in the demand for skilled jobs (Dolando, Jansen and Jimeno, 2004). However, it

[37] To eliminate the possible impact of wage outliers we drop the 1st and 99th percentiles from the hourly wage distribution in all the wage regressions

should be noted that even if significant the magnitude of the wage penalty from being OWM is about one third of the wage penalty in case of being badly matched (OBM) in all countries. Thus, we can conclude that in the five EU countries studied it is to a large extent skill mismatch what drives the wage penalty on wages and not over-qualification

Part B. Education mismatch in a transition economy: the case of Poland

In this part we measure education mismatch in Poland using data from the Polish Labour Force Survey over the period 1997-1003. Next, we analyse its consequences in the determination of wages. And finally, we study the nature of this mismatch, focusing on whether it is as transitory phenomenon at the individual's level related to inefficiencies of the labour market or a more structural or long lasting one.

Imposed by the nature of our data, we follow the strand of the literature that uses the so called data-based indexes of over/under education. This strand looks at the actual distribution of worker's educational attainment by type of occupation to define the (estimated) adequate level of education per occupation. Indexes of over/under education are based on measures of the deviations between the actual and adequate education levels. The two indexes used are the following:

- A mean based index that takes as adequate education per occupation one standard deviation mean-centred interval. It classifies as under/over educated those workers whose schooling is under/over the limits of this interval (Verdugo and Verdugo, 1989).

- A mode based index, according to which the adequate education for each occupation is represented by the mode of the distribution; any deviation from above/below the mode will be taken as over/under education (Mendes de Oliveira *et al*, 2000). Occupations for which less than 60% of the observations had an education level at the mode were dropped from the sample.

The main arguments in favour of data-based indexes, put forward by their supporters, are that 1) they do not suffer from subjectivity, when compared with measures based on the worker's own evaluation, and 2) they are much simpler (and often more accurate) that indexes based on exogenously designed criteria, which define the required (adequate) educational

level for each occupation relying on occupational classifications of job analysts, for example information on general educational development (GED) from the US Dictionary of Occupational Tittles. The problem with this sort of information is that its transformation into equivalent schooling can be very complicated and arbitrary. Additionally, these job classifications are costly and not frequently update.

The main drawbacks of the data-based indices that we are going to use here, are that different data-based indexes deliver usually different results and their accuracy heavily relies on how disaggregate is the available data on occupations. We think that these two problems are minor in the case of our study, because, first, the PLFS data provides data on a three digits classification of occupations, adding to 122 occupations. And second, we use 2 alternative data-based indexes of over/under education and the results turn out to be quite robust to the choice of the index. Additionally, it should be kept in mind that data-based measures are based on realized matches that involve labour demand and supply, being therefore inadequate as measures of the demand side.

5.5. Data

The PLFS is a household survey that collects detailed information on individual characteristics. It started in 1992 as a full panel survey and, due to the large attrition; its structure was changed into a rotating panel in 1993. It uses the rotation scheme 2-(2)-2, in which each person is surveyed for two consecutive quarters, excluded for other two quarters, and then included again two more quarters to be excluded definitively afterwards. Therefore, the maximum number of observations available per individual is 4.[38] The overall sampling fraction is 0.14% of private households and includes all the members of each surveyed household older than 15.

The variables definitions are quite harmonized with the European Labour Force Survey; the PLFS follows the international classifications of employment status and of occupations. Information on wages is far from ideal as, apparently, people are quite reluctant to disclose this information. Another peculiarity about wages is that, in fact, the PLFS does not collect information on wages but on monthly net remuneration, although for simplicity we will refer to the monthly net remuneration as wages. Years of education are not available as

[38] Each quarter, 25% of the sample is interviewed for the first time, 50% were already interviewed in the previous quarter, and the other 25% participated one year ago.

such, but the levels of education are disaggregated into 7 categories and we have assigned to then the years of education according to the current education system in Poland.

We restrict the sample to full-time employees in the working age (15-65) population, including all activities but agriculture[39]. Additionally, we exclude observations with wage values in the 1st and 99th percentiles of the wage distribution. All the analysis has been done for the two set of over/under education indexes.

Table 5.6 displays the percentage of the sample that is over and under educated over time according to the two indexes. Over education shows in both cases a clear trend upward while under education has decreased during the sample period.

Estimations on the probability of being over/under overeducated showed that it is more likely that a worker is over educated if is male and has high levels of education. While tenure, potential experience out of the job, having attended some training recently, and working in the public sector all have negative effects on the probability of being overeducated, and vice versa on the probability of being undereducated[40].

5.6. Returns to over/under education

We estimate two specifications for wages that have been used in this literature, to examine the returns to over/under education. Firstly, a specification called the augmented Mincer equation where a dummy on over/under education is included among the covariates. This allows us to directly compare workers that have similar features but suffer education mismatch. Table 5.7 shows that, according to the two indexes of education mismatch, on average, the wage of overeducated workers is around 8.5% lower than the one of similar workers adequately matched, while in the case of under education wages are between 10-14% higher. This result contrasts with the evidence presented in Table 5.4, where wage penalties in the largest EU-15 countries for over-qualified individuals were found to be negative but small and not always different from zero, except in the case of Spain. Although measures of over-education and over-qualification refer to slightly different concept the comparison of both sets of results suggests a greater penalty of educational mismatch in Poland than in the EU-15 countries.

[39] We re-did all the analysis in this chapter with a sample including agriculture: results did not change substantially. Nevertheless, it should be noted that, in the full sample, agricultures is under-represented because the PLFS sample under represents rural areas, and because we have dropped self-employed workers.
[40] Probit analysis results available upon request

Secondly, we estimate the following equation:

$$Ln(W) = aX_{it} + ßYAE_{it} + ?YOE_{it} + dYUE_{it} + e_{it} \quad (5.1)$$

where Ln(W) is the log of monthly real wages (remuneration) net of taxes. X are personal and job characteristics, YAE are the number of years of education that are adequate for the performed job, and YOE and YUE are measures of years of over and under education respectively. Thus, in this specification, years of education are decomposed as: YAE + YOE-YUE.

Then, ? and d measure the return to an additional year of over/under education with respect to the co-workers who are adequately educated for the job. ?-ß measures the return to an additional year of over education with respect to workers with the same level of education who are not mismatched (have a job that requires their level of education) and ß+d is the wage differential due to a year of under education with respect to workers with the same education, but who are well matched. A relatively large number of papers has followed this approach for several countries and periods. Hartog (2000) surveys this literature and concludes that the returns to required schooling are higher than the returns to actual schooling. Typically, returns to over-education are positive but lower than returns to required education while returns to under-education are negative but again lower than the returns to actual education, such that undereducated workers earn more than workers performing similar jobs with lower educational attainment but less than workers with their educational level who are allocated to a more demanding task.

Table 5.8 is an extract of the estimation results of equation (2). It shows the coefficients of the over/under education variables. Results are also as expected for the covariates in vector X: wages are higher for males and married individuals and for those working for the private sector. They are lower for disable and for those with vocational education. Wages, on average, increase with age and tenure. Regarding the indicators of over/under education, these are the main findings:

- There is a positive return to an additional year of over education with respect to co-workers who are adequately educated for the job (positive ?)
- d is around -0.034 according to the mode criteria and also negative but quite low in the case of the mean-based index.

- ?-ß is negative in all the cases, around (-0.04 with the mode criteria and -0.06 with the mean one).
- ß+d is positive in every case (0.057 from the mean and 0.04 from the mode criteria respectively)

In sum: our results to a great extent show that Poland is not a different case with regards to returns to over/under education than other economies. Workers that are overeducated for their occupation earn more that their co-workers but less than workers with similar education who work in occupations that require their level of education (i.e. are adequately matched). On the other hand, undereducated workers earn less that their co-workers but more than workers with similar education who are well matched.

5.7. Nature of education mismatch in Poland

We will try now to disentangle whether over/under education in Poland is a transitory situation at the individual's level while the worker finds a better match (new occupation, promotion, etc.) or whether it is a more long-lasting phenomenon in response to rapid change in the demand or supply of workers' education that cannot be easily matched in the market. Despite the data limitation, one can attempt to investigate whether over-education is not a proxy for more general mismatch, as part A showed for Western Europe. One test is to see whether overeducated workers eventually change occupation or sector when searching for a better match. This would additionally inform us about whether education mismatch is more a transitory or a permanent situation for individuals.

For that, we estimate probit models, where the dependent variable takes value 1 if the worker changes occupation. The control variables include a dummy for over and under education together with personal (gender, marital status, education, experience, disability, head of household, etc.) and job related characteristics (tenure, on the job training, and whether the employer belongs to the private or the public sector). Columns 1 and 2 in Table 5.9 display marginal effects of the expected changes in the predicted probability of changing occupation evaluated at the mean of the covariates. Standard errors are robust to clustering at the individual level. These results confirm that workers with education that differs from the adequate one to perform their job are more likely to change occupation, suggesting that educational mismatch in Poland is coupled with skill mismatch.

We study a bit deeper the occupational mobility of over/under educated workers in Poland to see whether (in the case of overeducated) it respond to career mobility. If this were the case, overeducated workers will be so only transitorily, and will eventually move to occupations that require higher levels of education. To test for this hypothesis we run a similar probit where now the dependent variable takes value 1 if the movement is into a more demanding occupation in terms of adequate education to perform that occupation. Estimation results, summarized in columns 3 and 4 of Table 5.9, deliver positive and significant estimates of the marginal effects for the over education dummy, while in the case of under education the estimates are not significant or even negative, which indeed confirm the hypothesis of career mobility.

These results suggest that over-education is associated with mismatch in Poland and can be thought as a transitory phenomenon at the individual's level.

5.8. Overall Conclusions.

1. There are important differences across countries in the incidence and consequences of educational and skill mismatch. While some of these differences seem to be related to the interplay of institutions and educational choices the issue deserves further study.
2. Wage penalties in the largest EU-15 countries for over-qualified individuals were found to be small and not always different from zero except perhaps Spain. In Poland, the wage of overeducated workers is around 8.5% lower than the one of similar workers, while undereducated workers earn between 10 and 14% more.
3. The analysis of the EU-15 sample shows that it is important to distinguish between different categories of over-qualified individuals. A more crucial variable than over-education seems to be whether individuals are properly matched in terms of their formal qualifications. The wage penalty is in fact primarily related to skill mismatch, and there is in general no additional wage penalty from being over-qualified.
4. Our results on Poland indicate that over-education is associated with greater occupational mobility. This suggests that as in the EU-15, over-education is a proxy for skill mismatch. It is also evidence of a transitory situation at the individual's level, probably rooted on matching frictions due to imperfect information and mobility.

Section 6. International mobility, wages and innovation

6.1. Introduction

There is a shared feeling that in the current macroeconomic context and last decade in particular, Europe has performed economically less well than the US. Many European governments, especially in large countries of the Union, would love to display figures similar to the US for several objective indicators such as growth of GDP, unemployment, labour market participation and even wage growth. This Section aims at developing a set of additional indicators, linked to labour mobility and international migration, that reinforce this perception. Indeed, we will compare the European Union to the United States considering the last as a more integrated, less regulated and more dynamic economy, at least since the nineties. *By assessing the* degree of (im)mobility of Europeans and the ability of the European Union to attract foreign workers and, in particular, the most skilled and talented among them vis-à-vis the experience of the Unites States, we hope to help policy makers realize to a greater extent the emergency to undertake several reforms. Here, our focus will be, mostly, on highly educated workers.

A growing phenomenon of the nineties, namely the increasing international mobility of highly skilled professionals, scientists and engineers, provided the EU with an excellent opportunity to attract "brains" from the rest of the world. Unluckily the evidence that we survey shows that most of this potential flow has been missed by EU countries and rather captured by the US. Second, we will argue that even within the EU, mobility of highly skilled workers across its countries has been very small. While in the US highly educated and talented people move to the states and cities where their reward (and productivity) is higher, in the EU they are still, to a very large extent, confined to their country of birth. In an empirical analysis of US states during the decades between 1970 and 2000, we find that the presence of highly skewed wages and, more importantly, of large investments in R&D, attracted a large inflow of highly educated workers, both from other US states, and internationally.

Finally, although preliminarily, we attempt to quantify the impact of highly educated workers on technological and scientific progress measured as innovation. The impact of applied technological progress is likely to affect the future growth rates of income

per capita, as discoveries and technological improvements get transferred on total factor productivity. We try, therefore, to capture such "dynamic effect" of highly educated and talented workers on the rate of scientific and technological innovation of a country, measured by its rate of patented innovation. Patents are acknowledge to be an imperfect, still very useful, index of innovation[41] and their use has shed light on the process and the determinants of innovation, across countries and over time. We find that highly skilled workers, especially those attracted from abroad (who are, arguably, particularly talented) have had a very significant impact on innovation even controlling for R&D spending and institutional features of US states. European countries that are loosing many highly educated professionals to the US, not attracting many of them from the rest of the world and not spending enough in R&D may be accumulating a lag in innovative potentials in science and technology which could leave them behind in productivity growth.

This Section is organized as follows. First, we analyse the patterns of attraction of foreign-born workers (Section 6.2) and internal mobility (Section 6.3) of native workers, for Europe and the US, focusing on their skill composition. We then document the "brain drain" from EU to the US arguing that it is large and it involves very productive and highly educated European workers (Section 6.4). In an attempt to substantiate the claims that high wage compensation for talented people (in science and technology) attracts these brains we use cross-state evidence in the US that supports the claim that states with higher median wage, higher wage dispersion and higher R&D spending attract more highly educated workers, especially foreign born (Section 6.5). Finally Section 6.6 uses data for US states to estimate the impact of highly educated workers on the rate of innovation of an economy, after controlling for R&D resources and institutional features.

[41] See among others Griliches (1994) and Jaffe and Trajtenberg (2002).

6.2. International Mobility of Workers

6.2.1. Immigration into the EU and the USA

In recent decades (notably during the eighties and the nineties), the US has regained its role as the primary destination for a large number of migrants[42], mainly from Asia and Latin America. During the same period the European Union has emerged as the destination of choice for those seeking better economic alternatives from Eastern Europe and North Africa. Both economies had therefore experienced a rising inflow of foreigners and it is useful to compare the magnitudes (in levels and flows) of foreign-born workers of the two economies. Tables 6.1 and 6.2 contain some summary statistics that capture the presence of foreign-born people in the population and labour force of the US and EU at the beginning and end of the nineties. Due to limited availability of comparable data we consider 1992 as the earliest year for European data and 1999 as the latest year. This choice allows us to use accurate and detailed statistics from the European Labour Force Survey[43]. Table 6.1 reports the aggregate values of foreign-born residents for the EU-12, EU-15 and for the five largest economies within the EU (Germany, France, UK, Italy and Spain). Our analysis considers the totality of EU countries as one large economy to be compared to the US. We define, therefore, "foreign-born" those workers who were born in a country outside EU-15[44] and work in one of its countries[45]. Similarly, workers born in a EU country but working in a different one are considered, as "internally mobile" comparable to US workers born in a state and working in a different one. Table 6.2 reports aggregate values for the US economy and for each of its five largest states (which happens to be those that also attract the largest percentage of immigrants). These data are obtained from the US Census of Population held in 1990 and 2000[46]. For the EU-12 as a whole, the presence of immigrant workers (born

[42] The percentage of foreign-born residents in the US. at the peak of the era of mass-migrations from Europe, in 1910, was equal to 14% of the population. As of year 2004 such percentage was still unmatched as the percentage of migrants was only slightly above 13% f the population.

[43] We are very grateful to Adriana Kugler and Joshua Angris t for providing their dataset covering information on nationality, country of birth, sex, working status, education and country of residence for a representative sample of the EU-15 labour force (from the European Labour Force Survey). The data used here are the same used in Angrist and Kugler (2003) and are described in detail in that article.

[44] For Italy and Germany data on nationality, rather than country of birth, have to be used to compute immigrants. See Munz (2004) for details.

[45] Both the US census and EU survey attempt to reach all people present on the territory, including illegal aliens. It is likely, however, that illegal immigrants are somewhat under-estimated. Hanson and Spilimbergo (1999) try to assess the extent of under-estimation for US immigrants.

[46] The statistics are based on our calculations using data from the Integrated Public Use Micro data Samples (Minnesota Population Center, IPUMS, http://www.ipums.org.)

outside EU-15) increased from 4.1% of the labour force in 1992 to 4.9% in 1999. The corresponding percentages for the US were 9.3% in 1990 and 12.4% in 2000. Even if the EU were to attract immigrants at the rates the US experienced in recent decades (which, as we document below, was much higher than its current rate of attraction of immigrants) it would still take thirty years to reach the level of immigrant presence currently found in the US.

If we calculate the rate of growth of the foreign-born population during the nineties, that turns out to be faster in the US (+0.45% a year) than in Europe (+0.14% a year), thereby increasing the gap between the presence of foreign-born workers in the two economies. The European Union is still very far from attracting and integrating the number of immigrants that the US economy has. In Table 6.1 we also show data for the five largest economies in the EU and compare them with the five largest US states (whose data, for 1990 and 2000, are reported in Table 6.2). Two facts emerge with striking evidence from a comparison of the two tables. First, the US economy attracts more foreign born on average, and its largest state economies are the main attractors of foreigners. California and New York, the largest poles of attraction for immigrants, have a percentage of foreign born in the year 2000 two to three times the average US percentage. Contrastingly, some large European economies (such as Italy and Spain) are still hardly affected by immigration, while even France, the major attractor of immigrants among large economies, had a percentage of foreign born in 1999 only 3 percentage points higher than the EU-15 average. Second, no large country in Europe experienced an increase in the share of foreign-born larger than 1.1% of the total labour force during the period 1992-1999, while no large US state experienced an increase in the foreign labour force smaller than 4% in the period 1990-2000. Even in terms of inflows, large US states experienced much more immigration than any large European country during the nineties.

6.2.2. Internal mobility: EU versus USA

Let us now consider another crucial aspect of mobility, namely "internal" mobility. Here, by internal, we mean, contrary to Section 4 devoted to within-country mobility, within EU (resp. US), i.e. between-countries (resp. between states). The fact that Americans or Europeans are potentially fully mobile within the boundaries of the US or the EU has important consequences on the efficiency of their skill allocation as well as on the impact of

foreign skills on these economies. If the native labour force is very mobile (as turns out to be the case for Americans) this is a sign that people move in search of their best opportunity (best match between skill and job). Moreover, high internal mobility allows the diffusion (over time) of the positive (or negative effects) of local shocks such as immigration from outside. Mobility of labour, as pointed out by Mundell (1961) in his analysis of optimal currency areas, can be a way to arbitrage away asymmetric shocks. The present section measures the extent of internal mobility of the population and labour force within the US and EU.

Table 6.3 shows two measures of long-run mobility across countries in Europe and then details it for the five largest countries. The values presented in the first, third and fifth columns of Table 6.3 are the percentages of individuals in the labour force who reside in one of the EU-12 country that is different from their EU-12 country of birth. The second, fourth and sixth columns report the percentage of individuals in the population of EU-12 states born in a different EU-12 state. The percentages are similar for population and labour force and they increase by a modest 0.3% in seven years, from 2.2% in 1992 to 2.5% in 1999. France, which attracted the largest share of EU citizens born in a different country, had a mere 3.5% of non-French Europeans in 1999. Italy and Spain confirm their small power of attraction even for EU citizens, counting less then 1% of foreign Europeans among their residents. The contrast between the EU and the US economies is stunning. Table 6.4 shows that in the average US state one third (30-33%) of the labour force and population in the year 2000 was made up of individuals born in a different state. This percentage decreased somewhat from 35% in 1990, although the decreased "out of state" presence was probably offset by the increased share of immigrants. Some US states are "open" labour markets to an extent positively alien to EU countries. For instance more than half of Florida's population in the year 2000 was born outside the state. As reference we also consider geographical units larger than states in the US, namely the nine census regions[47] and measure mobility as the percentage of people residing in a region and born in a different one. This percentage was 26% in the year 2000 (25% in year 1990), somewhat lower than for states (as regions are much larger units) but still ten times larger than for EU countries.

These measures of long-run mobility across countries in the EU complement the figures reported in Section 4.4 on mobility within EU countries. They together provide evidence of highly segmented labour markets for the EU.

[47] Each Census region is a group of states, the nine regions are: New England, Middle Atlantic, East North Central, West North Central, East Atlantic, east South Central, West South Central, Mountain, and Pacific.

6. 3. Skill distribution of Foreign-Born people

6.3.1. The V-shaped distribution of skills among Foreign-Born

Table 6.5 reports the composition of foreign-born across education groups. Considering the first two rows, we can see that, both in the early nineties and at the end of the nineties, the "central" skill group of high school graduates is under-represented among immigrants, while the two extreme groups (high school dropouts and college graduates) are over-represented both in the US and Europe. Considering the US in the year 2000, the average share of foreign-born residents was 12.4% of the labour force overall, but as many as 26% of high school dropouts and 12.5% of college graduates were foreign born, while only 8.6% of high-school graduates were foreign born[48]. The corresponding numbers for Europe (EU-12) in 1999 were 5.1% of foreigners in the group of high school dropouts, 3.5% in the group of high school graduates and 5.3% in the group of college graduates. Apparently, Europe was drawing relatively more immigrants in the same two skill groups as the US (low and high schooling, with a lower percentage of intermediate schooling levels).

Before showing, however, how the composition of the group of high-skilled workers differs between Europe and the US, three qualifications should already dampen the "good news" for the European economy. First, between 1990 and 2000 the growth of high skilled (college educated) migrants was faster in the US than in Europe. The share of college-educated foreigners grew 3.1 percentage points in the US (in line with the 3.1% increase of the overall foreign born share in the labour force) while in Europe it only grew by 0.4% (against a 0.8% growth of the share of foreign born overall). Second while the foreign labour force of all the large US states reproduce the "V"-shaped skill distribution (low in the middle skills and higher at the extremes), Germany, the largest EU economy, clearly attracts mostly low skilled workers with a significant under-representation of both medium and high skilled workers. Third, while highly educated foreign born workers in the US come from all over the world including developed countries (Europe) and fast growing countries such as China and India (more on this below) highly educated foreign born in Europe are mainly from Africa.

[48] Interestingly, most of the literature on the impact of foreign-born in the US has concentrated on the effect of unskilled foreign born, e.g. Borjas (1987), (1999), (2003), Borjas et al. (1997) Card (1990), (2001), Card and DiNardo (2000). The effect of highly educated foreign-born on the US economy has never been seriously measured.

6.3.2. Internal mobility of native skills

In Section 4, we showed evidence that in Europe within-country mobility of more educated workers was greater than of less educated workers: professionals move where their best opportunities are; further their cost of moving about should be smaller as they can afford the appurtenances of travel (cell-phones, laptops, video-conferencing devices, etc.). The same is true in the US. In 2000, 43% of college graduates worked in a state different from their state of birth, versus 32% of high school graduates and 20% of high school dropouts. Highly skilled workers in the US are very much a "national" (as opposed to local) resource for the economy.

Interestingly, what was true within EU-countries is no longer true if we consider between country (within E) mobility. It happens that college educated workers are less mobile than the average worker across countries, while low skilled (high school dropouts) turn out to be the most mobile of all workers across countries, with 2.7% of them living in a country different from the country of birth. This percentage is only 2.2% for college graduates and 1.7% for high school graduates. We will come back on this important point in Section 7 and provide notably some interpretations.

6.4. "Talents"

6.4.1. Measures of foreign-born "Talents" in the US and EU.

We now focus our attention on the international mobility of brains. Let us first emphasize that for advanced economies human talent may very well be one of the most important factors for growth and development. As scientific and technological progress is the recognized "engine of growth"[49] in economies at the technological frontier (such as the US and Europe), creative minds in the fields of science, engineering and technology have an incomparable role in advancing economic development and well-being[50].

