Tertiary Education Systems and Labour Markets

Stephen Machin[1] and Sandra McNally[2]

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[1] Professor of Economics, University College London, Research Director, Centre for Economic Performance, London School of Economics and Director, Centre for the Economics of Education.

[2] Research Fellow, Centre for Economic Performance, London School of Economics and Deputy Director, Centre for the Economics of Education.

Introductory Note

This paper was prepared in support of the OECD Education Committee's Activity *Thematic Review of Tertiary Education*. It was commissioned by the Education and Training Policy Division in the Directorate for Education and it complements the analyses being undertaken by the participating countries and the OECD Secretariat.

The objectives of the review are to examine how the organisation, financing and management of tertiary education can help countries achieve their economic and social objectives. The focus of the review is primarily upon *national* policies for tertiary education *systems*, rather than upon policies and practices at the institutional level. However the management of tertiary education institutions will be relevant to the extent that policies to improve institutional management can help to progress national policies. More specifically, the review will: (i) synthesise research-based evidence on the impact of tertiary education policies and disseminate this knowledge among participating countries; (ii) identify innovative and successful policy initiatives and practices; (iii) facilitate exchanges of lessons and experiences among countries; and (iv) identify policy options for participating nations. Detailed information about the activity is provided in the following internet site: www.oecd.org/edu/tertiary/review

Executive Summary

In recent decades, there has been rapid expansion of tertiary-level education across many countries. This report addresses what existing literature can say about the potential consequences of this expansion: Is there now 'over-supply' of graduates? Is there evidence of 'over-qualification' and skill mismatch? Are students studying the 'right type' of subjects at tertiary-level? Is there a shortage of science and technology graduates in particular? Finally, how does type of institution matter for labour market prospects?

The labour market consequences of increasing supply can be considered within a simple demand and supply framework. Starting from a position whether the demand for and supply of graduates are equalised, a boost in the supply of graduates should, *ceteris paribus*, lead to a reduction in the wage premium because employers have a wider range of similarly qualified people to choose from. However, if for whatever reason, employers demand more tertiary graduates, then there may not be a fall in the wage premium. The wage premium depends on the interaction of demand and supply. In recent decades, there has been a big increase in both the demand for and supply of tertiary-educated graduates. There is a controversial literature on reasons for the former, but the predominant view is that 'skill biased technology change' is a major contributory factor.

In most countries, there has been continued expansion of tertiary education in the last decade. However, the wage premium attached to tertiary education has increased in most of the countries considered here. The exceptions are Spain and New Zealand – two countries with particularly high expansion of tertiary education in the last 10 years. Also, in Korea, the wage premium declined markedly between 1974 and 1990, a period of industrialization when there was massive growth in tertiary education. However, even in these three countries, there is still a positive return to tertiary education. Thus, in no case considered here, can one speak of 'over-supply' of tertiary education. The strong, positive and (often) increasing return to tertiary education suggests that 'under-supply' is more of an issue and that continued expansion is justified. With regard to employability, in many countries there has been some catch-up of the less educated group over the last decade. However, those with tertiary education continue to have a much higher probability of being in employment.

On the other hand, it sometimes takes a long time for some (usually less well performing) graduates to find jobs after leaving tertiary education and even then, some graduates are not observed in jobs that appear to be well matched to their qualifications. At the same time, shortages in certain sectors are reported. An empirical literature has developed that attempts to measure this, and the (sometimes misused) terms of 'over-education' and 'under-education' have emerged. The former arises if an individual holds higher qualifications than required by his/her job whereas the opposite applies for the 'under-educated'. However, statistics of 'over-education' and 'under-education' are difficult to interpret as workers are matched to jobs based on a range of characteristics (not just their education level). Also, apparent mismatch may partly be a temporary phenomenon. The extent to which such problems are seen as temporary varies across studies and countries. One generalization which can be made is that the fact of observing 'over-qualified' individuals in the workforce does not mean that there is over-supply of tertiary educated graduates. If there were over-supply, relative wages and employment probabilities would fall to the level of their closest substitutes – and this has not happened.

Indications are that skill mismatch (or inadequate levels of skill) is more of a problem than 'over-qualification'. In some countries there is a need to improve the content and accreditation of vocational qualifications, such that they provide what employers need and are recognized to do so. This is not to say that tertiary education should be geared to providing

highly specific skills that are currently needed by employers. Some studies suggest that general education and skills are more valuable because they enable workers to respond to shocks to the economy (for example, those that require sectoral change) and advances in technology. There is also a question as to the balance between employer provided training and education provided (usually publicly) in institutes of tertiary education.