Anecdotal evidence shows that many of the great inventions of the twentieth century (such as the first controlled nuclear reaction achieved by Enrico Fermi, the first form of

[49] This was recognized by economists since Solow (1956) and re-emphasized by the literature on endogenous growth that has followed Romer (1990), Grossman and Helpman (1991) and Aghion and Howitt (1992).
[50] We will attempt in sub-section 6 to quantify the impact of talents on innovation.

plastic produced by Leo Baekeland, the first microprocessor built by Federico Faggin) were the products of foreign-born (European in the cases mentioned above) talent working in the US. This emphasizes the fact that even attracting very few extraordinary talents may have a relevant scientific (and later economic) impact. Let us turn, however, to more "objective" measures of foreign-born talent. In Figure 6.1 we report the percentage of foreign-born individuals in each of six "skill" groups in the US in the year 2000 (solid black line). While the first three groups are those reported in Table 6.6 (high school dropouts, high school graduates and college graduates), the last three groups try to identify workers with progressively higher "skills" and talent. The fourth group identifies workers with a Masters or a Ph.D. degree, the fifth group identifies those with a Masters or Ph.D. working in science, management or engineering, and the last group are the US based Nobel laureates in natural sciences during the preceding decade. Strikingly, both in 1990 (not reported) and 2000, the foreign born are increasingly represented the higher is the quality of the skill group. While 12.5% of college graduates were foreign-born, 15.3% of the Masters-Ph.D.s and 20.1% of the Masters-PhDs working in science-management-engineering were of foreign origin. Finally a stunning 26% (one out of four) of the Nobel laureates in the sciences that worked in the US (in the decade 1990-2000) were foreign-born[51]. The dashed line in Figure 6.1 represents the percentage of foreign-born in each group for the year 2000, were they distributed homogeneously across skills. While clearly the size of skill groups decreases as we move to the right, their relevance to economic productivity and growth (and even more to technological and scientific growth) increases dramatically. The US has attracted, and continues to attract, a disproportionate fraction of the very highly educated, and among them, the very best brains seem to be even more over-represented[52].

Figure 6.2 shows the same graph for Europe. While we could not find the overall share of those with a Masters or a Ph.D. born outside the EU-12, we could construct, from national data reported in European Commission (2003), the share of foreign born among the individuals with doctoral degrees operating in the fields of science or engineering. We then calculated the percentage of EU-based, foreign-born Nobel laureates in the sciences. Figure 6.2 summarizes these percentages, including those of the first three groups (high school dropouts, high school graduates and college graduates). It is clear from the graph that the "V" shape of the distribution disappears: among the college-educated foreign-born workers, the

[51] The data for Nobel laureates, their place of birth and their affiliation were found at the official website of the Nobel Foundation: http://nobelprize.org/nobel/ .

[52] We calculated the distribution of foreign-born by skills also for year 1990 and the shape is the same (at lower overall percentage levels).

European Union does not seem to attract the "highest quality" ones. The percentage of foreign-born Ph.D. holders in science and technology is a paltry 4.1%, and no Nobel laureate (1990-2000) among those operating in the EU was of foreign origin. While this evidence is preliminary at best it seems to reveal that Europe, in spite of attracting a respectable share of college-educated immigrants, is not able to select the most talented ones among them. To the contrary, some recent studies (Saint Paul 2004, EEAG 2003, Becker et al. 2004) have argued that the EU is loosing some of its best talent to the US.

6.4.2. US and EU: Brain losses or Brain Exchange?

So far we have established that, while the EU12 and the US both seem to have the ability to attract foreign-born college graduates in higher proportion than the average foreign-born, the United States seem to have the ability to attract, among them, the most educated (those with post-graduate degrees), and, simply put, the most talented (those who end up making major contributions to science). We discuss here two other measures of the ability of the EU and the US to attract high quality college graduates from the rest of the world. First, considering two large countries, sources of large brain drain to the rest of the world, such as China and India, and roughly equidistant to Europe and the US (possibly closer to Europe) we see the relative ability of EU and US to attract college graduate from each of them. India and China are interesting cases because these large and growing countries have a growing segment of the population that is highly educated and looks for opportunities abroad. Second we analyse the ability of each of the two regions (the US and EU) to attract college graduates from the other. Since the quality of undergraduate college education is high both in the US and the EU, the ability to attract graduates from the competing economy is certainly a sign that the general potential to attract talented graduates is strong.

Given that the EU-12 and the US are of comparable size in terms of labour force (see Table 6.1 and 6.2), a simple measure of the number of college graduates from China and India who moved to each economy during the nineties is a good measure of the relative ability to attract brains. The total number of Chinese college graduates in the EU was a minuscule 6,126 in year 1992 and grew to 30,675. For Indian college graduates the corresponding figures were 84,733 and 77,371. The overwhelming majority of these college graduates from either country worked in the U.K. We observe, therefore, an inflow of Chinese college graduates of 24,569 units and an outflow of Indian graduates of 7,362 units during the period 1992-1999. These numbers seem very small, and they hardly represent a

sizeable brain drain. In 1999 Indian and Chinese contributed less than 0.3% of the college graduates working in Europe. Very different picture emerges for the US. During the nineties the Chinese college graduates working in the US grew by 222,903 units (from 247,242 in 1990 to 470,145 in 2000), and Indian graduates grew by an even more starling 329,032 units (from 255,916 in 1990 to 584,948 in 2000). These inflows are an order of magnitude larger than those towards Europe. In year 2000 Chinese and Indian college graduates made close to 3% of the overall population of US College graduates.

As for the direct exchange of graduates between Europe and the US let us also present the absolute numbers. In 1992 the number of US-born college graduates working in Europe (EU-12) was 72,330 units, while in 1999 it was 94,700. Conversely college graduates born in the EU-12 and working in the US were 460,000 in 1990 and 643,700 in 2000. These are values five to six times larger than their American counterparts. There can be no doubt that these flows reveal a brain drain from Europe to the US and not a brain-exchange. During the nineties Europe had a net outflow of 176,300 graduates flocking to the US, while only 22,470 US college graduates left the US to work in Europe. In the year 2000 almost 2% of all college graduates working in the US were born in a country of the EU-12. In Europe less than 0.02% of college graduates in the year 1999 were from the US. Overall, Europe clearly lost the competition to attract international brains and had a substantial outflow of its own "brains" to the US.

6.4.3. Quality of Highly Skilled Foreign-Born in the US

It is extremely difficult to measure the contribution of talent to the economic well-being and development of a country. As suggested in the previous section attracting some extremely talented individuals may have a very large reward, even if their number is small, because the externalities of major scientific innovations are enormous. We postpone to section 6.6 an attempt to quantify the contributions of highly educated foreign-born to innovation. Our goal in this section, using data on wages and personal characteristics of the highly educated, is to give an idea of the unobserved quality of highly educated foreign-born workers in the US, especially those coming from the European Union and other developed (or fast growing) economies. Adopting the assumption that wages reflect productivity, we select groups of progressively more educated workers in the US labour force and, after controlling for observable characteristics of individuals (age, sex, race, marital status), we estimate the wage premium for people born in selected foreign countries using a "Mincerian"

regression. We consider some specific locations as potential places of origin of "talented" professionals, namely the EU15 countries and Canada, as well as China and India, two large countries, as we saw, that experienced a significant siphoning of talent to the United States. The reference group is always US born workers with the same observable characteristics. The natural interpretation of the wage premium for (say) a European born professionals is that it measures the average (unobserved) quality of a European relative to the average (unobserved) quality of a US born person in the considered group.

Table 6.6 reports the estimated coefficients for four different definitions of highly skilled workers and for four groups of foreign-born individuals. The groups considered are increasingly selective as we move to the right of Table 6.6. First we consider college-graduates, then holders of a post-graduate degree, then the interesting sub-group of *young* holders of a post-graduate degree (less than 45 years of age) and finally people with a graduate degree working in science, engineering or management. The coefficients (obtained from an individual Mincerian regression on individuals from the 2000 1% IPUMS sample) measure the wage premium for an individual born in a foreign economy relative to a US-born worker with the same observable characteristics, in the specific skill group. For instance, if we consider the first column, we see that a EU-born college graduate earns a 17% higher weekly wage (19% higher yearly wage) than a US-born college graduate with the same experience, race, sex and marital status. Our interpretation is that the productivity (quality) of the EU-born college-educated working in the US in 2000 was 17-19% higher than that of the average US-born college graduate. Consistent with our previous evidence, we interpret this as yet another indication that the US draws Europeans from the high end of the quality distribution, so that they end up being among the most skilled workers in the US.

Moving down the column we observe that Canadian-born college-graduates are also 19-22% more productive than US College graduates. The college graduates attracted from India and China are respectively 8% and 5% more productive than US-born ones (and the difference is significant)[53]. Moving to the other columns we can observe that the wage premium for EU-born is also between 16 and 19 per cent for holders of a graduate degree (column 3 and 4) or for young holders of a graduate degree (column 5 and 6) or for holders of a graduate degree working in science, engineering or management. Similarly for Canadian-born the wage premium fluctuates between 17 and 22 per cent depending on the

[53] Notice that the sign and magnitude of the coefficients on the country of birth vary depending on the country. In general Latin American and African countries have slightly negative coefficients while other Asian countries have close to 0. Our main interest is to show that the US attracts high quality talent from Europe as well as from some large and important countries experiencing emigration (such as China and India).

skill group, and for Indians it seems to increase from 7% to 12-16% as we move to more highly skilled groups (column 3-4 and then 7-8) and as we consider younger workers (column 5 and 6). Finally Chinese-born workers seem to be of slightly better quality than US born in the groups of college-graduate and post-graduate degree holders. All in all, not only does the US economy seem able to attract a disproportionate number of highly skilled foreigners, but also, especially from the European Union, those people appear to be highly talented within their skill group, and certainly more talented than the average US-born skilled worker.

6.5. What Attracts Talents? Some evidence using the US state data

Highly educated workers (with a Master or a Ph.D. degree) earn wages in the top of the wage distribution. They are disproportionately employed in scientific, engineering, managerial professions and often in highly technological sectors. They are also better informed about the best opportunities in their profession, wherever they arise in the world. In presence of high international mobility the US labour market has at least two characteristics that would make it attractive to highly educated workers vis-à-vis Europe. First, its higher wages at the top end of the distribution imply better compensation for very high skills. Second, larger private and public R&D spending implies more (and better paid) opportunities in research as well as in highly technological sectors. In order to test whether these two factors affect mobility of highly educated and in particular attract highly educated from abroad we use data on US states.

We use decennial census data on 50 US states over three decades (1970-2000). Controlling for a fixed state effect, a time effect and the initial endowment of highly educated workers in a state, we analyze whether the immigration during each decade depended on the initial value of median wage, initial wage dispersion and initial stock of R&D in that state. The idea is that, other things equal, a state with higher median wage, larger wage dispersion (measure as the percentage wage difference between median and top 90^{th} percentile) and larger real spending in R&D would be more attractive to highly educated workers. The regression results for the group of college-educated and Masters-Ph.D. educated US born and Foreign-born are reported in Table 6.7. Interestingly for both groups of highly skilled foreign-born the stock of R&D, median wage and wage dispersion are all (at least marginally) significant and economically important. R&D is also very important to attract

US born while wage dispersion has a very imprecisely estimated effect. Doubling R&D a state would attract 22% more Ph.D.'s born in the US plus 4% of foreign-born PhD's. Increasing the wage dispersion between median and top 90th percentile by 20% would also attract extra foreign-born Ph.D.'s in amount equal to 4% of initial PhD's.

We performed few robustness checks of this regression (excluding some decades such as the 90's and some important states such as California) and the results are robust and do not seem driven by a particular decade or state. Even within the US, for given institutions and policies, states that, due to their industry composition, technological choices and local incentives have more dispersed wage distribution and higher R&D investments attract a larger flow of highly educated workers from inside and outside of the country.

6. 6. "Impact" of foreign-born talents on innovation

The wage premium paid to foreign-born talents (especially European born) estimated in section 5 is a measure of their exceptional contribution to production. There is a sense, however, in which highly educated workers may have a much larger dynamic impact on productivity as they often engage in research and innovative activities and contribute to technological, scientific progress which, in turn, is the driver of economic growth. These social benefits may not be fully appropriated in their wages so that the overall impact of foreign-born talent is larger than captured by the private returns. As a final exercise, we try to quantify the impact of highly educated, and of foreign-born among them, on innovation.

Following previous work in this field (Branstetter 2001, Pakes and Griliches 1980, Peri 2005) we use patent count as measure of innovative output of a US state. Patents are awarded to innovation which shows originality, non-trivial characteristics and potentially profitable application. In spite of all the caveats (see Griliches 1994) this is the best measure of innovative output we have. We can think of Inventions produced by research conducted in different US states as the result of an innovation process that benefits from R&D spending and from the quantity and quality of "brains" employed in this process. We use patents granted in a decade as measure of innovation generated in a US state. In order to better capture the "quality" of innovation, we weight patents by the average yearly citations received during the first 3 years after their publication. The number of citations is an indicator of the relevance of a patent, so the weights adjust for the importance of patents. We

control for state and decade fixed effect and we include the stock of R&D at the beginning of the decade and the number of Ph.D. in the state as main determinant of the innovation output.

The results of the regressions, reported in Table 6.8 and run on 50 US states for the 1970-2000 decennial data, measure the importance of highly educated workers in innovation, once we control for institutional effects (state effects) secular trends (time effects) and R&D inputs. Specification 1 and 2 estimate the overall effect of PhD's on innovation and show that even controlling for R&D spending increasing the Ph.D.'s working in the state by 1% increases its innovation rate by 0.14-0.16%. We then try to decompose this contribution between the contribution of US and foreign-born PhD's. As the two "inputs" to innovation are highly correlated the precision of the estimate deteriorates, however consistently foreign-born Ph.D. have a larger and more precisely estimated impact. This is remarkable in particular as they are, on average, only 20% of total US PhD's. Either because they are disproportionately employed in R&D or because they are highly talented, the contribution of foreign-born Ph.D.'s to US innovation seems very important. Ultimately and in the long run this may very well be the most important effect of foreign-born on the US economy.

6.7. Conclusions

1. The EU as a whole is not promoting an adequate degree of internal mobility of highly educated workers; it is loosing many of them (among the very best) to the US and it is not competing effectively with the US in attracting brains from the rest of the world.
2. There seem to be evidence that the contribution of highly skilled Europeans and foreign-born in general, to the US economy in static terms (wages) and in dynamic terms (innovation) is important and beneficial to that country.
3. We find mild evidence of a role of wage dispersion and strong evidence of the role of R&D spending. This suggests that the EU should emphasize R&D and high technology, reward merit rather than insider status and attract talented foreigners even without dramatically altering its overall wage distribution.

Section 7. Policy implications

Drawing from the conclusions of the first six sections, this part examines a few policy implications. The main message of Sections 1 and 2 is that education systems in Europe did a good job at supplying basic skills, suggesting that primary and secondary schooling function relatively well in Europe. In contrast, tertiary education is under-financed: as we saw in the general introduction, the share of GDP devoted to higher education is three times (less and 2 percentage points lower) smaller in Europe than in the US. An obvious first recommendation is to reduce this gap.

How should this objective be achieved? There are three possibilities. The first one is to reallocate public spending from secondary to tertiary education. This can be justified in some instances, for example as the size of younger cohorts is reduced over time. However, reducing public spending in a given sector, however desirable it might be, is always politically difficult, and it is unlikely that two full points of GDP will be transferred from one sector of education to another in the short-term. This may not even be desirable given the evidence that well-financed secondary education may be one reason that Europe has experienced less inequality than the US. A second option is to raise public deficits and public debt in order to reach the objective. This is as unrealistic and undesirable as the first option: European countries already face huge and increased tensions to finance social security (health and pensions), and are bound to a large extent by the Stability and Growth Pact. One can simply forget this option.

We are thus left with the third option: let private money finance part of the education system. This can come partly from household money, by raising university fees to moderate amounts. To take the risk to propose an order of magnitude, 2000 euros per year of tertiary education, which is equal to a quarter of the price of a small car, does not seem unaffordable to most motorized students. Such raise should be accompanied to more student loans and student grants made available to the poorest students. A double-dividend of such a reform would be to reduce the misallocation of students to study fields: pure gratuity of tertiary education encourages students to differ in the decisions to specialize, induces student to less than careful choice of majors, enhance the consumption of leisure, and reduces the effort and success rates especially in the first years. Some of these themes were addressed in Dornbusch et al. (2000). Private money may also come from firms and foundations. Chairs

could be created, financed by endowments in order to avoid inference of the private sector into the nomination of professors. Donors from the private sector might finance university libraries, buildings and various other stocks. We think that a reason for why European universities cannot attract private money is cultural; another, sadly, is that the signal of quality they deliver is insufficient. We propose reforms at the tertiary level of education, notably providing more adaptability of institutions and better incentives to teachers and encourage a better financing by the private sector. Beyond the cultural change this involves, this will not happen in the absence of fiscal incentives, such as tax deductibility of private donations to universities.

A difficult issue, left aside so far, is the extent to which students have to pay for education and the extent to which taxes must finance education. On one hand, Psacharopoulos (2005) argues that arguments in favour of public financing of education are often the expression of simple conservatism and are not always corroborated by formal analysis: he gives the example of human capital externalities, hard to detect in the data. Further, as noted in Gurgand (2005), free education can be anti-redistributive in the sense that families above the median in the income distribution use free education more than those below the median. On the other hand, Benabou (2005) shows that credit constraints could be an obstacle to investments in human capital and that redistribution through subsidies to human capital accumulation could alleviate this problem. He further notes that there is no obvious connection between growth and the type of equilibria (Europe with high redistribution, implying efficient transmission of human capital across generations and thus low inequality and the US, with less redistribution, more inefficiency in the transmission of human capital across generations and therefore more inequality), but that biased-technical change might lead the relatively egalitarian European scenario to disappear, as incentives for most-educated to opt out would increase. In other words, the European model may be at threat.

This is why reforms of universities are also necessary. More autonomy and tougher evaluations, with financial rewards for excellence and financial cuts if needed, are a pre-requisite to induce universities to offer better curriculum to students. In centralized system where responsibility is diluted, the minimum effort is the rule, and faculty often spontaneously attempt to deliver the same diplomas and the same courses year after year, regardless of the demand from the market. The magnitude of the mismatch problem revealed in Section 5 is certainly in relation with this inability of the suppliers of education to react in real time. An anecdote: until recently, a very respected and nice European professor of

economics, at the latest stage of his career, distributed lecture notes where he referred to *"a recent colloquium in Portugal, March 1968"*. Another anecdote, this sentence was heard by a newly appointed full professor of economics: *"Young colleague, please accept the advice of an old fellow. When you will write your lecture notes, you should write big, because over time, you vision will deteriorate"*. In both cases, this was no joke.

As illustrated in sections 1, 4 and particularly 6, sluggish movements of people and labour market frictions within the European Union may slow down the allocation of workers, skills and talent: labour supply can be inadequate because of geographical constraints. It is hard to evaluate the extent to which low mobility figures translates into inefficiencies specific to Europe, but there is certainly a shared perception that perfect mobility of workers in Europe and optimal allocation of their skills to tasks that maximize their productivity would dominate the current outcome, which current institutions in the labour market may prevent.

In particular, we have discussed that labour market institutions, in general, tend to reduce mobility, both geographical and between jobs. This shapes the structure of investments, and notably generates more investments in skills that are specific to sectors and jobs. In a stable macroeconomic environment, this may be a desirable outcome for several reasons: notably, specialization implies efficiency on-the-job, and from the employers' perspective, makes workers relatively attractive. On the other hand, in a world of increased turbulence, e.g. in the context of the European Enlargement, skills oriented toward mobility may become more important. In the absence of such general investments in human capital, skills mismatch is a likely outcome, which we detected in the data.

Further, while mismatch should in principle generate additional mobility, we find instead low mobility rates in Europe. European style social insurance probably contributes to the lack of mobility, in that talents is not necessarily rewarded as it should be. Having said this, we could note that wage compression does not seem to impair mobility that much. Public and private R&D spending turns out to be more important for mobility than wage dispersion. Another dimension where action is needed is the low attractiveness of Europe to the most talented workers and researchers outside Europe. Although massive injections of both money and incentives in tertiary education would partly remedy in part this situation, all kinds of bureaucratic barriers, insider privileges, limited labour market competition and poor diffusion of information will still be major obstacles. Even removing these internal barriers it is not clear that highly educated and very talented workers would stay in Europe. Again, the compressed structure of wages (pre and post taxes) typical of EU countries (vis-à-vis the US)

may not provide sufficiently large economic rewards to talent, although our regressions indicate that this is not a major factor.

An important result is that the international mobility of European college-educated workers in Europe itself is lower than that of less educated workers. We think that one of the possible explanation for this phenomenon is the difficulty to harmonize the recognition of diplomas. As a last anecdote, we can cite the example of one of our PhD students in Belgium: he had to validate a bachelor degree (Maîtrise) obtained in University of Lille I, which is only 100 km away from Brussels, in order to become teaching assistant at Free University of Brussels. He sent his file to the regional ministry of education, and obtained the following answer (see also the PDF in Appendix A.7): *"Sir, (…) I transmit your application to the competent instance. For your complete information, I draw your attention to the fact that (…)a decision has to be notified to you within four months and fourty days (sic). In the absence of notification after this delay, the case can be brought to the* Conseil d'Etat, *the silence of the administration being assimilated to a negative answer.*" In this case, fortunately, the student however got his diploma validated and could obtain a salary for his teaching. But the tone of the letter and the mere fact that the validation of diploma was externalised to a regional administrative committee suggests the magnitude of informal barriers of all kinds.

To conclude, we saw that education is relatively egalitarian in Europe, and does not seem to be reactive enough to the macroeconomic context. Although labour market institutions per se explain why mismatch and specific skill investments may arise, we think that an efficient margin for policy is to reform higher education and raise its various sources of financing. It is however not our suggestion to privatise the supply of education. There is no evidence that a private sector is more efficient or responsive than a public sector when the latter has motivated, well-paid employees, who have the right incentives. However, as usual, the inability to reform a public system and let it die from poverty is the best way to let the market offer an alternative, at the cost of sacrificing social justice and equality of opportunity.

References

Abraham, K.G. and Farber H.S. (1987). "Job Duration, Seniority, and Earnings". American Economic Review, 77(3), pp. 278-97.

Acemoglu, D. (2003). "Cross-country Inequality Trends". Economic Journal, 113, F121-F149.

Acemoglu, D. and Pischke, J.S. (1999a). "The Structure of Wages and Investment in General Training". Journal of Political Economy, Vol. 107, Issue 3 (June), pp. 539-572.

Acemoglu, D. and Pischke, J.S. (1999b). "Beyond Becker: Training in Imperfect Labor Markets". Economic Journal Features, 109, F112-F142.

Aghion P. and Howitt P. (1992). "A Model of Growth through creative Destruction". Econometrica, 60, pp. 323-51.

Albrecht, J. and Vroman, S. (2002). "A Matching Model with Endogenous Skill Requirements". International Economic Review, 43, pp. 283-305.

Altonji, J.G. and Shakotko, R.A. (1987). "Do Wages Rise with Job Seniority?". Review of Economic Studies, LIV, pp. 437-459.

Angrist, J. and Lavy, V. (1999). "Using Maimonides' Rule to Estimate the Effect of Class Size on Scholastic Achievement". Quarterly Journal of Economics, 114, pp. 533-575.

Angrist, J. and Kugler, A. (2003). "Protective or Counter-Productive? Labor Market Institutions and the Effect of Immigration on EU natives". Economic Journal, Vol. 113, pp. 302-331.

Axelsson, R. and Westerlund, O. (1998). "A panel study of migration, self-selection and household real income". Journal of Population Economics, Vol. 11, No. 1, pp. 113 – 126.

Barcelo, C. (2002). "Housing Tenure and Labour Mobility: A Comparison Across European Countries". Mimeo CEMFI, December.

Barro, R and Lee, J.W (2001). "International Data on Educational Attainment: Updates and Implications". Oxford Economic Papers, 53, pp. 541-563.

Beaton, A., Mullis, I., Martin, M., Gonzalez, E., Kelly, D., and Smith, T. (1996). "Mathematics Achievement in the Middle School Years: IEA's Third International Mathematics and Science Study". Center for the Study of Testing, Evaluation, and Educational Policy, Boston College.

Becker G. (1964). Human Capital. The University of Chicago Press, Third Edition (1993).

Becker, S., Ichino, A. and Peri, G. (2004). "How Large is the Brain Drain from Italy?". Giornale degli Economisti e Annali di Economia, Vol. 63, No. 1, pp. 1-32.

Benabou, R. (2000). “Unequal Societies: Income Distribution and the Social Contract” American Economic Review, vol. 90(1), pages 96-129

Benabou, R. (2005). “Inégalité, technologie et contrat social”, keynote speech Banque du Canada-Congrès de la Société Canadienne d’Economie, Charlevoix, May 12-13, 2005

Bender, S., Dustmann, C., Margolis, D., and Meghir, C. (2002). “Worker Displacement in France and Germany”. In: P. J. Kuhn (Hrsg.), Losing work, moving on: international perspectives on worker displacement", Kalamazoo: Upjohn Institute for Employment Research S. 375-470.

Ben Porath, Y. (1967). “The Production of Human Capital and the Life-Cycle of Earnings”. Journal of Political Economy, vol. 75(4), pp. 352-365.

Bertola, G. (1999). “Microeconomic Perspectives on Aggregate Labor Markets”. In O.Ashenfelter and D.Card (eds.), Handbook of Labor Economics, vol.3B, Amsterdam: North-Holland, pp. 2985-3028.

Bertola. G., Blau F.D. and Kahn L.M. (2005). “Labor Market Institutions and Demographic Employment Patterns", mimeo Torino

Bertola G. and Ichino, A. (1995). “Wage Inequality and Unemployment: United States vs. Europe”. NBER Macroannuals, pp. 13-66.

Bertola, G. and Rogerson, R. (1997). “Institutions and labour reallocation”. European Economic Review, Vol. 41, Issue 6, pp. 1147-1171.

Björklund, A., Clark, M., Edin, P.A., Fredriksson, P. and Krueger, A. (2005). “The Market Comes to Education in Sweden”. Forthcoming Russell Sage.

Blanchard, O. and Katz, L. (1992). “Regional evolutions”. Brookings Papers on Economic Activity, 1, pp. 1-61.

Blanchard, O. and Wolfers, J. (2000). “The Role of Shocks and Institutions in the Rise of European Unemployment: The Aggregate Evidence”. Economic Journal, 110, C1-C33.

Blau, F. and Kahn, L. (2001). “Do Cognitive Test Scores Explain Higher US Wage Inequality?” NBER Working Paper, No. 8210.

Blinder , A.S. and Weiss, Y. (1976). “Human Capital and Labor Supply: A Synthesis”. The Journal of Political Economy, Vol. 84, No. 3, pp. 449-472.

Boeri, T. and Brücker, H. (2001). “Eastern Enlargement and EU-Labour Markets: Perceptions, Challenges and Opportunities”. IZA, dp. 256.

Boeri, T. (2002). Structural Change, Welfare Systems and Labour Reallocation. Oxford University Press.

Borjas, G.J. (1987). “Self-selection and the Earnings of Immigrants”. The American Economic Review, 77 (4), pp. 531-553.

Borjas, G. J. (1999). Heaven's Door. Princeton University Press, Princeton and Oxford, 1999.

Borjas, G. J. (2003). “The Labor Demand Curve is Downward Sloping: Reexamining the Impact of Immigration on the Labor Market”. Quarterly Journal of Economics, Vol. CXVIII (4), 1335-1374.

Borjas, G. J., Freeman, R. and Katz, L. (1997). “How much do Immigration and Trade Affect Labor Market Outcomes?”. Brookings Papers on Economic Activity, 1997 (1), pp. 1-90.

Branstetter, L. (2001). “Are Knowledge Spillovers International or Intranational in Scope? Microeconometric Evidence from the U.S. and Japan”. Journal of International Economics, 53:1, pp. 53-79.

Burda, M. (1992). “A Note on Firing Costs and Severance Benefits in Equilibrium Unemployment”. Scandinavian Journal of Economics, 94(3), pp. 479-89.

Caballero, R. and Hammour, M (1998). “The Macroeconomics of Specificity”. Journal of Political Economy, 106(4), pp. 724-767.

Card, D. (1990). “The Impact of the Mariel Boatlift on the Miami Labor Market”. Industrial and Labor Relation Review, XLIII, pp. 245-257.

Card, D. (2001). “Immigrant Inflows, Native Outflows, and the Local labor Market Impacts of Higher Immigration”. Journal of Labor Economics, XIX, pp. 22-64.

Card, D. and Di Nardo, J. (2000). “Do Immigrants Inflow lead to Native Outflows?”. NBER Working Paper, n. 7578.

Charlot, Olivier. (2003). “Education et chômage dans les modèles d'appariement”, these de doctorat, Paris I.

Clark, R.L. and Ogawa, N. (1992). “Reconsidering Tenure and Earnings Profile of Japanese Men”. The American Economic Review, 82, pp. 336-45.

Cole, H.L. and Rogerson, R. (1999). “Can the Mortensen-Pissarides Matching Model Match the Business-Cycle Facts?”. International Economic Review, vol. 40, no. 4, pp. 933-959(27).

Daveri, F. (2002). “The New Economy in Europe, 1992—2001”. Oxford Review of Economic Policy, Oxford University Press, vol. 18(3), pp. 345-362.

Davis, S., Haltiwanger, J. and Shuh, S. (1996). Job Creation and Job Destruction. MIT Press, Cambridge, MA.

Decressin, J. and Fatàs, A. (1995). “Regional Labor Market Dynamics in Europe”. European Economic Review, December.

De la Fuente, A. and Domenech, R. (2001). «Educational Attainment in the OECD 1960-1995”. Manuscript, Departemento de Analisis Economico, Universidad de Valencia.

DeLong, J.B, Goldin, C. and Katz, L. (2003). "Sustaining U.S. Economic Growth", in H Aaron, J Linday, and P Nicola, (Eds.), Agenda for the Nation. Brookings Institution, 17-60.

Devroye, D. and Freeman, R. (2002). "Does Inequality in Skills Explain Inequality of Earnings in Advanced Countries?" Discussion Paper, no 552, Centre for Economic Performance.

Dolado, J.J., Jansen, M. and Jimeno, J.F. (2004). "A Matching Model of Crowding-Out and On-the-Job Search". Mimeo, Universidad Carlos III.

Dornbusch, R., Gentilini A. and F. Giavazzi (2000). "Italian Labor Force Participation: Disguised Unemployment on Campus", mimeo Uni. Bocconi.

Duncan, G., and Hoffman, S.D. (1981). "The incidence and wage effects of over-education". Economics of Education Review, 1 (1), pp. 75–86.

EEAG (2003). "Report on the European Economy 2003". European Economic Advisory Group (EEAG) at CESifo, Munich.

Elley, W. (1992). "How in the World do Students Read? IEA Study of Reading Literacy", IEA, Hamburg.

European Commission (2003). Third European Report on Science and Technology Indicators. Directorate-General for Research, Bruxelles.

Falaris, E.M. (1987). "A Nested Logit Migration Model with Selectivity". International Economic Review, vol. 28(2), pp. 429-43.

Freeman, R.B. (1976). The Overeducated American. Academic Press, New York.

Gomez-Salvador, R., Messina, J. and Vallanti, G. (2004). "Job Flows Dynamics and Firing Restrictions: Evidence from Europe". Mimeo.

Gordon, R. (2004). "Why was Europe left at the Station When America's Productivity Locomotive Departed", NBER wp. 10661, August.

Gottschalk, P. and Joyce, M. (1998). "Cross-national Differences in the Rise in Earnings Inequality: Market and Institutional Factors". Review of Economics and Statistics, 80, pp. 489-502.

Gould, E. (2002). "Rising Wage Inequality, Comparative Advantage, and the Growing Importance of General Skills in the United States". Journal of Labor Economics, January.

Gould, E., Moav, O. and Weinberg, B. (2001). "Precautionnary Demand for Education, Inequality and Technological Progress". Journal of Labor Economics, January.

Griliches, Z. (1994). "Productivity, R&D and the Data constraint". The American Economic Review, No. 84(1), pp. 1-23.

Groot, W. and Maassen van den Brink, H. (2000). "Over-education in the labor market: a meta-analysis". Economics of Education Review, 19 (2), pp. 149–158.

Grossman, G. and Helpman, E. (1991). "Innovation and Growth in the Global Economy". The MIT Press, Cambridge, Ma.

Gurgand, M. (2005). Economie de l'éducation. Collection Repères, Ed. La Découverte, Paris.

Hanson, G.H. and Spilimbergo, A. (1999). "Illegal Immigration, Border Enforcement and Relative Wages: Evidence from Apprehensions at the U.S.-Mexico Border". The American Economic Review, 89, pp. 1337-57.

Hanushek, E. (1997). "Assessing the Effects of School Resources on Student Performance: An Update". Educational Evaluation and Policy Analysis, 19, pp. 141-164.

Hartog, J. (2000). "Over-education and earnings. Where are we, where should we go?". Economics of Education Review, 19(2), pp. 131–48.

Hashimoto, M. and Raisian, J. (1985). "Employment Tenure and Earnings Profiles in Japan and the United States". The American Economic Review, Vol. 75, Issue 4 (Sep.), pp. 721-735.

Hashimoto, M. and Raisian, J. (1985). "Employment Tenure and Earnings Profiles in Japan and the United States: A Reply". The American Economic Review, Vol. 82, Issue 1, pp. 346-354.

Hassler, J., Storesletten K., Rodríguez Mora, S. and Zilibotti, F. (2005). "A Positive Theory of Geographic Mobility and Social Insurance". International Economic Review, Vol. 46, 1, pp. 263-303.

Hassler, J., Storesletten K., Rodríguez Mora, S. and Zilibotti, F. (2000). "Unemployment, Specialization, and Collective Preferences for Social Insurance". Cohen D., Piketty T. and Saint-Paul G. eds. The New Economics of Inequalities, CEPR, London and Oxford Univ. Press

Hedges, L., Laine, R. and Greenwald, R. (1994). "Does Money Matter? A Meta-Analysis of Studies of the Effects of Differential School Inputs on Student Outcomes". Education Researcher, 23, pp. 5-14.

Ichino, A. and Riphan, R. (2004). "Absenteeism and Employment Protection: Three Case Studies". Forthcoming Swedish Economic Policy Review.

Jaffe, A. and Trajtenberg, M. (2002). "Patents, Citations and Innovations". MIT Press Cambridge, Ma.

Jovanovic, B. (1979). "Job matching and the theory of turnover". Journal of Political Economy, 87(5), pp. 972–90.

Katz, L. and Autor, D. (1999). "Changes in the Wage Structure and Earnings Inequality", in O Ashenfelter and D Card (eds.). Handbook of Labor Economics, vol. 3A, 1463-1548, North-Holland.

Katz, L. and Murphy, K.L. (1992). "Changes in Relative Wages 1963-1987: Supply and Demand Factors". Quarterly Journal of Economics, 107, pp. 35-78.

Kletzer, L.G. (1989). "Returns to Seniority After Permanent Job Loss". The American Economic Review, Vol. 79, No. 3. (Jun.), pp. 536-543.

Kletzer, L.G. (1998). "Job Displacement". The Journal of Economic Perspectives, Vol. 12, No. 1. pp. 115-136.

Knapp, T.A., White, N.E. and Clark, D.E. (2001). "A Nested Logit Approach to Household Mobility". Journal of Regional Science, 41 (1), pp. 1-22.

Kristensen, N. and Westergard-Nielsen, N. (2004). "Does Job Satisfaction Lead to Job Mobility". IZA discussion paper 1026, February.

Krueger, A. (1999). "Experimental Estimates of Educational Production Functions". Quarterly Journal of Economics, 115, 1239-1285.

Krueger, A. (2003). "Economic Considerations and Class Size". Economic Journal, 113, pp. 34-63.

Krueger, D. and Kumar, K. (2003). "US-Europe Differences in Technology-Driven Growth: Quantifying the Role of Education". Journal of Monetary Economics, Vol. 51(1), pp. 161-190.

Krueger, D. and Kumar, K. (2004). "Skill-specific rather than General Education: A Reason for US-Europe Growth Differences?". Journal of Economic Growth, Vol. 9(2), pp. 167-207.

Krugman, P.R. and Obstfelfd, M. (2000). International Economics, Theory and Policy. 5th international edition, Addison-Wesley, ed.

Kuhn (Hrsg.) (2002). Losing work, moving on: international perspectives on worker displacement", Kalamazoo: Upjohn Institute for Employment Research S.

Kwiatkowski, E., Socha Mieczyslaw, W. and Sztanderska, U. "Labour Market Flexibility and Employment Security in Poland". Employment paper 2001/28, ILO, Geneva

Lamo, A., Messina, J and Wasmer, E. (2005). "Labor reallocation in imperfect labour markets: Theory and Application to the case of Estonia and Poland". Mimeo ECB.

Layard, R. and Nickell, S. (1999). "Labour Market Institutions and Economic Performance". Handbook of Labor Economics. Edited by Ashenfelter, O.; Card, D. North-Holland, 1999.

Lazear, E.P. (1990). "Job Security Provisions and Employment". Quarterly Journal of Economics; 105(3), pp. 699-726.

Lazear, E. (2003). “Firm-Specific Human Capital: A Skill-Weights Approach”. NBER Working Paper No. w9679, May.

Lefranc, A. (2003). “Labor market dynamics and wage losses of displaced workers in France and the United-States”. The William Davidson Institute, wp 614, Michigan Univ.

Lefranc, A. (2004). “On the sensitivity of returns to seniority to the measurement of earnings”. International Journal of Manpower, forthcoming.

Leuven, E., Oosterbeck, H. and Van Ophem, E. (2004). “Explaining International Differences in Male Wage Inequality by Differences in Demand and Supply of Skills”. Economic Journal, 114, pp. 466-486.

Ljunqvist, L. and Sargent, T.J. (1998). “The European Unemployment Dilemna”. Journal of Political Economy, 106, pp. 514-550.

Ljunqvist, L. and Sargent, T.J. (2002). “The European Employment Experience”. Paper presented at the Center for Economic Performance Conference « The Macroeconomics of Labor Markets », May.

Loewenstein, and Spletzer, (1999). “General and Specific Training: Evidence and Implications”. Journal of Human Resources, Vol 34(4), Autumn, pp. 710-733.

Malcomson, J.M. (2000). “Individual Employment Contracts”. Handbook of Labor Economics, Vol. 3, D. Card and O. Ashenfelter, eds.

Mendes de Oliveira, M., Santos, M.C. and Kiker, B.F. (2000). “The role of human capital and technological change in over-education”. Economics of Education Review, 19(2), pp. 199–206.

Ministry of Economy, Labour and Social Policy, Poland (2003). “Poland 2003. Report Labour Market, and Social Security”. Warsaw

Mortensen, D.T. and Pissarides, C.A. (1994). “Job Creation and Job Destruction in the Theory of Unemployment”. Review of Economic Studies, 64, pp. 397-415

Mortensen, D.T. and Pissarides, C.A. (1999). “Job reallocation, Employment Fluctuations and Unemployment”. Handbook of Macroeconomics.

Mundell, R.A. (1961). “A Theory of Optimum Currency Areas”. American Economic Review, 51, pp. 657-65.

Munz, R. (2004). “Migrants, Labor Markets and Integration in Europe: A comparative analysis”. Global Migration Perspectives Discussion paper N. 16, Global Commission on International Migration.

Natanelsson, K. (2003), The development of the supply of skill across countries and the relation to wage inequality, manuscript, Department of Economics, Uppsala University.

OECD (1993), Education at a Glance, Organization for Economic Cooperation and Development, Paris.

OECD (1995), Education at a Glance, Organization for Economic Cooperation and Development, Paris.

OECD (1996), Education at a Glance, Organization for Economic Cooperation and Development, Paris.

OECD (1999a). Employment Outlook, Paris.

OECD (1999b), Preparing Youth for the 21st Century: the Transition from Education to the Labour Market. OECD, Paris.

OECD (2003), Education at a Glance, Organization for Economic Cooperation and Development, Paris.

OECD (2004a), Education at a Glance, Organization for Economic Cooperation and Development, Paris.

OECD (2004b), Learning for Tomorrow's World: First Results from PISA 2003, Organization for Economic Cooperation and Development, Paris.

OECD and Statistics Canada (1995), Literacy, Economy, and Society. Results of the First International Adult Literacy Survey, OECD and Statistics Canada, Paris.

Okun, A. (1975). Equality and Efficiency: The Big Tradeoff. Washington, DC: Brookings Institution.

Padoa Schioppa, F. (1991) (ed.). Mismatch and Labour Mobility. Cambridge University Press, Cambridge.

Pakes, A. and Griliches, Z, (1980). "Patents and R&D at the Firm Level: a First Report". Economic Letters 5, pp. 377-81.

Peri, G. (2005). "Determinants of Knowledge Flows and their Effects on Innovation". Review of Economics and Statistics, Vol. 87, Issue 2.

Psacharopoulos, P. (2005). "Public versus Private University Systems", CESIfo DICE report, 4/2004

Rogerson, R. and Schindler, M. (2002). "The welfare costs of worker displacement". Journal of Monetary Economics, Vol. 49, Issue 6, pp. 1213-1234.

Roland, G. (2001). "Transitions and Economics: Politics, Markets and Firms". The MIT Press, 2000.

Romer, P. (1990). "Endogenous Technological Change". Journal of Political Economy, 98, pp. 71-102.

Samuelson, P. (2004). "Why Ricardo and Mill Rebut and Confirm Arguments of Mainstream Economists Supporting Globalization?". The Journal of Economic Perspectives, Vol. 18 (3), pp. 135-146.

Saint-Paul, G. (2000). "The political economy of labour market institutions". Oxford University Press.

Saint-Paul, G. (2004). "The Brain Drain: some Evidence from European Expatriates in the United States". IZA discussion paper, n. 1310.

Serrano, L. (2003). "Measurement Error in Schooling Data: the OECD case". Applied Economics Letters, 10, pp. 73-75.

Sicherman, N. and Galor, O. (1990). "A theory of career mobility", Journal of Political Economy, 98(1), pp. 169–92.

Spence, M. (1973). "Job market signalling". The Quarterly Journal of Economics, 87(3), pp. 355–74.

Solow, R. (1956). "A Contribution to the Theory of Economic Growth". Quarterly Journal of Economics, 70, pp. 65-94.

Tatsiramos, K. (2004). "Geographical Labour Mobility and Unemployment Insurance in Europe". IZA discussion paper 1253, August.

Topel, R. (1991). "Specific Capital, Mobility, and Wages: Wages Rise with Job Seniority". The Journal of Political Economy, Vol. 99, No. 1, pp. 145-176.

UNESCO (1999). Operational Manual for ISCED-1997 (International Standard Classification of
Education), 1st edition, June.

Verdugo, R. and Verdugo, N. (1989). "The Impact of Surplus Schooling on Earnings: Some Additional Findings". Journal of Resources, 24, pp. 629-643.

Wasmer, E. (2002). "Interpreting Europe and US labour markets differences: the specificity of human capital investments". CEPR wp 3780, Aug. 2002, under revision.

Wasmer, E. (2005). "Short-Run Effects of Enlargement, Panel contribution", collective volume, ECB-CEPR conference. What explains the pattern of labour supply in Europe? Edward Elgar Publishing, CEPR-ECB, Gomez-Salvador, Lamo, Petrongolo, Ward and Wasmer eds.

Figure 1.1. ISCED-1997 Transition Pattern (Source: UNESCO, 1999)

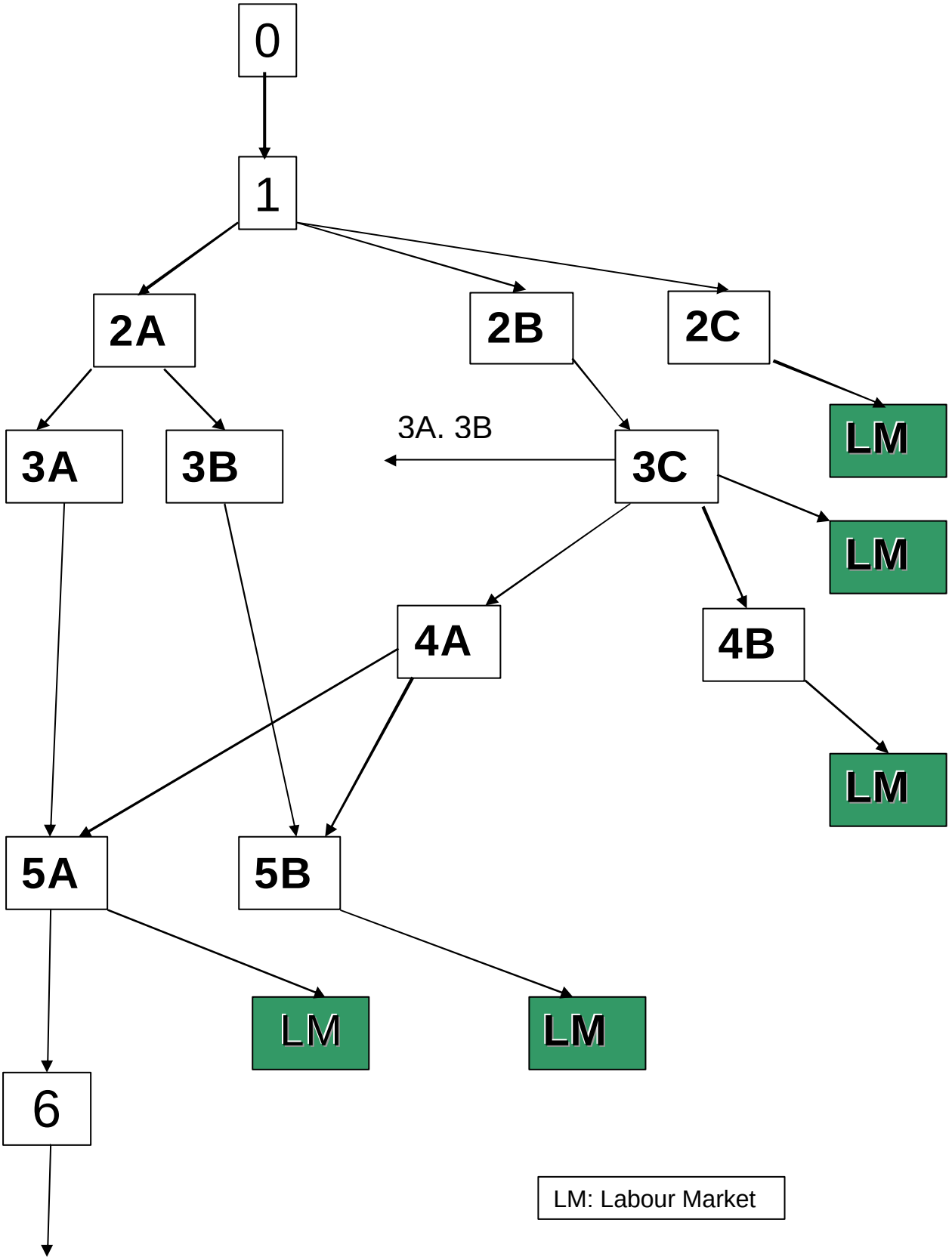
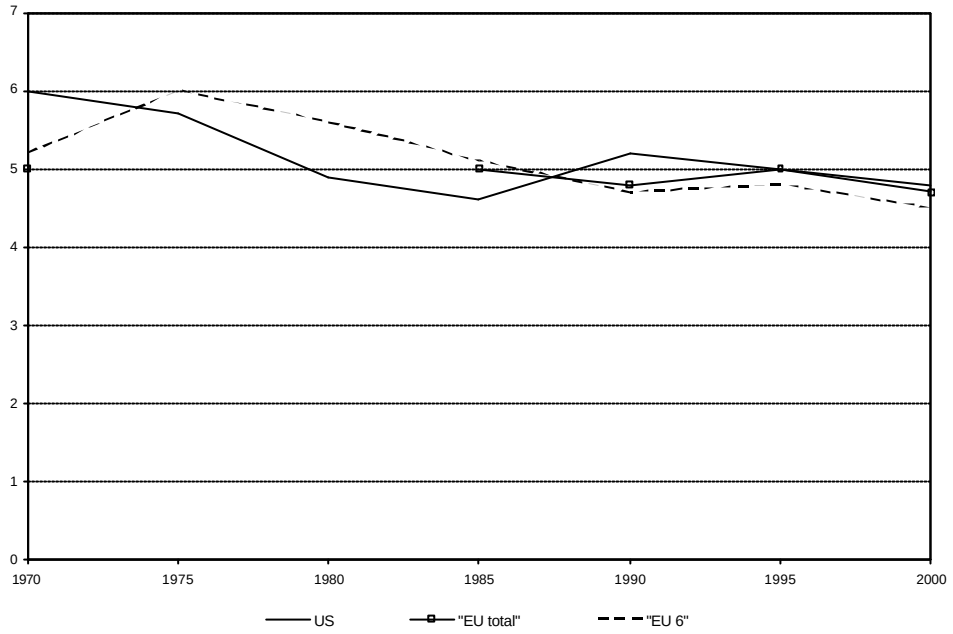
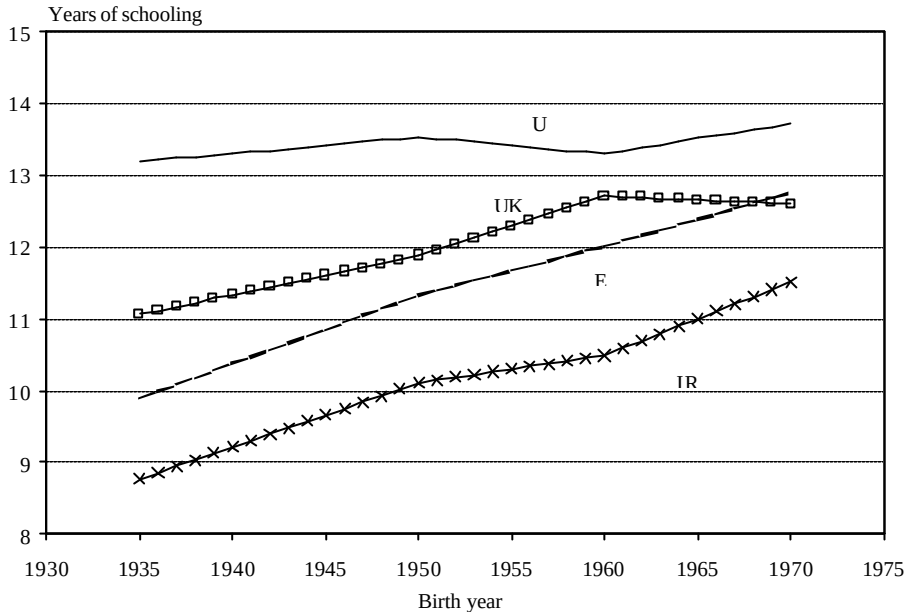


Figure 1.2. Long-run public expenditure patterns, percentage of GDP, 1970-2000.