One possibility for reports of skill shortage is that individuals are not studying the right type of graduate studies (whether this education is general/academic or vocational). In other words, the choice of higher education made by individuals does not correspond to the needs of the labour market in terms of field of study. As yet, there are relatively few academic studies that estimate returns to higher education by subject of degree – especially when we are most interested in change over time. A study considering changes in returns to subject of degree over time in Britain, Germany, France and the US (where this is defined consistently over time and across countries) finds that a return to an Arts degree had the lowest relative return within all countries, for the time periods considered (the early 1990s and 2000) and for both men and women. In contrast, the return to Science/Engineering/Technology is higher (especially for men). Such findings are broadly consistent with what is found for a number of other countries – Science/Engineering/Technology is often among the category of subjects with a relatively high return (along with some social science subjects and professions such as law and medicine) whereas Arts and Humanities is often among the category of subjects with a relatively low return. It may be relevant to talk of 'over-supply' in relation to some subjects of degree. For example, there have been estimates to suggest that the wage return to an Arts and Humanities degree is zero in the UK. Potential policy responses include differential fees (or bursaries) by degree subject so that graduates are encouraged to choose to study subjects for which there is high relative demand in the labour market. There may also be a case for the provision of better information to potential students on job prospects and earnings by degree subject.

The existence of the relatively high wage differential for Science/Engineering/ Technology compared to other subjects illustrates the high value placed on the field by employers and indicates high relative demand for graduates with this field of study. This might be interpreted as a 'shortage' of Science and Technology graduates and would be consistent with some reports of 'shortages' that have appeared in several countries including Belgium, Australia, New Zealand and the UK. There are big differences between countries in the proportion of graduates who qualify with a degree in Science and Technology. Comparing across continents in 2000, Asia has the highest percentage of graduates with Science and Technology degrees (32%), which is just above the Europe (28%) and considerably above North America (18%), South America (22%) and Oceania (22%). Within Asia, China has a particularly large share of graduates with a degree in Science and Technology (53%). Even though the EU has a better performance than the US in terms of Science and Engineering graduates, it lags well behind the US in terms of the proportion of researchers in the labour market. Nonetheless, like in other countries, there are claims of a 'shortage' in the US which economists have struggled to reconcile with the facts (which belie this concern). Further analysis suggests that the underlying issue is that the US maintains an adequate supply of scientists and engineers only because of the sizeable influx of foreign-born students and employees. This could be a risk to US research and development if there is any interruption of the flow of immigrant scientists and engineers. The 'brain-drain' to the US is also a concern for other countries. For example, analysis of migration flows in and out of Europe suggests that Europe has lost out in terms of its own potential supply of 'domestic' graduates and its ability to attract scientists and engineers from other countries. The shortage of personnel in these areas is likely to have cost in terms of innovation and consequent productivity growth.

Countries differ across a number of dimensions regarding institutional type. Some have 'unitary' systems whereas others have 'binary' systems. Institutional change in the last 15

years has been very pronounced in countries that have experienced major political change – federalization in Belgium; decentralization of power in Korea; and most especially the collapse of communism in Central and Eastern European countries. In many of these countries the tertiary system has become more decentralized and there has been an increase in the number of tertiary institutions. One would expect wage returns to vary by the quality of institute attended – to the extent that this is understood by employers.

Differences in the earnings of graduates who attend different institutions may have a number of explanations. One of the most difficult issues is how to separate the effect of institutional type from the fact that students with very different characteristics may choose to attend different types of institution. For example, higher ability students are more likely to attend higher quality institutions – in this case, it is difficult to know whether to attribute any institution-related premium to higher ability of the student or to the institution he/she attends. If institutions differ according to the type of education provided (e.g. academic versus vocational), differences in the 'higher education institution' premium may reflect differences in how the labour market rewards different types of education rather than reflect anything about the quality of the educational establishment. In a context where participation in tertiary education has greatly expanded and (in many cases) the number of institutions has increased, there are concerns about whether the quality of education received has been deteriorating. There is little empirical evidence to comment directly on this question. Most of the literature focuses on returns to tertiary institutions in the US. For the most part, this shows that quality of institution (as measured by various quality indices and resources) has a wage return in the labour market. Some authors speculate that this finding might not be generalisable to countries with a more centralized system of tertiary education. However, this is a point about which there is no empirical evidence.

To sum up, concerns about the 'over-supply' and/or 'over-qualification' of tertiary graduates are misplaced. There is good reason to expand the system further. There is a role for policy in understanding and alleviating problems that constrain individuals (especially those from lower socio-economic groups) from participating in tertiary education. There is also a role for policy in providing information and incentives that will direct people into subject areas for which there is relatively high demand in the labour market. There is much need for data collection and analysis on matters such as labour market returns to subject of degree and type of institution attended.

1. Introduction

The tertiary education systems of many countries have expanded rapidly, with different rates of change being experienced across countries and with expansions occurring at different times. This has had important and profound impacts on labour markets and in the way in which employers use highly educated labour.

These expansions have, for the most part, been predicated on the assumption that more education is good for individuals and for society as a whole, not only in terms of economic outcomes like wages or employment, but also for a wide range of social outcomes like improved health, reduced crime and higher well being.

However, along with expansion of the system has come a range of new questions that have emerged as consequence of there being many more tertiary graduates. For example, has the increase in tertiary graduates resulted in an oversupply of workers with tertiary qualifications, and thus a decline in the 'value of a degree?' Has the increased supply of tertiary graduates changed labour markets for skilled workers? Are labour markets for graduates in some nations with relatively mature and stable non-university tertiary institutions

different from those of nations with less well established non-university institutions? Are there substantial (or widening) differences in returns to schooling across different fields of tertiary study? Is there any evidence that supply of science and technology graduates is failing to keep pace with labour market demand in OECD member nations?