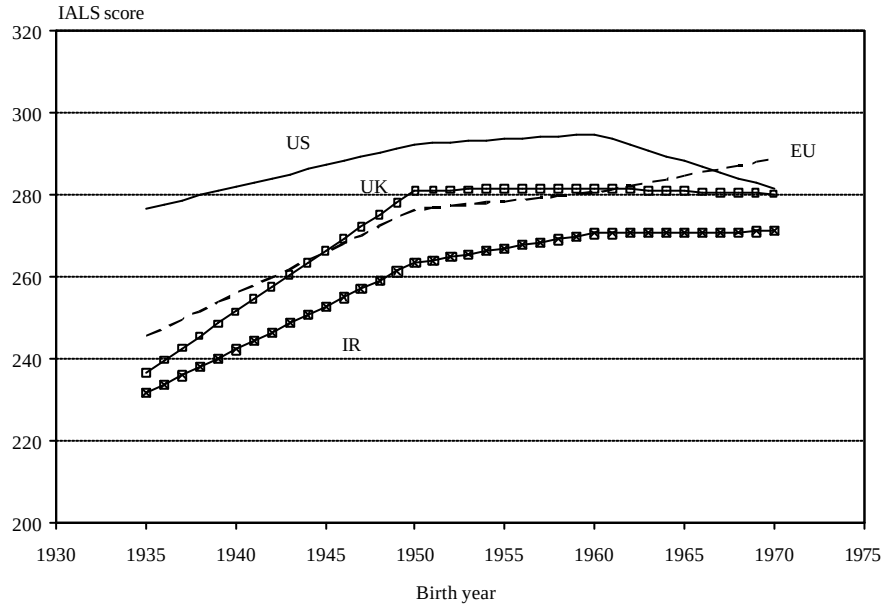
Notes: EU 6 is the population weighted average for Austria, Germany, Ireland, the Netherlands, Sweden, and the UK. EU total is, generally, the population weighted average for the EU15 countries, excluding Luxembourg; no data are available for Greece in 1990, however. Notice also that there are some time series breaks in these data; see OECD (1996) for further details. *Source:* OECD (1996, 2003).

Figure 2.1. Schooling by cohort in the EU, the UK, Ireland, and the US



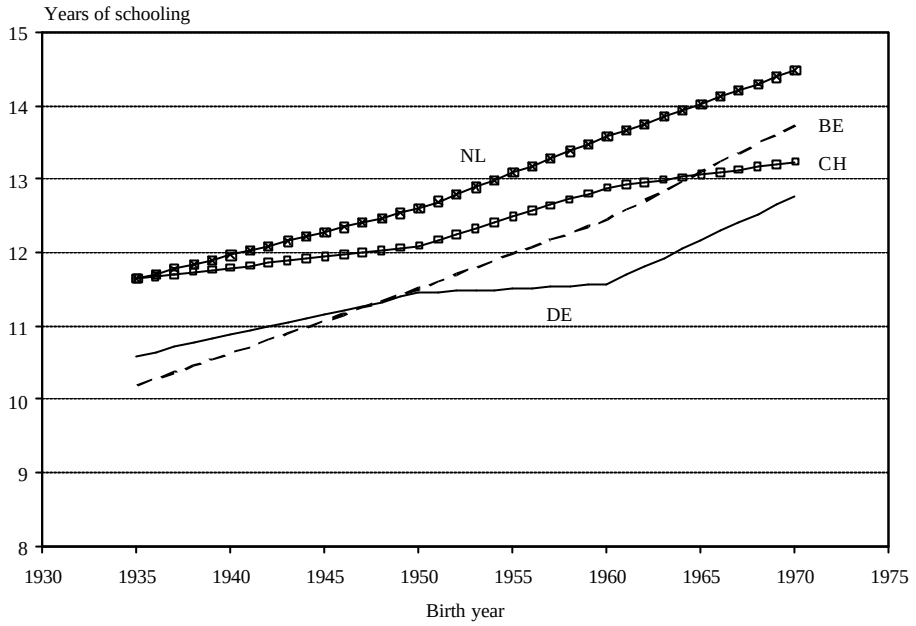
Notes: The figure show smoothing splines with knots in 1950 and 1960 fitted to raw cohort data. EU is the population-weighted average across the EU countries. UK = United Kingdom; IR = Ireland; US = United States.

Figure 2.2. Skills by cohort in Skills by cohort in the EU, the UK, Ireland, and the US



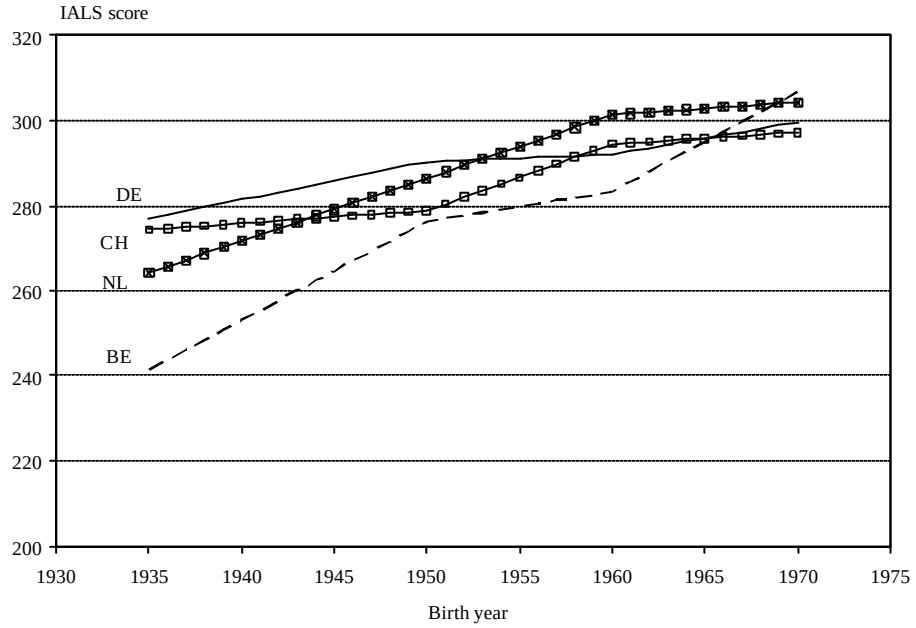
Notes: The figure shows smoothing splines with knots in 1950 and 1960 fitted to raw cohort data. See notes to Fig. 2.1 for a description of the legends.

Figure 2.3. Schooling by cohort in Belgium, Germany, the Netherlands, and Switzerland



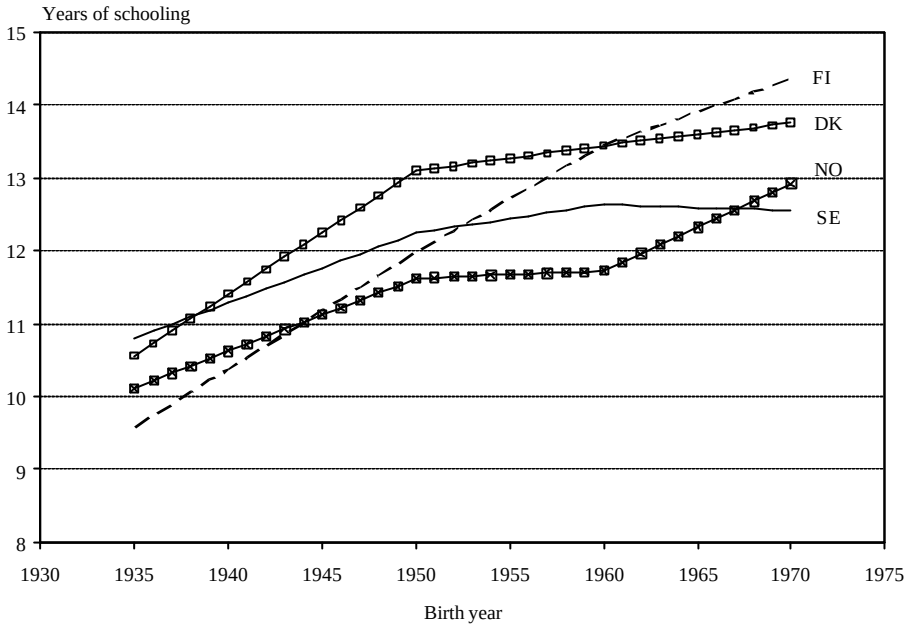
Notes: The figure shows smoothing splines with knots in 1950 and 1960 fitted to raw cohort data. BE = Belgium; DE = Germany; NL = the Netherlands; CH = Switzerland.

Figure 2.4. Skills by cohort in Belgium, Germany, the Netherlands, and Switzerland



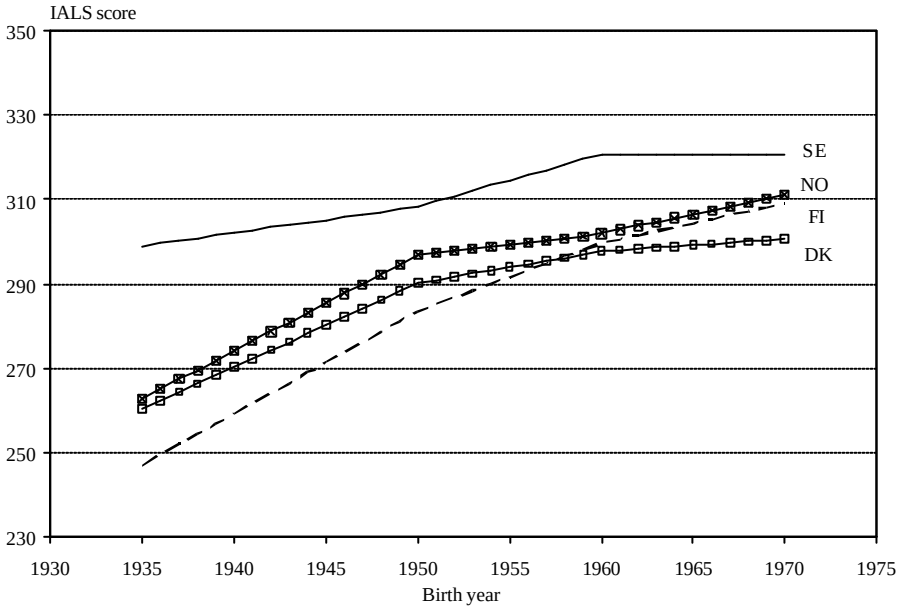
Notes: The figure shows a smoothing spline with knots in 1950 and 1960 fitted to raw cohort data. See Fig. 2.3 for a description of the legends.

Figure 2.5. Schooling by cohort in Denmark, Finland, Norway, and Sweden



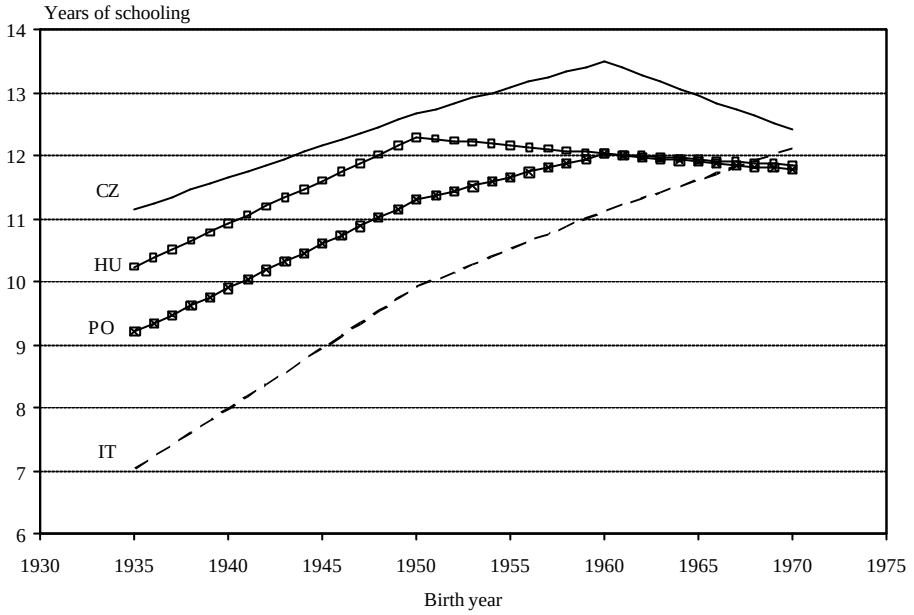
Notes: The figures show a smoothing spline with knots in 1950 and 1960 fitted to raw cohort data. DK = Denmark; FI = Finland; NO = Norway; SE = Sweden.

Figure 2.6. Skills by cohort in Denmark, Finland, Norway, and Sweden



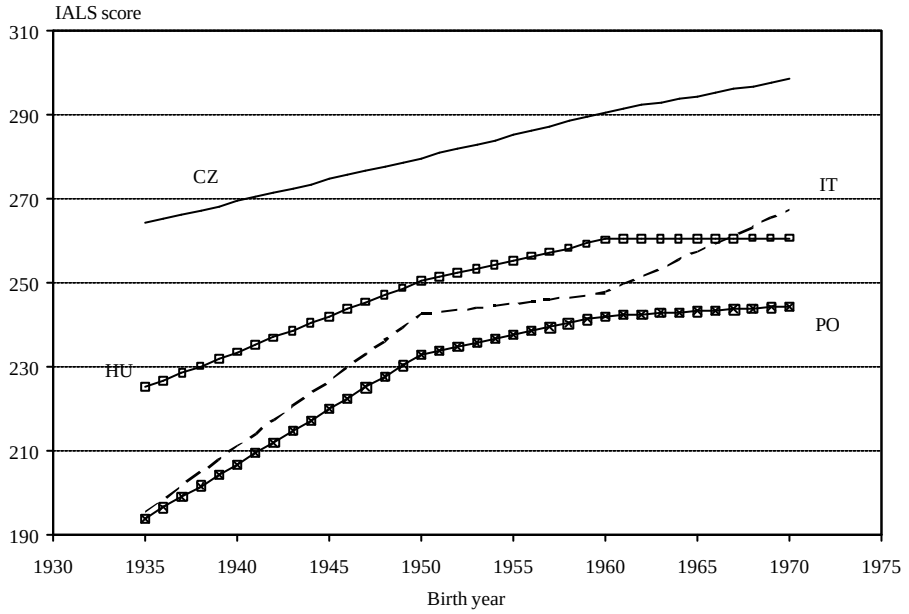
Notes: The figure shows smoothing splines with knots in 1950 and 1960 fitted to raw cohort data. See Fig. 2.5 for a description of the legends.

Figure 2.7. Schooling by cohort in the Czech Republic, Hungary, Italy, and Poland



Notes: The figure shows smoothing splines with knots in 1950 and 1960 fitted to raw cohort data. CZ = the Czech Republic; HU = Hungary; IT = Italy; PO = Poland.

Figure 2.8. Skills by cohort in the Czech Republic, Hungary, Italy, and Poland



Notes: The figure shows smoothing splines with knots in 1950 and 1960 fitted to raw cohort data. See Fig. 2.7 for a description of the legends.

Figure 3.1. Determination of the level of schooling

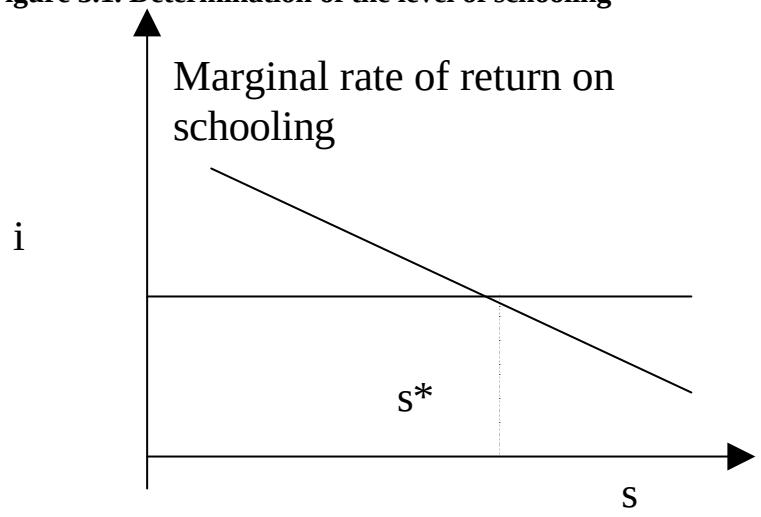
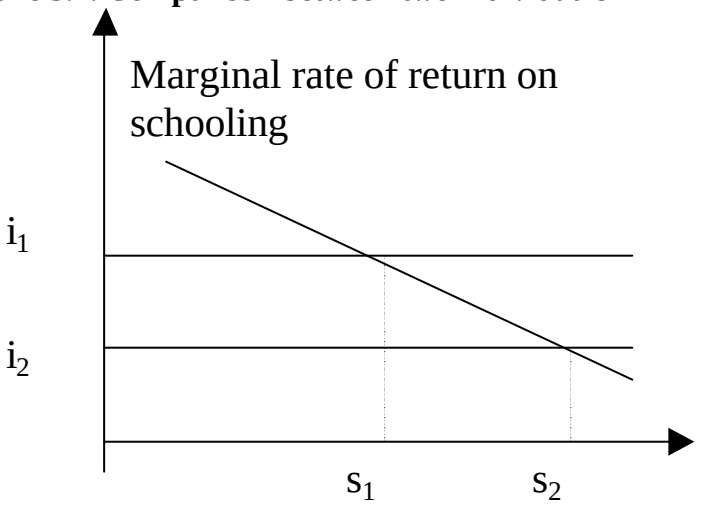


Figure 3.2. Comparison between two individuals



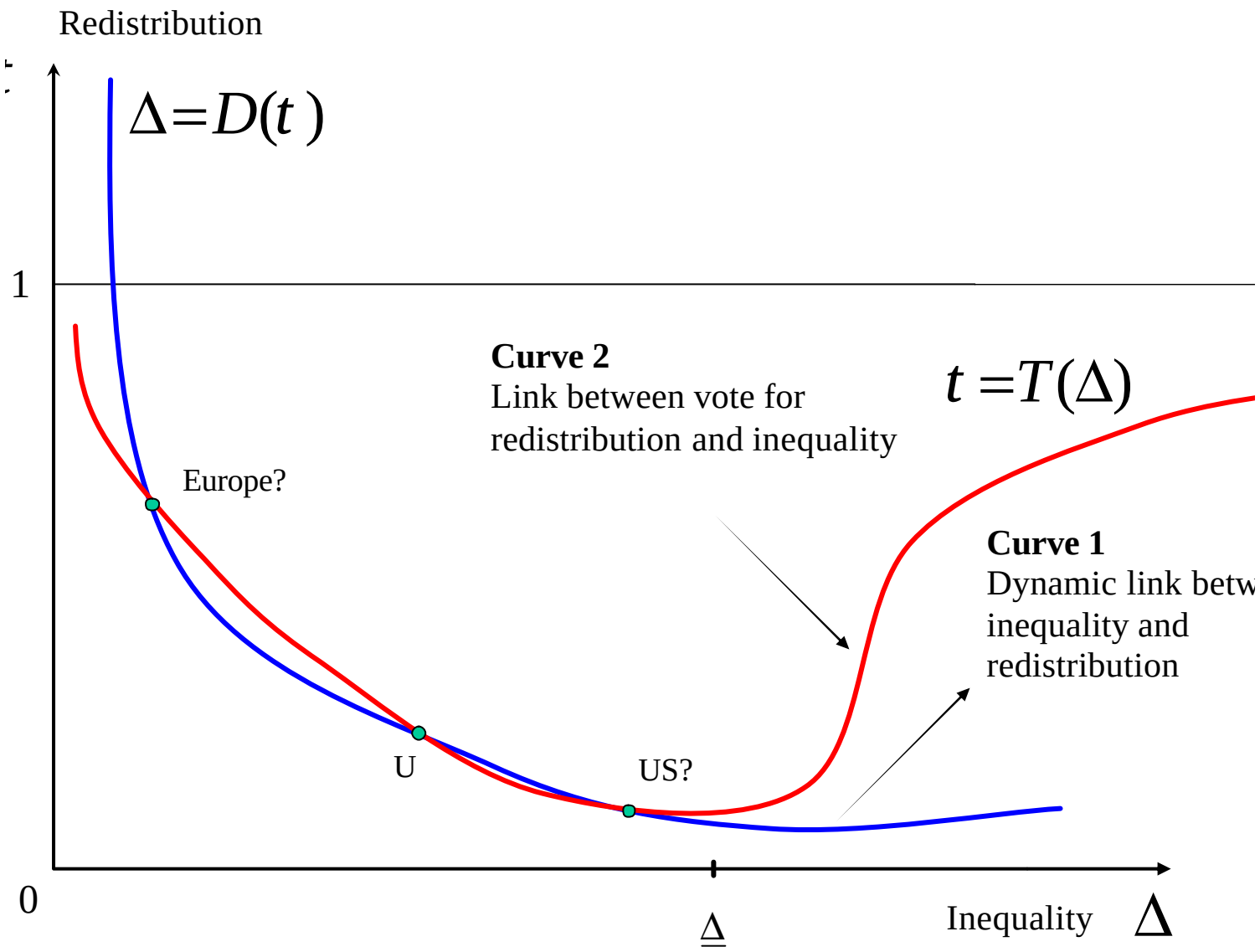
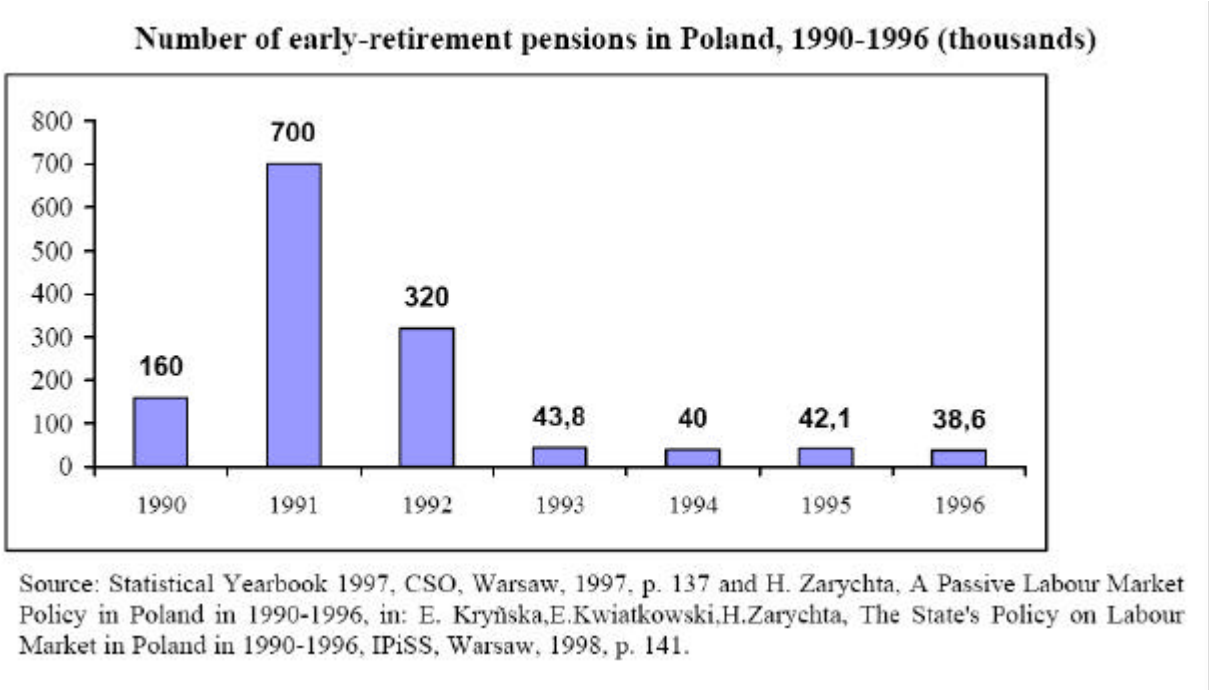


Figure 3.3. Links between inequality of human capital and redistribution.

Notes: Inequality: $?^2$ = inequality in human capital (variance of log-normal).
Redistribution: $t \leq 1$ = degree of progressivity / equalization in fiscal (taxes + transfers)
or education (school finance), or labor market (minimum wage, unions) policy.

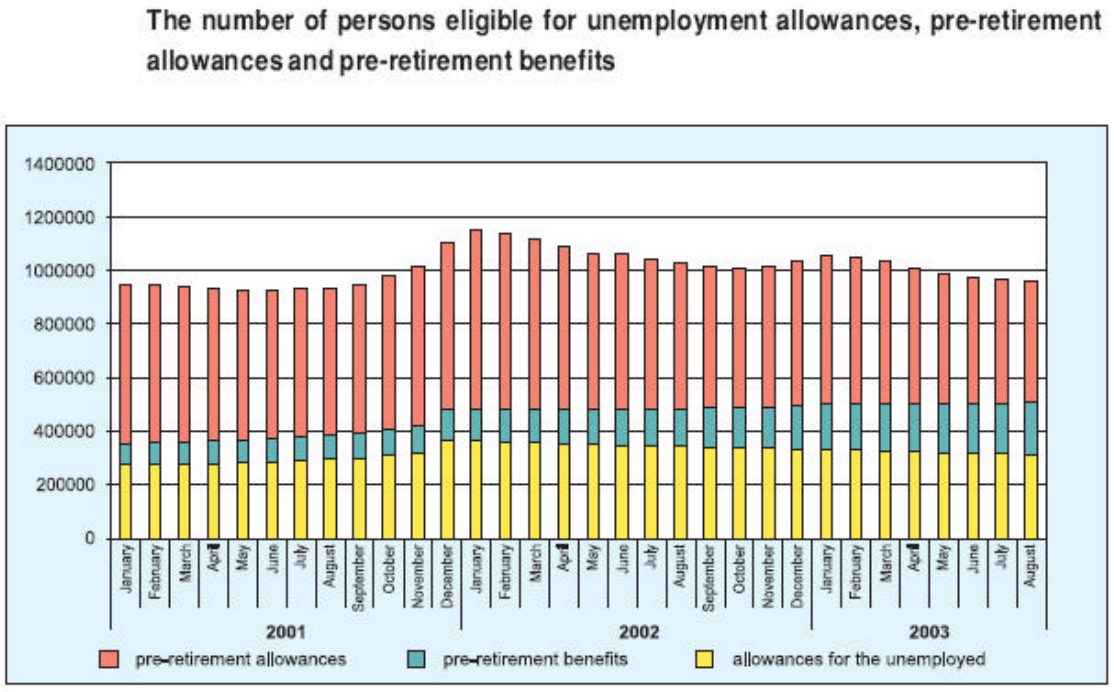
Source: Benabou (2000 and 2005).

Figure 3.4. Macroeconomic context during the transition to a market economy, Poland



Source: Kwiatkowski et al.

Figure 3.5. Macroeconomic context during the adhesion to the European Union, Poland



Source: Ministry of Economy, Labour and Social Policy.

Figure 3.5. Hiring and separation rates. Estonia 1997-2002

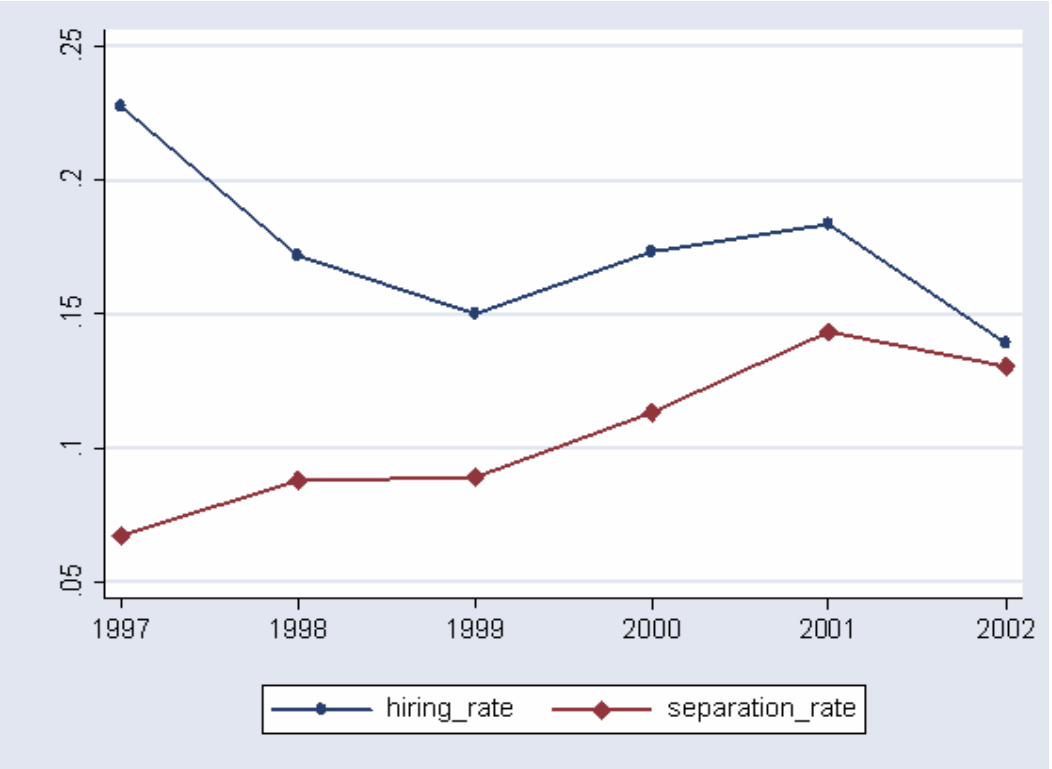


Figure 4.1. Mobility rate in the last three years, job-related reason & outside the area/city, by education (EU15 less Luxembourg and Sweden, 1995-2001)

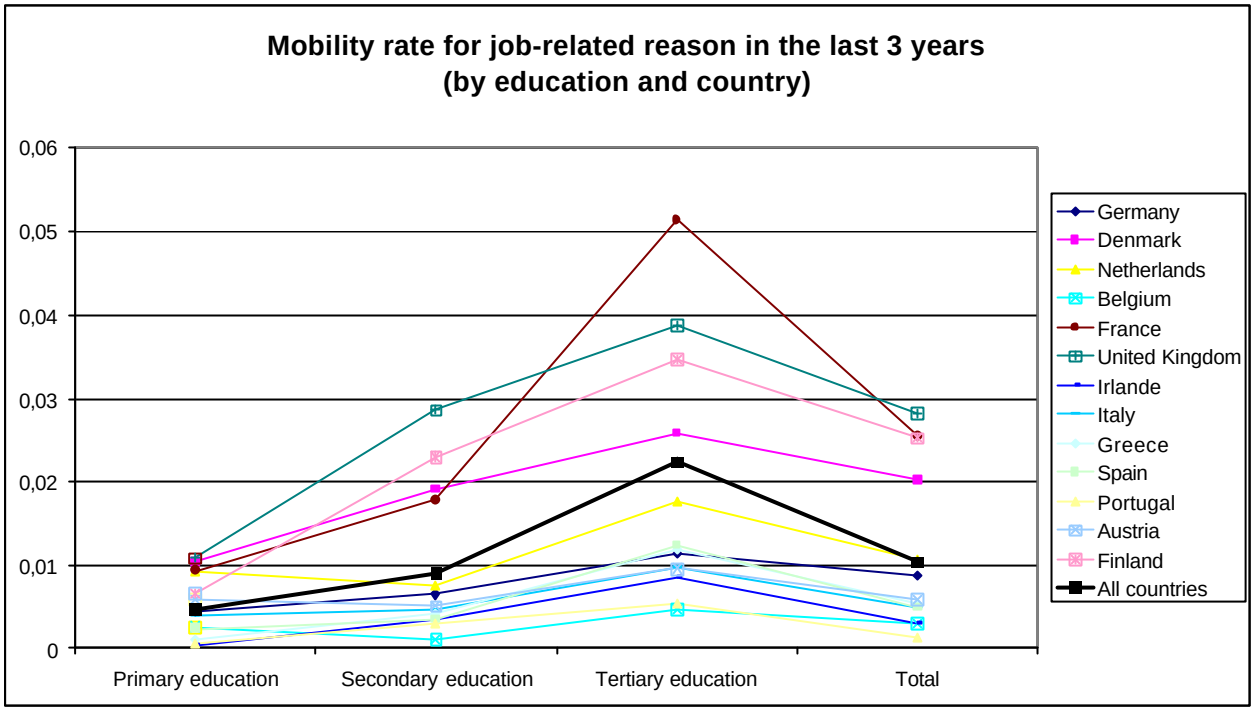
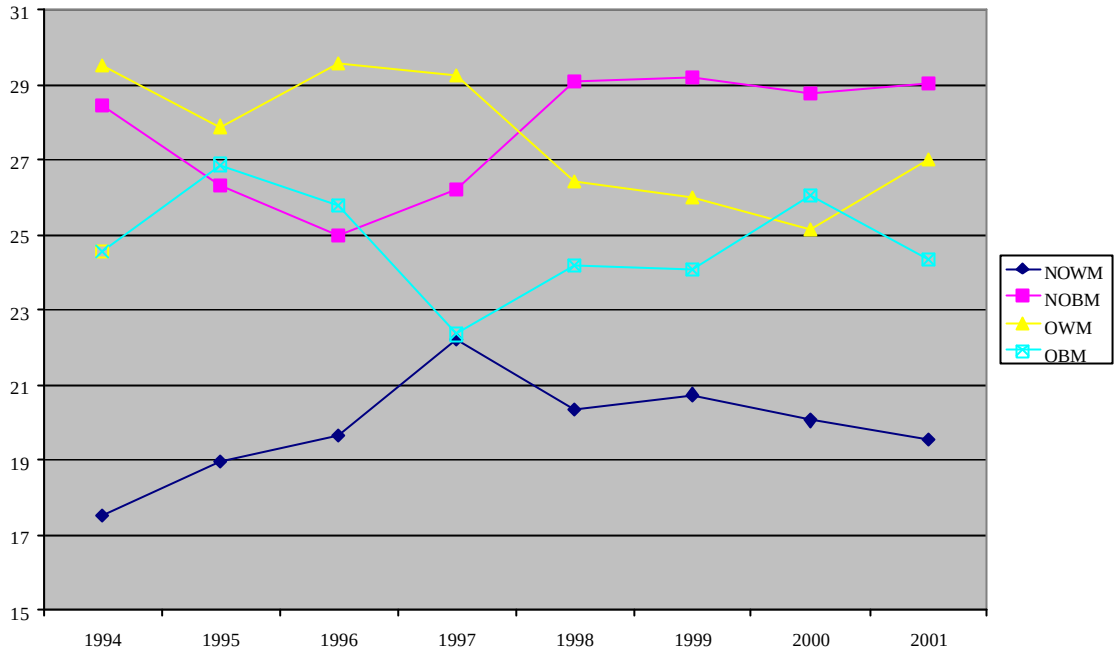


Figure 5.1. The incidence of Skill Mismatch in EU-15, time series.



Notes: Weighted averages (using population shares in 2001) of 10 European countries (Austria, Belgium, Denmark, Finland, France, Greece, Ireland, Italy, Portugal and Spain). Germany and the UK are excluded from the averages since data is only available for the period 1994-1996

Figure 5.2. The incidence of Skill Mismatch in EU-15, cross-country.

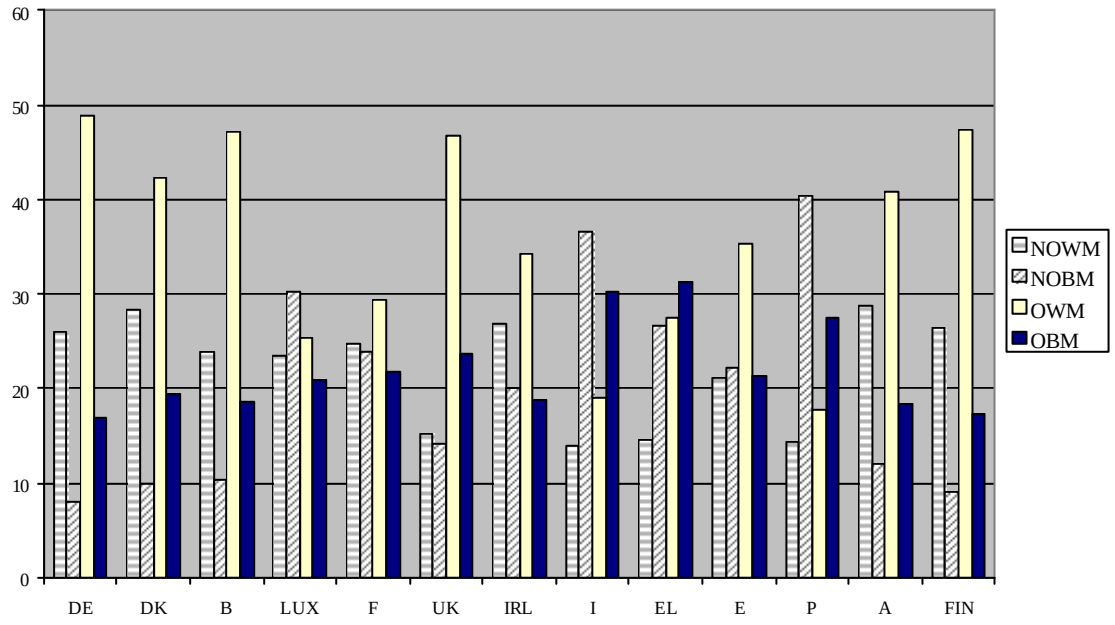


Figure 5.3. Skill Mismatch and Employment Protection Legislation in Europe: Rank Correlations

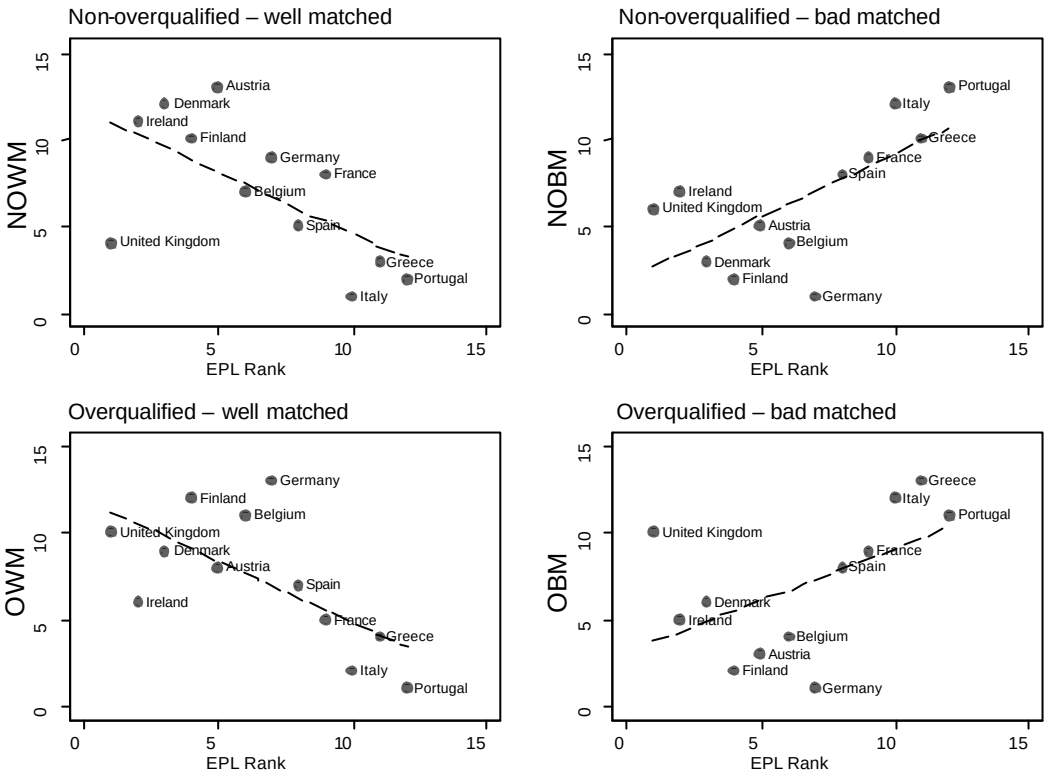
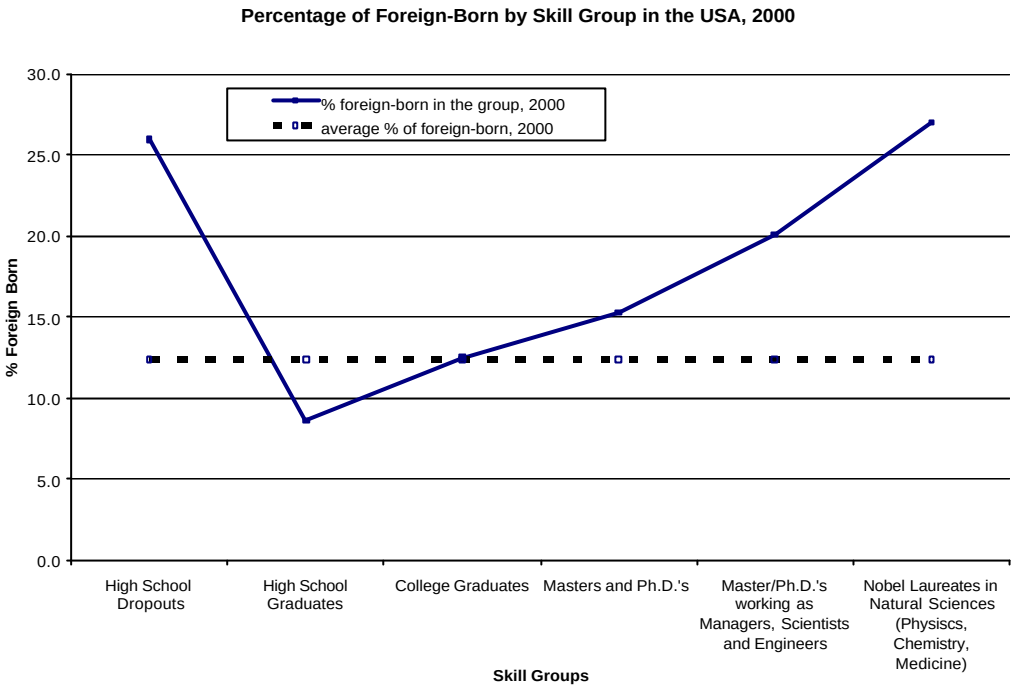
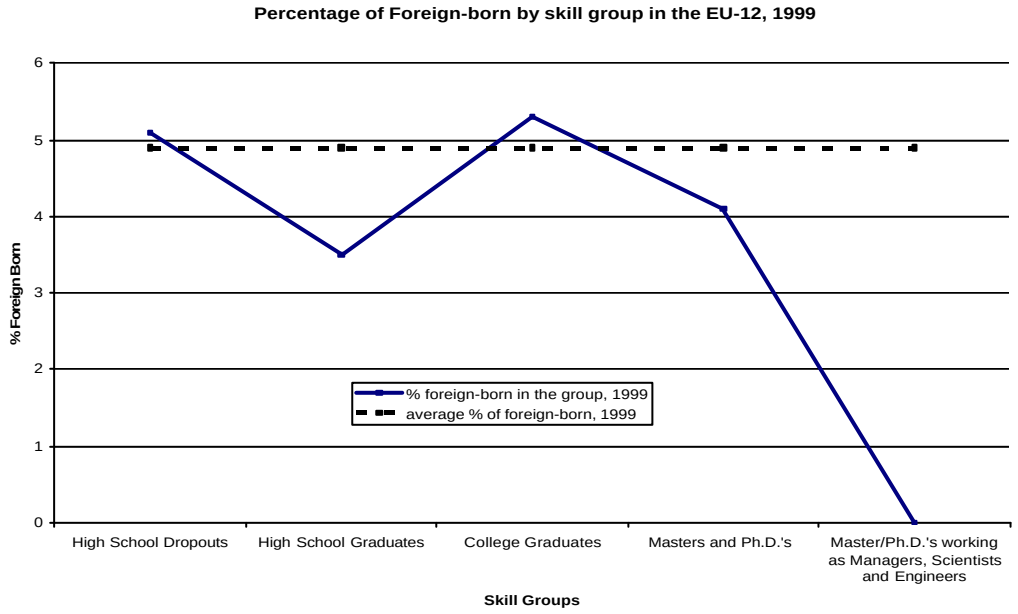


Figure 6.1.



Sources: U.S. census IPUMS data, 2000 plus website of the Nobel Foundation: http://nobelprize.org/nobel/ .

Figure 6.2.



Sources: European LFS data, 1999, plus website of the Nobel Foundation: http://nobelprize.org/nobel/ .

Table 1.1. Educational attainment: adult population (2002)

Distribution of the 25-to 64-year-old population, by highest level of education attained

	Pre-primary and primary education	Lower secondary education	Upper secondary education			Post-secondary non-tertiary education	Tertiary education		All levels of education	Average years of schooling
			ISCED 3C Short	ISCED 3C Long/3B	ISCED 3A		Type B	Type A and advanced research programmes		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
Austria	x(2)	22	na	49	7	7	7	7	100	11,3
Belgium	19	21	na	8	24	1	15	13	100	11,2
Denmark	Na	20	x(2)	46	5	1	8	20	100	13,3
Finland	x(2)	25	na	na	42	n	17	16	100	12,4
France	17	18	27	3	10	n	12	12	100	10,9
Germany	2	15	na	52	3	5	10	13	100	13,4
Greece	37	10	2	2	25	5	6	13	100	10,5
Ireland	21	18	na	na	23	12	10	16	100	12,7
Italy	20	33	2	6	26	2	x(8)	10	100	9,4
Netherlands	12	22	x(4)	24	13	5	3	22	100	13,5
Portugal	67	13	x(5)	x(5)	11	x(5)	2	7	100	8,0
Spain	32	26	na	6	11	na	7	17	100	10,3
Sweden	8	10	na	x(5)	49	x(7)	15	18	100	12,4
United Kingdom	Na	16	19	22	15	x(9)	8	19	100	12,7
EU14	**Na**	**20,1**	**na**	**na**	**14,1**	**na**	**na**	**14,2**	**100,0**	**11,6**
United States	5	8	x(5)	x(5)	49	x(5)	9	29	100	12,7
Canada	6	12	a	x(5)	28	12	22	21	100	12,9

Notes: x indicates that data are included in another column. The column reference is shown in brackets after x *e.g.* x(2) means that data are included in column 2. EU14 refers to EU15 except Luxemburg. *Source:* OECD Education at a Glance 2004, Table A1.1 and authors' calculations.

Table 1.2. Population that has attained tertiary education (2002)

Percentage of the population which has attained tertiary-type B education or tertiary-type A and advanced research programmes, by age group

	Tertiary-type B education					Tertiary-type A and advanced research programmes				
	25-64	25-34	35-44	45-54	55-64	25-64	25-34	35-44	45-54	55-64
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Austria	7	7	8	8	6	7	7	8	7	5
Belgium	15	20	16	13	10	13	18	13	11	8
Denmark	5	6	6	5	4	23	23	24	25	18
Finland	17	19	21	16	12	16	21	17	14	11
France	12	17	12	9	6	12	19	11	10	9
Germany	10	8	11	11	10	13	13	15	14	11
Greece	6	7	8	4	3	13	17	14	12	7
Ireland	10	14	10	7	5	16	23	15	12	9
Italy	5	6	6	5	4	5	6	6	5	4
Netherlands	3	2	3	2	2	22	25	23	21	17
Portugal	2	3	2	2	2	7	12	7	5	3
Spain	7	12	7	4	2	17	25	18	13	8
Sweden	15	17	18	14	10	18	22	16	17	16
United Kingdom	8	8	9	8	7	19	23	18	18	13
EU14	**8,5**	**10,0**	**9,3**	**7,7**	**6,1**	**13,5**	**16,9**	**13,8**	**12,6**	**9,4**
United States	9	9	10	10	7	29	31	29	30	26
Canada	22	25	23	21	16	21	26	20	20	16

Notes: for Italy, data in columns 2-5 are missing. One has assumed that the profile of columns 2-5 is the same as the profile of columns 7-10 and that half of students are in each broad category (type A and B). Assuming 0 in B and 10% in A does not change much EU averages. EU14 refers to EU15 except Luxemburg. *Source:* OECD Education at a Glance 2004, and authors' calculation.

Table 1.3. Trends in the educational attainment of the population aged 25-64, 1960-2002.

Country	Less than upper secondary (%)			Upper secondary and post-secondary non-tertiary (%)			University (%)			Years of schooling		
	1960	1980	2002	1960	1980	2002	1960	1980	2002	1960	1980	2002
Austria	58	45	22	39	50	63	3	6	14	9.7	10.9	12.5
Belgium	84	60	39	8	25	33	8	15	28	7.9	9.7	11.3
Czech Republic	na	na	12	na	na	76	na	Na	12	na	na	12.4
Denmark	40	27	20	51	53	53	9	20	27	11.5	12.2	12.7
Finland	84	56	25	8	26	42	9	19	33	7.9	10.3	12.3
France	83	58	35	11	30	41	6	11	24	7.2	9.2	11.0
Germany	62	31	17	33	54	60	5	15	23	9.4	12.0	13.1
Greece	83	73	47	11	17	34	6	10	18	7.4	8.2	10.3
Hungary	na	na	29	na	na	57	na	Na	14	na	na	11.5
Ireland	86	73	40	10	21	35	3	6	25	7.3	8.4	11.2
Italy	90	76	54	7	17	36	3	6	10	6.3	8.0	10.2
Netherlands	87	64	34	7	23	42	6	14	24	8.3	10.2	12.1
Norway	61	35	13	28	44	55	11	21	31	10.6	11.7	12.8
Poland	na	na	18	na	na	70	na	na	12	na	na	11.9
Portugal	94	90	80	4	5	11	2	5	9	6.5	6.8	7.8
Spain	96	89	58	1	3	17	3	8	24	5.5	6.3	9.6
Sweden	68	48	18	26	37	49	6	15	33	8.4	9.9	12.2
Switzerland	44	28	15	48	57	59	8	15	25	10.8	12.1	13.2
United Kingdom	54	40	16	38	47	57	8	14	27	10.0	10.9	12.4
United States	48	24	13	44	57	49	8	19	38	10.2	11.7	12.8
EU14	**76**	**56**	**34**	**19**	**32**	**44**	**5**	**11**	**22**	**8.0**	**9.6**	**11.5**

Notes: EU14 refers to EU15 except Luxemburg. Values for 1960 and 1980 have been imputed using OECD (2004a), OECD labour force statistics 1995-2000, and De la Fuente and Domenech (2001). To link the different data sources we have used the 1995 values reported in De la Fuente and Domenech (2001) and OECD labour force statistics on the educational attainment in the population for the year closest to 1995. Then we used the growth rates during 1960-1980 and 1980-95 reported in De la Fuente and Domenech (2001) to impute values for 1980 and 1960. Years of schooling have been calculated from the attainment data generated by this procedure. In general, we have used the mapping between years of schooling and attainment provided by De la Fuente and Domenech (2001). Years of schooling for the Czech Republic, Hungary and Poland come directly from OECD (2004a). *Sources:* OECD (2004a); OECD labour force statistics 1995-2000; and De la Fuente and Domenech (2001).

Table 1.4. Total education expenditure as a fraction of GDP and expenditure per student as a fraction of GDP per capita, percent, 1991 and 2001

Country	Total expenditure		Expenditure/student	
	1991	2001	1991	2001
Austria	5.4*	5.8 (5.6*)	27*	27*
Belgium	5.4*	6.4 (6.0*)	23	26
Denmark	6.1	7.1	31	28
Finland	6.6	5.8	32	24
France	6.0	6.0	24	25
Germany	5.4	5.3	29	25
Greece	na	4.1	na	22
Ireland	5.9	4.5	21	18
Italy[a]	5.1*	5.3 (4.9*)	26*	30*
Netherlands	5.8	4.9	26	22
Portugal	5.5*	5.9 (5.8*)	28*	28*
Spain	5.6	4.9	22	24
Sweden	6.8	6.5	38	26
United Kingdom	5.3*	5.5 (4.7*)	28*	19*
EU13	**5.5**	**5.3**	**27**	**25**
United States	7.0	7.3	30	30

Notes: [a] Data refer to 1992 rather than 1991. * Expenditure data are from public sources only. Total expenditure includes all levels from pre-primary to tertiary education. EU13 average is the population-weighted average for the 13 EU countries where data are available 1991 and 2001; the sizes of the populations in 2001 are used as weights; if only public expenditure is reported in one year we use public expenditure for the other year as well. *Source*: OECD (1993, 1995, 2004).

Table 1.5. Expenditure and enrollment shares by level of education, percent, 1991 and 2001

Expenditure (resp. enrollment) shares are reported in normal fonts (resp. italics), while bold face numbers are ratios of expenditures to enrollment.

Country	Pre-primary		Primary		Secondary		Tertiary	
	1991	2001	1991	2001	1991	2001	1991	2001
Austria	7	9	19	21	51	48	23	22
	13	*14*	*24*	*25*	*48*	*46*	*16*	*15*
	0.54	**0.64**	**0.79**	**0.84**	**1.06**	**1.04**	**1.44**	**1.47**
Belgium	10	9	20	23	51	45	19	22
	17	*16*	*34*	*31*	*25*	*40*	*11*	*13*
	0.59	**0.56**	**0.59**	**0.74**	**2.04**	**1.12**	**1.73**	**1.69**
Denmark	4	11	28	28	46	36	21	27
	5	*21*	*34*	*29*	*46*	*34*	*15*	*15*
	0.80	**0.52**	**0.82**	**0.97**	**1.00**	**1.06**	**1.4**	**1.8**
Finland	2	6	31	23	43	41	24	30
	4	*11*	*38*	*31*	*42*	*40*	*16*	*17*
	0.50	**0.55**	**0.82**	**0.74**	**1.02**	**1.02**	**1.5**	**1.76**
France	10	11	20	19	52	51	18	18
	18	*17*	*29*	*27*	*41*	*42*	*12*	*14*
	0.56	**0.65**	**0.69**	**0.70**	**1.27**	**1.21**	**1.5**	**1.29**
Germany	4	11	11	13	66	55	19	21
	15	*14*	*21*	*21*	*50*	*52*	*15*	*13*
	0.27	**0.79**	**0.52**	**0.62**	**1.32**	**1.06**	**1.27**	**1.62**
Greece	na	na	na	29	na	40	Na	31
				37		*37*		*26*
				0.78		**1.08**		**1.19**
Ireland	8	0.15	28	32	40	35	24	31
	13	*0.21*	*42*	*46*	*36*	*37*	*8*	*17*
	0.62	**0.72**	**0.67**	**0.70**	**1.11**	**0.95**	**3.00**	**1.82**
Italy[a]	8	9*	24	24*	50	48*	18	19*
	11	*12*	*27*	*27*	*48*	*44*	*14*	*17*
	0.73	**0.64**	**0.89**	**0.89**	**1.04**	**1.10**	**1.29**	**1.12**
Netherlands	6	7	23	28	41	39	30	26
	11	*11*	*34*	*37*	*42*	*39*	*13*	*13*
	0.55	**0.56**	**0.89**	**0.76**	**0.98**	**1.00**	**2.31**	**2.00**
Portugal	2	na	42	na	38	na	17	na
	4		*50*		*40*		*7*	
	0.50		**0.84**		**0.95**		**2.43**	
Spain	8	10	22	25	52	40	18	25
	10	*14*	*29*	*31*	*48*	*38*	*13*	*17*
	0.80	**0.71**	**0.76**	**0.81**	**1.08**	**1.05**	**1.38**	**1.47**
Sweden	3	7	35	31	44	35	18	26
	6	*15*	*40*	*34*	*41*	*39*	*13*	*12*
	0.50	**0.47**	**0.88**	**0.91**	**1.07**	**0.90**	**1.38**	**2.17**
United Kingdom	4*	8	28*	24	47*	48	21*	20
	7	*7*	*40*	*33*	*44*	*49*	*9*	*11*
	0.57	**1.14**	**0.70**	**0.73**	**1.07**	**0.98**	**2.33**	**1.82**
EU12	6	9	21	21	53	48	20	21
	12	*13*	*30*	*28*	*45*	*45*	*13*	*14*
	0.50	**0.69**	**0.70**	**0.75**	**1.18**	**1.07**	**1.54**	**1.50**
United States	6	7	28	27	31	29	34	37
	12	*8*	*38*	*39*	*33*	*35*	*17*	*18*
	0.50	**0.88**	**0.74**	**0.69**	**0.94**	**0.83**	**2.00**	**2.06**

Notes: [a] 1992 data are used in place of 1991 data. * Expenditure data are from public sources only. EU12 average is the population-weighted average for the 12 EU countries where data are available 1991 and 2001; the size of the populations in 2001 are used as weights. Enrollment data for 2001 are based on full-time equivalents. In 2001, expenditures not allocated by level

have been distributed to the remaining educational levels in proportion to their expenditure shares. In 2001, expenditure (enrollment) at the post-secondary, non-tertiary level, have been allocated to the secondary and tertiary level in proportion to the expenditure (enrollment) shares. *Source:* OECD (1993, 1995, 2004).

Table 1.6. Share of private expenditure in total expenditure, percent, 2001

Austria	3.4
Belgium	6.3
Denmark	4.2
Finland	1.7
France	6.7
Germany	18.9
Greece	4.9
Ireland	6.7
Italy	7.5
Netherlands	8.2
Portugal	1.7
Spain	12.2
Sweden	3.1
United Kingdom	14.5
EU14	10.8
United States	31.5

Notes: EU average is the population-weighted average for the 14 EU15 countries where data are available; the sizes of the populations in 2001 are used as weights. *Source:* OECD (2004).

Table 1.7 Relative earnings across countries

By level of educational attainment and gender for 30- to 44-year-olds (upper secondary education = 100)

	Year	Gender	Below upper secondary education	Tertiary-type B education	Tertiary-type A and advanced research programs	All tertiary education
Belgium	2002	Males	97	120	149	136
		Females	83	124	185	146
Denmark	2001	Males	83	109	135	128
		Females	89	112	122	121
Finland	2001	Males	89	125	180	155
		Females	94	124	167	141
France	2002	Males	86	132	173	157
		Females	80	135	159	148
Germany	2002	Males	87	113	152	137
		Females	72	112	153	138
Ireland	2000	Males	77	123	140	133
		Females	61	126	155	144
Italy	2000	Males	72	m	140	140
		Females	80	m	132	132
Netherlands	1997	Males	86	130	133	132
		Females	73	136	154	152
Portugal	1999	Males	57	155	194	185
		Females	58	139	206	185
Spain	2001	Males	82	97	135	122

		Females	65	88	138	126
Sweden	2001	Males	86	114	162	149
		Females	85	109	137	126
United Kingdom	2001	Males	67	126	162	151
		Females	74	133	216	183
United States	2002	Males	70	122	205	195
		Females	67	122	191	182
Canada	2001	Males	78	115	183	147
		Females	65	120	179	145
EU12		**Males**	**80**	**120**	**154**	**143**
		Females	**75**	**120**	**161**	**146**

Notes: The numbers generally pertain to earnings before tax. The earnings concept for Belgium is, however, tax-adjusted. The reference period is: a week for Ireland and the UK; a month for France, Germany, and Portugal; a year for the remaining countries. The EU12 average is a population-weighted average of EU15 countries reported here. *Source:* OECD (2004).

Table 1.8. Private rates of return associated with tertiary education

Country	Males	Females
Denmark	6.7	6.1
Finland	14.2	15.2
Spain	9.2	8.5
Sweden	8.8	7.3
United Kingdom	11.2	13.7
United States	11.0	7.9
EU5	**10.3**	**11.2**

Notes: Rates of return take taxes and employment probabilities into account. EU5 average is the population-weighted average of the five EU15 countries in the table. *Source:* OECD (2004).

Table 1.9. Employment Rates and educational attainment (2002)

Number of 25 to 64-year-olds in employment as a percentage of the population aged 25 to 64, by level of education attained and gender

		Pre-primary and primary education	Lower secondary education	Upper Secondary	Tertiary education		All levels of education
		ISCED0/1	ISCED 2	ISCED 3A	ISCED 5B	ISCED 5A and advanced research programmes (ISCED 6)	
		(1)	(2)	(3)	(4)	(5)	(6)
Austria	Males	x(2)	65	77	86	91	80
	Females	x(2)	48	66	81	85	64
Belgium	Males	49	74	83	87	88	77
	Females	25	45	65	79	82	57
Denmark	Males	a	73	84	88	92	83
	Females	a	52	71	86	84	74
Finland	Males	x(2)	61	77	84	89	76
	Females	x(2)	54	72	83	85	72
France	Males	57	77	83	88	86	79
	Females	43	56	71	80	80	64
Germany	Males	54	65	63	84	88	77
	Females	33	45	54	78	80	62
Greece	Males	75	84	83	81	88	81
	Females	36	42	45	73	76	47
Ireland	Males	64	86	89	91	91	84
	Females	30	47	63	80	84	60
Italy	Males	52	79	82	x(5)	88	77
	Females	18	39	61	x(5)	77	46
Netherlands	Males	63	82	91	91	91	84
	Females	35	50	74	80	82	64
Portugal	Males	82	88	85	84	93	84
	Females	60	77	80	78	90	67
Spain	Males	69	86	83	88	87	81
	Females	28	44	58	68	76	48
Sweden	Males	67	80	83	85	89	83
	Females	51	69	80	83	88	79
United Kingdom	Males	a	59	88	88	90	82
	Females	a	48	77	84	86	72
EU14	Males	**a**	**75**	**82**	**a**	**91**	**82**
	Females	**a**	**49**	**66**	**a**	**83**	**62**
United States	Males	67	69	80	86	89	82
	Females	39	49	68	77	79	69
Canada	Males	55	72	82	86	86	81
	Females	31	51	68	78	79	69

Notes: x indicates that data are included in another column. x(2) means that data are included in column 2, etc… *Source:* OECD Education at a Glance 2004, Table A1.1 and authors' calculations. a: not applicable.

Table 1.10. Unemployment ratio and educational attainment (2002)

Number of 25 to 64-year-olds who are unemployed as a percentage of the population aged 25 to 64, by level of education attained and gender

		Pre-primary and primary education	Lower secondary education	Upper Secondary	Post-secondary non-tertiary education	Tertiary education		All levels of education
				ISCED 3A		Type B	Type A and advanced research programmes	
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Austria	Males	x(2)	5,9	1,5	2,6	1,0	2,2	3,2
	Females	x(2)	2,9	2,7	1,5	1,0	2,4	2,5
Belgium	Males	6,7	5,3	3,6	5,9	2,6	3,1	4,5
	Females	4,5	6,0	4,8	4,6	2,8	3,9	4,6
Denmark	Males	a	3,5	1,4	7,2	3,5	3,2	3,1
	Females	a	4,6	2,9	4,7	2,5	4,8	3,2
Finland	Males	x(2)	8,0	7,4	a	4,8	3,1	6,5
	Females	x(2)	8,1	7,0	a	4,8	3,1	6,2
France	Males	6,0	9,8	6,0	a	5,0	4,8	5,8
	Females	5,4	9,4	6,0	a	3,9	4,8	6,4
Germany	Males	17,7	12,8	5,4	5,2	3,9	3,6	7,4
	Females	7,7	6,4	3,7	3,9	4,7	3,8	5,9
Greece	Males	3,4	5,6	4,4	5,9	4,6	3,6	4,3
	Females	3,9	8,8	7,8	12,6	8,4	7,0	6,6
Ireland	Males	5,6	4,0	2,8	1,7	2,3	1,9	3,3
	Females	1,7	2,5	2,0	2,3	1,4	1,1	1,9
Italy	Males	4,8	5,2	4,1	6,6	x(6)	3,3	4,5
	Females	3,2	6,1	5,6	10,5	x(6)	5,9	5,4
Netherlands	Males	2,8	2,4	1,6	1,7	1,1	1,9	1,9
	Females	2,1	2,2	2,1	2,7	1,7	2,0	2,1
Portugal	Males	3,0	3,6	3,5	x(3)	4,5	1,8	3,1
	Females	3,4	5,0	4,0	x(3)	2,8	4,8	3,8
Spain	Males	6,5	6,5	5,0	a	4,7	4,7	5,8
	Females	5,8	10,1	8,6	a	10,4	8,4	8,3
Sweden	Males	3,8	4,5	4,5	x(5)	3,3	3,2	4,0
	Females	4,4	3,9	3,3	x(5)	2,4	2,1	3,1
United Kingdom	Males	a	6,8	3,1	x(7)	2,6	2,5	3,8
	Females	a	3,2	2,4	x(7)	1,5	1,8	2,7
EU14	**Males**	**a**	**8**	**5**	**a**	**a**	**4**	**5**
	Females	**a**	**7**	**5**	**a**	**a**	**5**	**5**
United States	Males	6,9	7,9	5,3	x(3)	3,8	2,8	4,7
	Females	5,1	5,5	3,7	x(3)	2,5	2,1	3,3
Canada	Males	7,8	8,6	5,8	5,9	5,4	4,5	5,9
	Females	4,5	5,7	5,0	5,1	3,9	3,9	4,6

Notes: x(2) means that data are included in column 2, etc... *Source:* OECD Education at a Glance 2004, Table A1.1 and authors' calculations ; a : not applicable.

Table 1.11. Mobility experience in the last three years, 15-64 population, by reason and country

# obs. 152902		Primary reason for move			
Country	Mobility Rate	Job related	House related	Personal reason	Total
DK	0.237	0.1234	0.6219	0.2547	1
NL	0.201	0.1217	0.4457	0.4325	1
B	0.167	0.0659	0.6503	0.2838	1
F	0.214	0.1625	0.5704	0.2671	1
IRL	0.0647	0.056	0.6001	0.3438	1
I	0.0871	0.0869	0.3815	0.5316	1
EL	0.0752	0.0955	0.6744	0.2301	1
E	0.105	0.0877	0.5521	0.3603	1
P	0.101	0.0611	0.5953	0.3436	1
A	0.010	0.0978	0.5622	0.34	1
FIN	0.270	0.1534	0.5607	0.2859	1
L	0.282	na	na	na	1
D	0.206	0.0974	0.722	0.1806	1
UK	0.2054	0.1631	0.5855	0.2514	1
S	0.252	na	na	na	1
Total	0.162	0.1153	0.5723	0.3125	1

Notes: Sample 1995-2001, survey weights. Columns 2-4: repartition of the main reason for move, sum is 100%. The EU15 average is computed without Luxembourg and Sweden.

Table 1.12. Mobility experience in the last three years, by education

	Mobility rate, Any Reason	# obs.
All	0.145	750168
Primary	0.113	730422
Secondary	0.154	730422
Tertiary	0.205	730422
	Mobility rate, Job-related Reason	# obs.
All	0.083	58337
Primary	0.055	57093
Secondary	0.080	57093
Tertiary	0.110	57093

Notes: Samples. Any reason: all EU15 population 15-65, 1995-2001; job-related reason: active population, 15-65 of head of households, EU15 less Luxembourg and Sweden, 1995-2001. Survey weights.

Table 1.13. Summary of Internal Mobility and Immigration, USA and EU 1990-2000

Year	*Early 90's*			*2000*		
Variable	Total Labour force	% Labour Force Born outside Union	% Labour force living in a state (country) different from that of birth	Total Labour force	% Labour Force Born outside Union	% Labour force living in a state (country) different from that of birth
USA	124,772,500	9.3%	35.3%	138,733,660	12.4 %	35.6%
EU12	154,007,000	4.1%	2.5%	160,780,000	4.9%	2.5%
EU15	167,000,000	4.6%	2.2%	171,668,000	5.0%	2.6%

Table 2.1. Test scores in the adult population

					Sample			
Country	Target population (ages 16-65)		Natives (ages 16-65)			Natives & ages 25-64		
	Mean	SD	Mean	SD	Sample (% of target)	Mean	SD	Sample (% of target)
Belgium	277	55	279	53	96	275	55	65
Czech Republic	283	46	284	46	99	282	47	83
Denmark	289	40	289	40	98	289	41	80
Finland	288	48	289	47	98	285	47	78
Germany	285	42	287	41	92	286	42	79
Hungary	254	48	254	48	99	250	47	77
Ireland	263	57	262	57	94	258	59	73
Italy	244	60	244	61	97	238	62	81
Netherlands	286	44	288	42	94	286	42	82
Norway	294	45	296	42	93	295	42	73
Poland	229	64	230	64	98	225	65	77
Sweden	304	49	308	44	91	308	44	71
Switzerland	271	57	285	39	75	283	40	65
United Kingdom	267	62	270	58	95	270	59	80
United States	272	65	284	55	78	287	55	63
All Europe	266	54	268	52	95	266	52	79
EU9	271	52	273	51	95	271	51	80

Notes: Row headed All Europe reports the population-weighted average of all European (Western and Eastern) countries included in the table. Row headed EU9 reports the population-weighted average of the nine countries in the Western EU15. Columns headed "Sample" report the percent of the target population that remains after making the indicated sample exclusions.

Table 2.2. Changes in the "quality of education" (change in residual skills)

Each cell reports the annual change in residual skills relative to the standard deviation within country.

	Birth cohorts		
Country	1935-1950	1950-1960	1960-1970
Belgium	**0.4**	-0.2	**0.3**
	(2.9)	(1.7)	**(2.3)**
Czech Republic	-0.3	-0.1	**1.6**
	(1.5)	(0.5)	**(6.1)**
Denmark	0.0	0.0	-0.1
	(0.1)	(0.1)	(0.1)
Finland	0.6	-0.3	0.3
	(1.8)	(0.9)	(0.9)
Germany	0.0	-0.3	-0.2
	(0.3)	(1.8)	(1.3)
Hungary	-0.4	**1.1**	0.3
	(1.7)	**(4.7)**	(1.1)
Ireland	1.1	-0.3	**-0.8**
	(6.5)	(1.5)	**(4.8)**
Italy	0.3	**-0.9**	**0.4**
	(1.7)	**(4.7)**	**(2.2)**
Netherlands	**0.6**	0.1	-0.3
	(3.1)	(0.6)	(1.4)
Norway	**1.1**	-0.2	-0.1
	(4.9)	(1.0)	(0.6)
Poland	**0.9**	**-0.5**	0.3
	(4.2)	**(2.3)**	(1.6)
Sweden	**-0.8**	0.3	0.0
	(4.0)	(1.6)	(0.0)
Switzerland	-0.3	0.2	0.0
	(1.2)	(1.0)	(0.0)
United Kingdom	**1.2**	**-0.5**	0.0
	(10.0)	**(4.5)**	(0.2)
United States	**0.4**	-0.1	**-0.7**
	(2.7)	(0.4)	**(4.5)**
EU9	**0.8**	**-0.8**	0.0
	(5.3)	**(4.9)**	(0.1)
All European	**0.9**	**-0.8**	0.1
	(5.4)	**(4.6)**	(0.6)

Notes: Bold face numbers are significant at conventional levels (t-values in parentheses). "Residual skills" is estimated from a regression relating the cohort IALS score to a country fixed effect, a spline (with knots at 8, 10, and 12 years of education) in the cohort years of schooling, and two time period indicators equaling unity for cohorts born during the 1950s and 1960s respectively. EU9 and All Europe: see Table 2.1.

Table 2.3. Literacy test scores

Country	PISA 2003		Change in rank order*	
	Reading	Math	Reading 1991→2003	Math 1995→2003
Austria	491	506	NA	-4
Belgium	507	529	NA	-2
Czech Republic	489	516	NA	-3
Denmark	492	514	-2	7
Finland	543	544	0	NA
France	496	511	-5	-1
Germany	491	503	-2	0
Greece	472	445	-1	-1
Hungary	482	490	-6	-6
Ireland	515	503	11	-3
Italy	476	466	-3	NA
Netherlands	513	538	8	3
Norway	500	495	5	0
Poland	497	490	NA	NA
Portugal	478	466	-4	1
Spain	485	485	3	1
Sweden	514	509	0	1
Switzerland	499	527	-3	-1
United Kingdom[a]	517	532	NA	9
United States	495	483	-2	-1
EU14	**494**	**501**	**-1**	**2**
All Europe	**494**	**501**	**-1**	1

Notes: [a] Score refers to England. The 2003 score has been predicted using the PISA 2000 results on all three domains. * In calculating the change in rank order we have first ordered the countries from best to worst among the tabulated countries participating at both time points and then calculated the change from the base year to the last year. Positive numbers thus reflect improvements in the rank order. EU14 and All Europe: see Table 2.1. *Sources:* Elley (1992), OECD (2004b), and Beaton et al. (1996).

Table 2.4. Student/Teacher ratios in lowe r secondary schools, 2002 and 1992.

Country	2002	1992	Relative change (%)
Austria	9.8	7.7	27.3
Belgium*	13.1	13.7	-4.4
Czech Republic	14.4	17.0	-15.3
Denmark*	10.9	10.9	0.0
Finland*	15.8	19.0	-16.8
France*	19.4	20.4	-4.9
Germany	15.7	14.6	7.5
Greece	9.3	NA	NA
Hungary	10.7	11.6	-7.8
Ireland*	19.5	25.6	-23.8
Italy	9.9	9.0	10.0
Netherlands*	17.0	23.6	-28.0
Norway	10.3	8.5	21.2
Poland	14.1	NA	NA
Portugal	9.3	NA	NA
Spain	13.7	17.6	-22.2
Sweden	12.2	10.6	15.1
Switzerland	NA	NA	NA
United Kingdom	17.6	15.9	10.7
United States	15.5	16.8	-7.7
EU9	**14.9**	**15.5**	**0.8**
All Europe	**15.3**	**14.6**	**0.4**

Notes: * Numbers refer to the primary level. EU9 and All Europe: see Table 2.1. *Source:* OECD (2004a) and OECD (1995).

Table 2.5. Variations in Math skills across students and the share of the variance attributable to schools

	Variation across students (Coefficient of variation, percent)		Share of variance attributable to schools, percent	
Country	PISA 2003	Change (PISA 2003-TIMSS 1995)	PISA 2003	Change (PISA 2003-TIMSS 1995)
Austria	18.4	1.3	55.5	22.5
Belgium*	20.8	4.5	56.9	20.9
Czech Republic	18.6	1.9	50.5	28.5
Denmark	17.8	1.0	13.1	7.1
Finland	15.4	NA	3.9	NA
France	18.0	3.9	NA	NA
Germany	20.4	2.7	56.4	9.4
Greece	21.1	2.9	68.1	54.1
Hungary	19.1	1.8	66.0	49.0
Ireland	17.0	-0.7	13.4	-31.6
Italy	20.5	NA	56.8	NA
Netherlands	17.2	0.8	54.5	3.5
Norway	18.6	1.9	6.5	0.5
Poland	18.4	NA	12.0	NA
Portugal	18.9	4.8	30.3	14.3
Spain	18.1	3.2	17.2	1.2
Sweden	18.6	2.2	10.9	-0.1
Switzerland	18.7	2.5	36.4	-2.6
United States	19.7	1.5	27.1	-3.9
EU13	**19.2**	**2.9**	**45.5**	**7.6**
European average	**19.7**	**2.5**	**41.7**	**9.4**

Notes: * The measures of the variation in TIMSS pertain to the Flemish community in Belgium. EU13 and All Europe: see Table 2.1. Population-weighted averages. *Sources:* OECD (2004b) and Beaton et al (1996).

Table 2.6. Earnings regressions, pooled country/cohort data.

	All countries			EU		
	(1)	(2)	(3)	(4)	(5)	(6)
Years of education	.089	-.020	.101	-.090	.086	-.074
	(.022)	(.028)	(.017)	(.022)	(.024)	(.032)
IALS score	--	.013	--	.020	--	.017
		(.002)		(.002)		(.002)
Relative cohort size	-9.25	-9.46	.261	-6.11	2.02	-6.25
	(2.85)	(2.75)	(2.54)	(2.30)	(3.77)	(3.68)
Weighted by country size	No	No	Yes	Yes	Yes	Yes
# observations	540	540	540	540	324	324
R-squared	.835	.846	.879	.907	.823	.850

Notes: Standard errors in parentheses. All regressions include country and cohort fixed effects. Columns headed EU report population-weighted estimates for the nine EU15 countries included in the data.

Table 3.1. Sectoral composition of employment, OECD and Eastern Europe

	Agriculture (%)	Industry (%)	Service (%)
OECD (top third, 1991)	5.5	29.8	64.7
OECD (mid. third, 1991)	5.8	30.4	63.9
OECD (bottom third, 1991)	17.9	29.5	52.6
East Germany (1989)	10	44.1	45.9
Czechoslovakia	11.6	46.8	41.6
Hungary	17.5	36.1	46.4
Poland	27.2	36.3	36.4

Source: Boeri (2002), Roland (2001).

Table 3.2. Human capital specificity and mobility in Poland and Estonia

	Estonia	Poland
	Dep var: Log hourly wages	
More than one year before move (bm_2)	0.09	-0.03
	(3.31)**	(3.15)**
Less than one year before move (bm_1)	0.03	-0.05
	(1.61)	(6.11)**
Less than one year after move (am_1)	0.13	0.03
	(6.77)**	(3.51)**
More than one year after move (am_2)	0.14	0.01
	(6.50)**	(1.67)
Education dummies	Yes (unreported)	Yes (unreported)
Secgen*bm_2	-0.08	-0.06
	(2.27)*	(1.85)
Secgen*bm_1	-0.06	-0.07
	(2.78)**	(2.76)**
Secgen*am_1	-0.09	-0.02
	(3.92)**	(0.73)
Secgen*am_2	-0.08	-0.05
	(3.11)**	(2.02)*
Secvoc*bm_2	-0.04	-0.02
	(0.95)	(1.24)
Secvoc*bm_1	-0.04	-0.01
	(1.58)	(0.81)
Secvoc*am_1	-0.07	0.00
	(2.62)**	(0.14)
Secvoc*am_2	-0.10	0.02
	(3.14)**	(1.14)
Tertiary*(am, bm, etc…)	Yes (unreported)	Yes (unreported)
Number of observations	64577	254842
R-squared	0.32	0.29

Notes: z-statistics (in absolute value) in parentheses. * significant at 5% level; ** significant at 1% level. Random effects regressions. The regressions include a full set of time and geographical (county) dummies, a male dummy, age, tenure and their squares.

Table 4.1. Mobility rate in the last year and in the last three years, any reason, active 15-64 population, head of households, by unemployment status

	Mobility rate	# obs.
Last year		
Employed	0.065	218765
Unemployed	0.086	15369
Last three years		
Employed	0.178	218765
Unemployed	0.213	15369

Notes: EU15 less Luxembourg and Sweden, 1995-2001, survey weights.

Table 4.2. Mobility rate in the last year, any reason, occupied 15-64 population, head of households, by occupation

Grouped occupation	Mobility rate
Legislators, senior officials and managers	0.058
Professionals	0.079
Technicians and associate professionals	0.078
Clerks	0.065
Service workers, shop and market sale workers	0.071
Skilled agricultural and fishery worker	0.022
Craft and related trades workers	0.053
Plant and machine operators, assemblers	0.060
Elementary occupations	0.060
Total	0.063

Notes: EU15 less Luxembourg and Sweden, 1995-2001, survey weights.

Table 4.3. Mobility rate outside the area in the last three years, active 15-64 population, head of household, by country

Country	Any reason	Job-related reason
DK	0.054	0.020
NL	0.029	0.010
B	0.013	0.003
F	0.042	0.025
IRL	0.01	0.003
I	0.011	0.005
EL	0.008	0.006
E	0.009	0.005
P	0.007	0.001
A	0.015	0.006
FIN	0.058	0.024
D	0.021	0.008
UK	0.072	0.027
Total	0.025	0.011

Notes: EU15 less Luxembourg and Sweden, 1995-2001, survey weights.

Table 4.4. Mobility rate outside the area, active 15-64 population, head of household, by education level

Education	Mobility rate
Primary	0.014
Secondary	0.023
Tertiary	0.045
Total	0.024

Notes: EU15 less Luxembourg and Sweden, 1995-2001, survey weights

Table 4.5. Mobility in the last three years, by reason and distance, heads of households

	# obs.	Percent	Cum.
0 No move	434,247	79.44	79.44
11 Job-related move, same area	3,650	0.67	80.10
12 Job-related move, other area	4,517	0.83	80.93
21 House-related move, same area	32,072	5.87	86.80
22 House-related move, other area	3,271	0.60	87.40
31 Personal reason move, same are	19,547	3.58	90.97
32 Personal reason move, other ar	3,401	0.62	91.59
0 Missing	45,955	8.41	100.00
Total	546,66	100.00	

Notes: EU15 less Luxembourg and Sweden, 1995-2001, survey weights.

Table 4.6. Multinomial models of mobility. 3 level-mlogit

With and without control for unemployment status, with and without control for total net (PPP adjusted) household income and with occupation and industry dummies. Columns 1-3: first model ; columns 4-6: second model ; columns 7-9: third model ; columns 10 -12: fourth model. Relative Risk Ratios.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	1	2	3	1	2	3	1	2	3	1	2	3
Reason	Job	House	Perso	Job	House	Perso	Job	House	Perso	Job	House	Perso
Sex	0.730	0.900	0.863	0.738	0.904	0.862	0.740	0.913	0.861	0.763	0.865	0.868
	(0.042)**	(0.026)**	(0.032)**	(0.043)**	(0.026)**	(0.032)**	(0.043)**	(0.026)**	(0.032)**	(0.051)**	(0.029)**	(0.037)**
AgeD1	2.796	1.629	2.304	2.843	1.643	2.302	2.927	1.700	2.278	3.390	1.768	2.466
	(0.228)**	(0.092)**	(0.130)**	(0.232)**	(0.093)**	(0.130)**	(0.243)**	(0.097)**	(0.130)**	(0.309)**	(0.111)**	(0.155)**
AgeD3	0.301	0.296	0.238	0.301	0.296	0.238	0.297	0.292	0.238	0.293	0.297	0.230
	(0.016)**	(0.008)**	(0.008)**	(0.016)**	(0.008)**	(0.008)**	(0.016)**	(0.007)**	(0.008)**	(0.017)**	(0.008)**	(0.008)**
AgeD4	0.103	0.119	0.112	0.105	0.120	0.111	0.102	0.117	0.112	0.092	0.123	0.106
	(0.012)**	(0.006)**	(0.007)**	(0.013)**	(0.006)**	(0.007)**	(0.012)**	(0.006)**	(0.007)**	(0.012)**	(0.007)**	(0.008)**
Educ	**1.080**	**1.035**	**1.020**	**1.078**	**1.035**	**1.020**	**1.076**	**1.031**	**1.020**	**1.044**	**1.028**	**1.021**
	(0.005)**	**(0.003)****	**(0.003)****	**(0.005)****	**(0.003)****	**(0.003)****	**(0.005)****	**(0.003)****	**(0.003)****	**(0.006)****	**(0.003)****	**(0.004)****
Burden	0.886	0.754	0.786	0.871	0.750	0.788	0.873	0.742	0.787	0.826	0.731	0.777
	(0.027)**	(0.011)**	(0.016)**	(0.027)**	(0.011)**	(0.016)**	(0.027)**	(0.011)**	(0.016)**	(0.028)**	(0.012)**	(0.017)**
Unemp.				0.618	0.870	1.046						
				(0.060)**	(0.037)**	(0.052)						
Log. Inc.							1.146	1.166	0.974			
							(0.056)**	(0.026)**	(0.022)			
HSize D.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year D.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ctry D.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind. D.	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes
Occ. D.	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes
Obs.	200091	200091	200091	200091	200091	200091	199426	199426	199426	171646	171646	171646
Pseudo Rsq:		13.70			13.69			13.69			14.51	

Notes: EU15 less Luxembourg and Sweden, 1995-2001; dependent variable: 0 if no recent move, 1 if job-related move, 2 if house-related move, 3 if personal reason move Robust to clustering standard errors in parentheses, * significant at 5% level; ** significant at 1% level ; AgeD1 = 16-24 y.o. ; AgeD2 (ref.) = 25-34 y.o. ; AgeD3 = 35-54 y.o. ; AgeD4 = 54-65 y.o. ; Burden = 1 (Shelter costs represent a heavy burden) ; 2 (some burden) or 3 (not a burden) ; Unemp=1 if unemployed, 0 otherwise Outcome (No mobility) is the comparison group. HSizeD : dummy variable for household size (1, 2 …, 5 & 6+).

Table 4.7. Multinomial models of mobility. 6 level-mlogit

Benchmark specification. Columns 1-6: Coefficients; columns 7-12: Relative Risk Ratios.

Reason	Job	Job	House	House	Perso	Perso	Job	Job	House	House	Perso	Perso
Place	Same area	Outside	Same area	Outside	Same area	Outside	Same area	Outside	Same area	Outside	Same area	Outside
Sex	-0.196	-0.403	-0.110	-0.172	-0.168	0.085	0.822	0.668	0.896	0.842	0.845	1.089
	(0.090)*	(0.079)**	(0.032)**	(0.091)	(0.043)**	(0.082)	(0.074)*	(0.053)**	(0.028)**	(0.077)	(0.036)**	(0.090)
AgeD1	0.953	1.053	0.436	0.506	0.713	0.790	2.594	2.865	1.547	1.658	2.041	2.204
	(0.132)**	(0.113)**	(0.062)**	(0.153)**	(0.065)**	(0.128)**	(0.342)**	(0.324)**	(0.096)**	(0.254)**	(0.133)**	(0.282)**
AgeD3	-1.120	-1.297	-1.183	-1.678	-1.431	-1.434	0.326	0.273	0.306	0.187	0.239	0.238
	(0.080)**	(0.072)**	(0.028)**	(0.084)**	(0.037)**	(0.083)**	(0.026)**	(0.020)**	(0.008)**	(0.016)**	(0.009)**	(0.020)**
AgeD4	-2.073	-2.393	-2.108	-2.583	-2.196	-1.813	0.126	0.091	0.121	0.076	0.111	0.163
	(0.178)**	(0.176)**	(0.060)**	(0.178)**	(0.073)**	(0.154)**	(0.022)**	(0.016)**	(0.007)**	(0.013)**	(0.008)**	(0.025)**
Educ	**0.048**	**0.134**	**0.036**	**0.072**	**0.011**	**0.041**	**1.049**	**1.144**	**1.037**	**1.075**	**1.011**	**1.042**
	(0.010)**	**(0.008)****	**(0.003)****	**(0.011)****	**(0.005)***	**(0.010)****	**(0.010)****	**(0.009)****	**(0.004)****	**(0.011)****	**(0.005)***	**(0.011)****
Burden	-0.114	-0.119	-0.280	-0.285	-0.260	-0.131	0.892	0.888	0.755	0.752	0.771	0.877
	(0.047)*	(0.042)**	(0.016)**	(0.051)**	(0.022)**	(0.049)**	(0.042)*	(0.037)**	(0.012)**	(0.038)**	(0.017)**	(0.043)**
HSize D.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year D.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ctry D.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind. D.	No	No	No	No	No	No	No	No	No	No	No	No
Occ. D.	No	No	No	No	No	No	No	No	No	No	No	No
Obs.	196158	196158	196158	196158	196158	196158	196158	196158	196158	196158	196158	196158
Pseudo-Rsq	13.70											

Additional specifications: with and without control for total net (PPP adjusted) household income and with and without occupation and industry dummies. Columns 1-6: first model (Relative Risk Ratios) ; columns 7-12: second model (Relative Risk Ratios).

Reason	Job	Job	House	House	Perso	Perso	Job	Job	House	House	Perso	Perso
Place	Same area	Outside	Same area	Outside	Same area	Outside	Same area	Outside	Same area	Outside	Same area	Outside
Sex	0.831	0.686	0.911	0.891	0.843	1.101	0.895	0.662	0.851	0.804	0.833	1.171
	(0.076)*	(0.054)**	(0.029)**	(0.081)	(0.036)**	(0.091)	(0.093)	(0.060)**	(0.032)**	(0.090)	(0.041)**	(0.114)
AgeD1	2.617	3.143	1.614	1.932	2.031	2.224	2.746	3.726	1.657	2.073	2.173	2.438
	(0.352)**	(0.359)**	(0.100)**	(0.297)**	(0.134)**	(0.288)**	(0.401)**	(0.487)**	(0.114)**	(0.338)**	(0.158)**	(0.350)**
AgeD3	0.325	0.266	0.301	0.179	0.240	0.238	0.306	0.276	0.308	0.179	0.233	0.217
	(0.026)**	(0.019)**	(0.008)**	(0.015)**	(0.009)**	(0.020)**	(0.026)**	(0.022)**	(0.009)**	(0.016)**	(0.009)**	(0.019)**
AgeD4	0.126	0.089	0.119	0.073	0.112	0.163	0.111	0.080	0.127	0.075	0.105	0.158
	(0.022)**	(0.016)**	(0.007)**	(0.013)**	(0.008)**	(0.025)**	(0.022)**	(0.016)**	(0.008)**	(0.015)**	(0.009)**	(0.026)**
Educ	**1.047**	**1.133**	**1.030**	**1.059**	**1.011**	**1.039**	**1.026**	**1.077**	**1.026**	**1.031**	**1.011**	**1.023**
	(0.010)**	**(0.009)****	**(0.004)****	**(0.012)****	**(0.005)***	**(0.011)****	**(0.012)***	**(0.011)****	**(0.004)****	**(0.013)***	**(0.006)***	**(0.013)**
Burden	0.888	0.861	0.741	0.712	0.770	0.874	0.844	0.812	0.730	0.727	0.765	0.842
	(0.042)*	(0.037)**	(0.012)**	(0.037)**	(0.017)**	(0.043)**	(0.043)**	(0.038)**	(0.013)**	(0.043)**	(0.019)**	(0.047)**
log. Inc.	1.055	1.326	1.188	1.668	0.988	1.054						
	(0.078)	(0.093)**	(0.028)**	(0.146)**	(0.025)	(0.073)						
HSize D.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year D.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ctry D.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind. D.	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Occ. D.	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	195498	195498	195498	195498	195498	195498	168416	168416	168416	168416	168416	168416

Notes: EU15 less Luxembourg and Sweden, 1995-2001; dependent variable: 0 if no recent move, 11 if job-related move in the same area, 12 if job-related move in another area, 21 if house-related move in the same area, 22 if house-related move in another area, 31 if personal reason move in the same area 31 and 32 if personal reason move in another area ; robust to clustering standard errors in parentheses, * significant at 5% level; ** significant at 1% level ; AgeD1 = 16-24 y.o. ; AgeD2 (ref.) = 25-34 y.o. ; AgeD3 = 35-54 y.o. ; AgeD4 = 54-65 y.o. ; Burden = 1 (Shelter costs represent a heavy burden) ; 2 (some burden) or 3 (not a burden) ; Outcome (No mobility) is the comparison group. HSizeD: dummy variable for household size (1, 2 …, 5 & 6+).

Table 4.8. Probit model of household job-related mobility and income model

	(1) Model of Mobility Reduced form	(2) Model of Mobility Semi-struct.	(3) Model of Income, Stayers Only	(4) Model of Income, Movers only
Imputed Income Growth	-	**0.108 (0.034)****	-	-
Inv. Mills Ratio	-	-	**2.956 (0.100)****	**0.552 (0.075)****
Sex	-0.081 (0.026)**	-0.049 (0.036)	-0.082 (0.006)**	-0.108 (0.045)*
AgeD1	0.392 (0.041)**	0.267 (0.079)**		
AgeD3	-0.341 (0.024)**	-0.310 (0.033)**		
AgeD4	-0.695 (0.052)**	-0.702 (0.069)**		
Educ	**0.033 (0.003)****	**0.030 (0.004)****	**0.053 (0.001)****	**0.057 (0.005)****
Burden	-0.014 (0.016)	-0.035 (0.021)	-	
hhszD2	-0.002 (0.032)	-0.074 (0.045)	0.465 (0.010)**	0.621 (0.055)**
hhszD3	-0.131 (0.035)**	-0.167 (0.047)**	0.563 (0.010)**	0.610 (0.062)**
hhszD4	-0.199 (0.037)**	-0.204 (0.048)**	0.609 (0.010)**	0.517 (0.074)**
hhszD5	-0.121 (0.048)*	-0.116 (0.061)	0.666 (0.011)**	0.560 (0.076)**
hhszD6	-0.181 (0.075)*	-0.160 (0.092)	0.767 (0.014)**	0.687 (0.086)**
htenD2	0.505 (0.025)**	0.450 (0.033)**	-	-
marD2	-	-	-0.209 (0.020)**	0.029 (0.130)
marD3	-	-	-0.142 (0.010)**	-0.293 (0.078)**
marD4	-	-	-0.061 (0.016)**	-0.443 (0.167)**
marD5	-	-	-0.008 (0.007)	-0.108 (0.047)*
potexp	-	-	0.014 (0.001)**	0.048 (0.009)**
potexpsq	-	-	-0.000 (0.000)**	-0.001 (0.000)**
year D.	Yes	Yes	Yes	Yes
Ctry D.	Yes	Yes	Yes	Yes
Observations	201397	148787	199022	1597
R-squared			0.9	0.9

Notes: EU15 less Luxembourg and Sweden, 1995-2001; robust (to clustering) standard errors in parentheses, * significant at 5% level; ** significant at 1% level ; NB, there is no correction of s.e. for the two-stage procedure ; AgeD1 = 16-24 y.o. ; AgeD2 (ref.) = 25-34 y.o. ; AgeD3 = 35-54 y.o. ; AgeD4 = 54-65 y.o.; Burden = 1 (Shelter costs represent a heavy burden) ; 2 (some burden) or 3 (not a burden) ; Outcome (No mobility or mobility for non-job reason) is the compariso n group of probit analysis. hhSizeDn takes value 1 if household size is n if n<6 ; hhSizeD6 takes value 1 if household size is >=6 ; marital status variables: reference = married. Rent = 1 if dwelling rented in the private sector. Reference is owner.

Table 5.1. A taxonomy of mismatch in Europe

	FORMAL TRAINING OR EDUCATION THAT HAS GIVEN YOU SKILLS NEEDED FOR YOUR PRESENT TYPE OF WORK?		*TOTAL*
	Yes	No	
NON OVER-QUALIFIED (%)	69,097.32 (21.2)	59,404.03 (24.7)	128,501.30 (45.9)
OVER-QUALIFIED (%)	92,269.88 (33.0)	58,883.78 (21.1)	151,153.70 (54.1)
TOTAL (%)	161,367.20 (57.7)	118,287.80 (42.3)	279,655 (100)

Table 5.2. The determinants of over-qualification: Marginal effects from Probit Analysis

	(1) Germany	(2) UK	(3) France	(4) Italy	(5) Spain	(6) All
marry	-0.006	0.004	0.018	0.020	0.021	0.012
	(0.32)	(0.20)	(1.14)	(1.38)	(1.76)	(1.67)
sex	-0.116	-0.090	-0.136	-0.074	-0.033	-0.081
	(5.75)**	(4.84)**	(8.58)**	(5.42)**	(2.70)**	(11.51)**
hhsize	-0.004	-0.001	-0.009	-0.001	-0.000	-0.002
	(0.59)	(0.18)	(1.75)	(0.21)	(0.05)	(1.01)
yeduc	0.003	0.017	0.021	0.024	0.025	0.021
	(1.37)	(5.65)**	(7.70)**	(10.80)**	(13.74)**	(20.26)**
exper	-0.004	-0.002	-0.004	-0.003	-0.005	-0.004
	(4.69)**	(2.96)**	(4.10)**	(4.37)**	(9.41)**	(12.36)**
tend2	0.006	-0.016	0.020	-0.039	-0.010	-0.017
	(0.30)	(0.81)	(1.29)	(2.68)**	(0.81)	(2.33)*
tend3	0.046	-0.009	-0.004	-0.010	0.002	-0.006
	(1.85)	(0.39)	(0.20)	(0.52)	(0.13)	(0.73)
tend4	0.004	-0.029	-0.020	-0.059	-0.037	-0.037
	(0.17)	(1.17)	(1.07)	(3.43)**	(2.45)*	(4.21)**
unem	0.062	0.072	-0.004	-0.031	0.022	0.012
	(2.29)*	(2.81)**	(0.15)	(1.18)	(1.34)	(1.15)
nunem	-0.034	-0.007	0.044	-0.001	0.007	0.003
	(0.76)	(0.18)	(1.33)	(0.03)	(0.41)	(0.21)
lunem	0.063	-0.041	0.006	0.036	0.025	0.020
	(1.28)	(0.90)	(0.16)	(1.30)	(1.53)	(1.63)
Dummy France						-0.073
						(6.24)**
Dummy UK						0.074
						(5.61)**
Dummy Italy						-0.114
						(9.92)**
Dummy Spain						-0.053
						(4.67)**
Sectoral Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Occupation Dummmy	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummmy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10474	7960	20343	31424	31556	101757

Notes: Robust (to individual clustering) z-statistics (in absolute value) in parentheses. * significant at 5% level; ** significant at 1% level

Table 5.3. The determinants of skill mismatch. Multinomial Logit Analysis. Pooled Country Sample

	Coefficients			Relative Risk Ratios		
	(1)	(2)	(3)	(4)	(5)	(6)
	NOBM	OWM	OBM	NOBM	OWM	OBM
marry	-0.124	-0.009	-0.034	0.883	0.991	0.967
	(2.94)**	(0.23)	(0.76)	(2.94)**	(0.23)	(0.76)
sex	0.006	-0.381	-0.260	1.006	0.683	0.771
	(0.14)	(10.36)**	(6.09)**	(0.14)	(10.36)**	(6.09)**
hhsize	0.056	0.003	0.042	1.057	1.003	1.042
	(4.00)**	(0.20)	(2.49)*	(4.00)**	(0.20)	(2.49)*
yeduc	-0.186	0.048	-0.048	0.830	1.049	0.953
	(26.56)**	(9.47)**	(7.48)**	(26.56)**	(9.47)**	(7.48)**
exper	0.006	-0.017	-0.009	1.006	0.983	0.991
	(3.06)**	(8.54)**	(4.21)**	(3.06)**	(8.54)**	(4.21)**
tend2	-0.009	-0.024	-0.128	0.991	0.976	0.880
	(0.19)	(0.56)	(2.71)**	(0.19)	(0.56)	(2.71)**
tend3	0.014	0.085	-0.131	1.015	1.088	0.877
	(0.26)	(1.69)	(2.38)*	(0.26)	(1.69)	(2.38)*
tend4	-0.202	-0.080	-0.471	0.817	0.923	0.625
	(3.85)**	(1.64)	(8.69)**	(3.85)**	(1.64)	(8.69)**
unem	0.157	0.066	0.182	1.170	1.068	1.199
	(2.43)*	(1.11)	(2.76)**	(2.43)*	(1.11)	(2.76)**
nunem	0.077	0.049	0.091	1.080	1.050	1.095
	(1.02)	(0.66)	(1.17)	(1.02)	(0.66)	(1.17)
lunem	0.117	0.087	0.210	1.124	1.091	1.234
	(1.52)	(1.15)	(2.63)**	(1.52)	(1.15)	(2.63)**
Dummy France	0.974	-0.209	0.411	2.649	0.811	1.509
	(12.91)**	(3.67)**	(6.16)**	(12.91)**	(3.67)**	(6.16)**
Dummy UK	0.865	0.508	0.687	2.375	1.661	1.988
	(9.62)**	(7.45)**	(8.74)**	(9.62)**	(7.45)**	(8.74)**
Dummy Italy	1.986	-0.206	1.235	7.288	0.814	3.438
	(26.29)**	(3.43)**	(18.34)**	(26.29)**	(3.43)**	(18.34)**
Dummy Spain	0.584	-0.074	0.019	1.794	0.929	1.019
	(7.79)**	(1.31)	(0.29)	(7.79)**	(1.31)	(0.29)
Constant	1.366	0.346	0.326			
	(6.39)**	(1.74)	(1.50)			
Sectoral Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Occupation Du.	Yes	Yes	Yes	Yes	Yes	Yes
Time Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	99535	99535	99535	99535	99535	99535

Notes: Robust (to individual clustering) *z*-statistics (in absolute value) in parentheses. * significant at 5% level; ** significant at 1% level

Table 5.4. Over-qualification and wages

	(1) Germany	(2) UK	(3) France	(4) Italy	(5) Spain	(6) All
			OLS Regressions			
Over-qualified	-0.015	0.017	0.002	-0.008	-0.032	-0.010
	(1.35)	(1.36)	(0.23)	(1.44)	(4.56)**	(2.75)**
Observations	10614	8160	20781	32123	31164	102842
R-squared	0.31	0.32	0.36	0.42	0.45	0.41

Notes: Robust (to individual clustering) z-statistics (in absolute value) in parentheses in the OLS regressions. * significant at 5% level; ** significant at 1% level. The regressions include a full set of time and country dummies (column 6), male, married and household size dummies, experience and its square, and three dummies of unemployment experience during the last 5 years: ever unemployed, unemployed more than once and unemployed for more than 1 year.

Table 5.5. Skill mismatch and wages

	(1) Germany	(2) UK	(3) France	(4) Italy	(5) Spain	(6) All
			OLS Regressions			
NOBM	-0.097	-0.165	-0.087	-0.101	-0.118	-0.112
	(4.54)**	(8.07)**	(8.61)**	(11.34)**	(11.93)**	(21.36)**
OWM	-0.012	-0.011	-0.001	-0.029	-0.045	-0.022
	(0.97)	(0.63)	(0.11)	(2.83)**	(4.75)**	(4.24)**
OBM	-0.110	-0.149	-0.089	-0.106	-0.149	-0.121
R-squared	0.32	0.35	0.37	0.44	0.46	0.42
			Random Effect Regressions			
NOBM	-0.040	-0.090	-0.020	-0.033	-0.040	-0.033
	(3.70)**	(6.57)**	(4.42)**	(8.69)**	(8.93)**	(14.17)**
OWM	-0.022	-0.013	0.003	-0.009	-0.011	-0.005
	(2.46)*	(1.11)	(0.71)	(2.30)*	(2.87)**	(2.29)*
OBM	-0.071	-0.086	-0.015	-0.030	-0.050	-0.035
	(6.87)**	(6.53)**	(3.12)**	(7.55)**	(10.79)**	(14.58)**
Observations	10520	6112	20775	32091	31128	100626
R-squared	0.31	0.33	0.30	0.40	0.42	0.38

Notes: Robust (to individual clustering) z-statistics (in absolute value) in parentheses in the OLS regressions. * significant at 5% level; ** significant at 1% level. The regressions include a full set of time and country dummies (column 6), male, married and household size dummies, experience and its square, and three dummies of unemployment experience during the last 5 years: ever unemployed, unemployed more than once and unemployed for more than 1 year.

Table 5.6. Percentage of under/over educated workers by year

	Mean-based		Mode-based	
year	Under	Over	Under	Over
1997	0.158	0.116	0.147	0.130
1998	0.148	0.119	0.140	0.134
1999	0.136	0.121	0.130	0.139
2000	0.126	0.125	0.116	0.139
2001	0 .118	0.137	0.110	0.141
2002	0.113	0.149	0.108	0.153
2003	0.104	0.158	0.095	0.153
total	0.130	0.131	0.122	0.140

Table 5.7 Coefficient on the over/under education variables of an augmented standard Mincer equation

	Mean based	Mode based
Year of education ?	0.071	0.072
	(86.76)**	(57.25)**
over educated t	-0.083	-0.087
	(19.09)**	(16.85)**
under educated ?	0.107	0.147
	(19.41)**	(17.26)**

Notes: Robust (to individual clustering) z-statistics (in absolute value) in parentheses in the OLS regressions. * significant at 5% level; ** significant at 1% level. The regressions also include a full set of regions, sectors and firm size dummies, male, married, disable, head of household, on the job training, vocational education and public firm dummies, tenure and its square, age and its square.

Table 5.8. Coefficient on the over/under education variables of equation (5.1)

	Mean based	Mode based
Years adequate educ ß	0.068	0.071
	(101.18)**	(62.37)**
years over educ. ?	0.004	0.026
	(1.14)	(10.21)**
Years under educ d	-0.007	-0.034
	(2.51)**	(21.90)**

Notes: Robust (to individual clustering) z-statistics (in absolute value) in parentheses in the OLS regressions. * significant at 5% level; ** significant at 1% level. The regressions also include a full set of region, sector and firm size dummies, male, married, disable, head of household, on the job training, vocational education and public firm dummies, tenure and its square, age and its square.

Table 5.9. Occupational /career mobility and education mismatch. Extract of education coefficients.

	Mean based	Mode based	Mean based	Mode based
	Occ. Mobility		**Career mobility**	
Over educated	0.012	0.009	0.011	0.013
	(6.74)**	(4.43)**	(9.96)	(12.06)**
Under educated	0.022	0.028	0.001	-0.004
	(10.69)**	(10.04)**	(1.37)	(-6.03)**

Table 6.1. Foreign Born Residents of the EU, 1992-1999

Year	*1992*			*1996*			*1999*		
Variable	Total Labour Force[a]	% workers Born outside EU15	% Population Born outside EU15	Total Labour Force[a]	% workers Born outside EU15	% Population Born outside EU15	Total Labour Force[a]	% workers Born outside EU15	% Population Born outside EU15
EU12	154,007	4.1%	3.9%	156,338	4.7%	4.4%	160,780	4.9%	4.7%
EU15	na	na	na	167,000	4.8%	4.6%	171,668	5.0%	4.8%
France	24,525	7.1%	7.2%	25,335	8.2%	8.2%	25,875	8.2%	8.3%
Spain	15,141	1.1%	1.0%	15,872	1.4%	1.1%	16,339	1.8%	1.4%
UK	28,556	5.4%	5.5%	28,514	5.3%	5.4%	29,127	5.7%	6.1%
Germany[b]	38,994	5.1%	4.7%	39,082	6.1%	5.8%	39,595	6.1%	5.8%
Italy[b]	22,769	0.6%	0.6%	22,787	0.3%	0.2%	23,346	0.8%	0.6%

Notes:
a. In thousands
b. Data on place of birth are not available, therefore statistics are based on nationality of residents.
Source: Author's Calculation using the Extract of the European Labour Force Survey, (1992-1999) produced by Eurostat for Angrist and Kugler (2003).

Table 6.2. Foreign Born Residents of the USA, 1990, 2000

Year	*1990*			*2000*		
Variable	Total Labour Force	% Labour force Born outside USA	% Population Born outside USA	Total Labour Force	% Labour force Born outside USA	% Population Born outside USA
USA[a]	124,772,500	9.3%	7.9%	138,733,660	12.4%	11.0%
California	15,237,296	25.4%	21.7%	15,984,433	28.0%	26%
New York	8,969,551	18.2%	15.9%	9,037,552	23.1%	19.9%
Texas	8,270,447	10.5%	8.9%	9,929,292	15.7%	13.9%
Florida	6,269,753	15.1%	12.8%	7,469,356	19.2%	16.5%
Illinois	5,720,396	10.5%	8.4%	6,189,302	14.2%	12.4%

Notes:
a. In thousands
Source: Author's Calculation on IPUMS 1990 and 2000, Minnesota Population Center, http://www.ipums.org

Table 6.3. Internal Mobility in the EU

Year	1992		1996		1999	
	Labour Force	Population	Labour Force	Population	Labour Force	Population
EU12	2.2%	2.1%	2.2%	2.1%	2.5%	2.4%
EU15	n.a.	n.a.	2.2%	2.0%	2.6%	2.4%
France	3.8%	3.9%	3.7%	3.7%	3.5%	3.6%
Spain	0.8%	0.7%	0.9%	0.8%	1.0%	0.9%
UK	2.2%	2.4%	2.1%	2.3%	2.2%	2.5%
Germany[a]	2.8%	2.4%	2.8%	2.3%	2.7%	2.2%
Italy[a]	0.2%	0.2%	0.1%	0.1%	0.2%	0.1%

Notes:

a. The Data on place of birth are not available, therefore statistics are based on nationality of residents.

The number in each cell represents the percentage of EU-born labour force/population born in a EU country different from the country of Residence. The first two rows reports the average for the whole Union (EU12 or EU15) and each of the following lines reports the percentage of residents (labour force) of the specific country who were born in a different country of the EU.

Table 6.4. Internal Mobility in the USA

Year:	*1990*		*2000*	
	Labour Force	Population	Labour Force	Population
USA	35.3%	32.1%	33.6%	29.2%
California	36.2%	30.6%	28%	23.7%
New York	17.8%	16.6%	16.1%	14.5%
Texas	32.4%	26.1%	30.4%	24.1%
Florida	61.1%	56.6%	55.6%	50.6%
Illinois	25.7%	22.5%	23%	20.7%

Notes: the number in each cell represents the percentage of US-born labour force/population born in a US state different from the state of Residence. The first row reports the average for the whole US and each of the following lines reports the percentage of residents (labour force) of the specific state who were born in a different state.

Table 6.5. Skill Distribution of Immigrants, 1990-2000

	Beginning of Nineties[a] (1990-1992)				*End of Nineties[b] (1999-2000)*			
	Overall	HSD	HSG	COG	Overall	HSD	HSG	COG
USA	9.3%	18.6%	6.1%	9.4%	12.4%	26%	8.6%	12.5%
EU12	4.1%	4.1%	3.1%	4.9%	4.9%	5.1%	3.5%	5.3%
California	25.4%	55%	17.2%	19%	28%	57%	21%	25%
New York	18.2%	32%	14.7%	15.4%	23.1%	42%	18.5%	19%
Texas	10.5%	25.5%	5.8%	7.7%	15.7%	38%	9%	12.5%
France	7.1%	6.9%	6.5%	9.3%	8.2%	9.7%	5.9%	9.1%
Germany	5.1%	8.9%	2.8%	2.7%	6.1%	11%	3.5%	3.5%
UK	5.4%	6.8%	3.8%	8.2%	5.7%	7.2%	3.3%	7.3%

Notes:
a: The data are relative to year 1992 for the EU countries and to 1990 for the USA.
b: The data are relative to year 1999 for the EU countries and to year 2000 for the US.
HSD: High school Dropouts, for EU data these are worker with only a primary school degree, HSG: high School Graduates, for EU data these are workers with a secondary school degree, COG: College Graduates, for EU data, these are workers with a tertiary school degree. *Sources:* for US, our calculations using the 1990 and 2000 IPUMS data from the U.S. bureau of Census. For Europe our calculations using ELFS data.

Table 6.6. Wage differentials of foreign High Skilled Workers relative to US-born, 2000

Origin	*College Graduates*		*Post-Graduate Degrees*		*Young Post-Graduates Degrees*		*Post-Graduate Degree working in Engineering, Science, Management*	
	Weekly Wage	Yearly Wage	Weekly Wage	Yearly Wage	Weekly Wage	Yearly Wage	Weekly Wage	Yearly Wage
EU15 Born	0.17	0.19	0.17	0.18	0.16	0.17	0.18	0.19
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Canada-Born	0.19	0.20	0.20	0.21	0.20	0.22	0.18	0.17
	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
India-Born	0.08	0.074	0.12	0.15	0.13	0.16	0.12	0.11
	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)
China-Born	0.07	0.05	0.05	0.06	0.04	0.06	-0.01	0.01
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Observations	307,103	307,103	108,933	108,933	55,632	55,632	36,825	36,825

Notes: The estimates are from individual regressions on IPUMS, Census 2000 data. The dependent variable is ln(wage) (using weekly or yearly wages). Each column is a separate regression. Each regression includes 5-years experience dummies, gender dummy, race dummy and marital status dummies. The reported value is the coefficient on a dummy that identifies the country of birth. Standard errors are reported in parenthesis.

Table 6.7. Impact of wage level, wage dispersion and R&D spending in attracting high skilled

Dependent Variable:	*1 Foreign-Born Ph.D.*	*2 US-born Ph.D*	*3 Foreign - born College Graduates*	*4 US-born College Graduates*
Initial log of R&D	0.04*	0.22*	0.01*	0.21*
Stock	(0.01)	(0.05)	(0.005)	(0.05)
Initial log of Skill	-0.06*	-0.79*	-0.02*	-0.54*
Level	(0.01)	(0.10)	(0.01)	(0.07)
Log of Median	0.12*	0.44	0.18*	0.14
Yearly Wage	(0.05)	(0.52)	(0.04)	(0.30)
Yearly Wage	0.20	1.20	0.27*	0.58
Dispersion	(0.11)	(1.10)	(0.11)	(0.80)
State fixed effect	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes
R^2	0.20	0.33	0.13	0.34
Observations	150	150	150	150

Notes: Period 1970-2000. Panel, 3 decades, 50 US states. Dependent Variable is the change in skilled workers during the decade as percentage of the initial size of employment in that skill group. The explanatory variables are all measured at the beginning of the period. *= Significant at 5% level. Huber-White robust standard errors. Sources: Data on wages and education are from the US census IPUMS 1970-2000, data on R&D for each decade and in each state are from the National Science Foundation/Division of Science Resources Studies, Survey of Industrial Research and Development: 1998. Foreign-born are defined as those workers who were born outside the US and without US citizenship at birth.

Table 6.8. Impact of High Skills on Innovation

Dependent variable	*1 Patent Count*	*2 Patent Count adjusted for quality*	*3 Patent Count*	*4 Patent Count adjusted for quality*
log of R&D Stock	0.16*	0.17*	0.17*	0.14*
	(0.07)	(0.08)	(0.07)	(0.07)
Log of Ph.D.	0.16*	0.14*		
	(0.06)	(0.06)		
Log of US born Ph.D.			0.06	0.04
			(0.06)	(0.05)
Log of Foreign born Ph.D.			0.08	0.08*
			(0.05)	(0.04)
State Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes
R^2	0.98	0.98	0.98	0.98
Observations	150	150	150	150

Notes: Period 1970-2000 Panel, 3 decades 51 U.S. states. Column 1 and 3: dependent variable is average yearly count of patent granted during each decade. Column 2 and 4: dependent variable is average yearly count of patent weighting each of them by 1 plus the average citation number received per year in the first 3 years. Explanatory variables are all measured at the beginning of the decade. *= Significant at 5% level. Huber-White robust standard errors. Sources: Data on number of U.S.-born and Foreign-born PhD's are from the US Census IPUMS. Data on the number of patents are from the NBER dataset described in Jaffe and Trajtenberg (2002). Patents have been assigned to a state according to the address of the first inventor. Data on R&D by state are from the National Science Foundation/Division of Science Resources Studies, Survey of Industrial Research and Development: 1998.

Appendix

A.2. Appendix to Section 2. Data

List of countries in the IALS
Belgium (Flemish community, excluding the city of Brussels), Czech Republic, Denmark, Finland, Germany, Hungary, Ireland, Italy, Netherlands, Poland, Sweden, Switzerland (French and German communities), the United Kingdom (Great Britain and Northern Ireland), and the United States.

Data collection in the IALS
The data in the IALS were obtained via stratified sampling. Whenever using these data we weight the estimates using the sampling weights provided in the survey.

A.4. Appendix to Section 4.

Data definition
We define the variable *Recentmove* = 1 if the household has moved within 12 months preceding the interview and 0 otherwise; and *Recentmove3* = 1 if the household has moved within 36 months preceding the interview and 0 otherwise. We also define *Bigrmove*= 1 if *Recentmove*=1 and the household came from another location; *Bigrmove3*= 1 if *Recentmove3*=1 and the household came from another location; *BigrmoveJob*=1 if *Bigrmove*=1 and the move was job-related; *Bigrmove3Job*= 1 if *Bigrmove3*=1 and the move was job-related.

Selection model

$$E(Y|M=1) = Xb + a + Zd + E(e|M=1) = Xb + a + Zd + r s_e f(Wg) / F(Wg) \quad \text{(A1)}$$

$$E(Y|M=0) = Xb + Zd + E(e|M=0) = Xb + Zd + r s_e f(Wg) / (1 - F(Wg)) \quad \text{(A2)}$$

and thus the difference is

$$DY_{E,imp} = a + r s_e f(Wg) / \{ F(Wg) [1 - F(Wg)] \} \quad \text{(A3)}$$

A.5. Appendix to Section 4 and 5: definition of education in the ECHP.

Years of education are not directly observable from the ECHP. Instead, education is broadly aggregated into three categories that report the maximum degree obtained by the individual: less than secondary, secondary and tertiary education. It also contains information regarding the year of end of education from which a proxy for the number of years of education can be constructed. We have crossed this information with the above-mentioned three categorical variables of education to minimise the noise, and we corrected for outliers.

A.5. Appendix to Section 5.

Table A5.1. Definition of variables: EU 15

marry	Dummy Variable, 1 if worker is married
female	Dummy Variable, 1 if worker is female
hhsize	Number of members of the household
yeduc	Years of completed education
exper	Potential experience: age - years of education - 6
tend2	Dummy Variable, 1 if worker's tenure is >1 &<=5
tend3	Dummy Variable, 1 if worker's tenure is >5 &<=10
tend4	Dummy Variable, 1 if worker's tenure is >10
unem	Dummy Variable, 1 if worker is ever unemployed in the last 5 years
nunem	Dummy Variable, 1 if worker is unemployed more than once in the last 5 years
lunem	Dummy Variable, 1 if worker is unemployed for more than a year during the last 5 years
indd2	Dummy Variable, 1 if worker is employed in "mining, quarrying, and utilities supply"
indd3	Dummy Variable, 1 if worker is employed in "manufacturing"
indd4	Dummy Variable, 1 if worker is employed in "construction"
indd5	Dummy Variable, 1 if worker is employed in "wholesale and retail trade"
indd6	Dummy Variable, 1 if worker is employed in "transport, storage and communication"
indd7	Dummy Variable, 1 if worker is employed in "FIRE"
indd8	Dummy Variable, 1 if worker is employed in "public administration and education"
indd9	Dummy Variable, 1 if worker is employed in "health, social work and other"
ocud2	Dummy Variable, 1 if worker is employed as "professionals"
ocud3	Dummy Variable, 1 if worker is employed as "technicians and associate professionals"
ocud4	Dummy Variable, 1 if worker is employed as "clerks"
ocud5	Dummy Variable, 1 if worker is employed as "service workers, shop and market sales workers"
ocud6	Dummy Variable, 1 if worker is employed as "skilled agricultural and fishery workers"
ocud7	Dummy Variable, 1 if worker is employed as "craft and related trades workers"
ocud8	Dummy Variable, 1 if worker is employed as "plant and machine operators, assemblers"
ocud9	Dummy Variable, 1 if worker is employed as "elementary occupations"
yd2	Dummy Variable, 1 if year is 1995
yd3	Dummy Variable, 1 if year is 1996
yd4	Dummy Variable, 1 if year is 1997
yd5	Dummy Variable, 1 if year is 1998
yd6	Dummy Variable, 1 if year is 1999
yd7	Dummy Variable, 1 if year is 2000
yd8	Dummy Variable, 1 if year is 2001
cd2	Dummy Variable, 1 if country is France
cd3	Dummy Variable, 1 if country is UK
cd4	Dummy Variable, 1 if country is Italy
cd5	Dummy Variable, 1 if country is Spain

A.7. Appendix to Section 7.

Ministère de la Communauté française

Administration générale de l'Enseignement et de la Recherche scientifique

Bruxelles, le 24 -08- 2004

Direction générale de l'Enseignement non obligatoire et de la Recherche scientifique(*)

Service général de l'Enseignement universitaire et de la Recherche scientifique

[redacted]

Direction de la Réglementation
Cellule Equivalences

Votre correspondant : [redacted]

Monsieur JANIAK Alexandre
Rue Le Titien, 39
1000 BRUXELLES

Votre lettre du
Vos références :
Nos références : ***DR / 04-1712 / EUE / PP***
Annexes :

Objet: **demande d'équivalence de votre diplôme de maîtrise d'économétrie (4 années d'études) délivré le 19 septembre 2002 par l'Université Lille I (France).**

Monsieur,

Par la présente, j'accuse réception des documents que vous me faites parvenir en vue d'obtenir l'équivalence de votre diplôme de maîtrise d'économétrie.

Je transmets votre dossier à l'organe consultatif compétent.

Pour votre complète information, j'attire votre attention sur ce que, à dater de la présente, une décision doit vous avoir été notifiée, sous pli recommandé, au plus tard dans un délai de 4 mois et 40 jours. A défaut de notification à l'expiration de ce délai, un recours en annulation devant le Conseil d'Etat vous est possible à l'encontre du silence de l'administration assimilé à une décision négative.

Veuillez recevoir, Monsieur, l'assurance de ma considération distinguée.

P/o [redacted]

Attaché

(*)Ens. universitaire, Hautes Ecoles, Architecture, Ens. artistique supérieur, Ens. sec. artistique à horaire réduit, Ens. de promotion sociale, Ens. à distance

Adresse postale : Cité administrative de l'Etat boulevard Pachéco 19 boîte 0 1010 BRUXELLES
Adresse visiteurs : rue Royale 204

Toute demande de renseignement sera formulée par écrit. Les visites sont généralement sur rendez-vous.

Site Internet http://www.cfwb.be
Téléphone vert (0800) 20 000