These are the questions we set out to answer in this report. The aim is to present material (from our own data analysis or from existing research by us or others) that is of relevance to these questions. The report will offer some conclusions about the way in which the expansion of tertiary education in many countries has had important effects on economic outcomes.

The rest of the report is structured as follows. In Section 2 we consider, and show evidence on, the expansion of tertiary education systems. In Section 3, we look at the impact that the increased supply of tertiary gradates has had on the labour market. Section 4 looks at some of the labour market consequences of the changing nature of supply, especially focusing on the fact that there have been important changes in the composition of graduates in terms of their individual characteristics. Section 5 looks at the role played by different institutions and how this matters. Section 6 summarises the main findings and concludes.

2. The Increasing Supply of Tertiary Graduates

The expansion of tertiary education is a general phenomenon across OECD countries, which has been evident for several decades. Table 1 shows the most recent decade to have been no exception. It gives the percentage of the population (aged between 25 and 64) that has attained tertiary education in 1994 and 2003 for the countries participating in this study (where available).

Specifically, there are 18 countries for which we can observe such a change. In all but one, there has been an increase in the percentage of the working age population that has achieved tertiary education. The exception is Greece, for which no change has been observed.[3] Countries for which there has been a small change (i.e. 1-4 percentage points) are Chile (+1), the Czech Republic (+2), Germany (+1), Portugal (+1), The Netherlands (+3) and Norway (+4). Countries for which the increase has been 10 percentage points or more are Finland (+12), the Russian Federation (+10), New Zealand (+10) and Spain (+10). In the remaining 7 other countries, the magnitude of the increase is in the range of 6-8 percentage points. Of the countries where a large change is observed, only Spain started from a relatively low base (in 1994) as compared to other countries. Of the countries where the increase has been relatively small, Portugal and the Czech Republic and Chile start from a low base – in fact they are well below most countries in the percentage of the population achieving a tertiary education both in 1994 and 2003.

However, rates of expansion can differ across cohorts. This is not reflected in Table 1, where the rate is expressed as a percentage of the population aged 25-64. For example, although the increase in Portugal seems very small, from 1990 to 2000, there was a 105.8% increase in the number of student enrolments in higher education. The percentage of 'new employees' with a higher degree increased from 2.1% in 1992 to 10.7% in 2002 (OECD Country Background Report).

Comparable data is unavailable for some of the countries in Table 1. However, we know from other sources that the growth in tertiary education has also been substantial in most of

[3] However estimates reported in Tsakloglou and Cholezas (2005) suggest that the percentage of the labour force with tertiary education increased from 14.1% in 1988 to 22.2% in 1999. These are the authors own estimates from the Household Budget Survey micro-data they use in their study.

these countries[4]: the gross enrolment rate in Croatia increased from 24.6% in 1994 to 41.3% in 2003; in Poland, it increased from 17.6% in 1994/95 to 46.4% in 2003/04; in Estonia, it increased from 30% in 1993 to 63% in 2003. In Korea, the percentage of 16-19 year olds participating in tertiary education increased from 22.8% in 1998 to 32.9% in 2004. For those aged between 20 and 29, participation increased from 21.8% to 27% over the same period. In Iceland, the percentage of 20-24 year olds working for an undergraduate degree increased from 34.8% in 1994 to 49.9% in 2001. In China and Japan, the number of first university degrees awarded in 2001 was, respectively, 83% and 18% higher than the number awarded in 1994.[5]

Despite the increase in tertiary education in most of the countries in Table 1, it remains the case that many countries lag behind the US in the proportion of the 25-64 year old age group that have a tertiary education. Wasmer *et al.* (2006) investigate this further in relation to the US and Europe and find that the difference in tertiary education can mostly be attributed to the lack of supply of general and advanced research programmes: the EU average reaches 14.2% of the population while it is 29% in the US. Furthermore, this gap does not narrow for younger cohorts. Indeed the gap in educational attainment between the EU and the US has moved from the upper secondary level to the tertiary level in recent decades.

3. Labour Market Consequences of Increasing Supply

3.1. Conceptual framework

The labour market consequences of the expansion of tertiary education depend on the demand for graduates as well as the supply of graduates. Starting from a position where the demand and supply are perfectly equalized (in a competitive market), a boost in the supply of graduates should, *ceteris paribus*, lead to a reduction in the wage premium because employers have a wider range of similarly qualified people to choose from.

To see this, consider Figure 1 which shows a labour market with two types of labour – tertiary graduates (G) and non-graduates (N). The wages of graduates and non-graduates are denoted by W_G and W_N, and their employment rates are respectively L_G and L_N. In the usual economic model we have an initial equilibrium at the intersection of the initial relative demand and supply curves, D_0 and S_0 respectively, with associated relative wages $(W_G/W_N)_0$ and relative employment $(L_G/L_N)_0$. The clear prediction from this model is that, if an increase in the supply of tertiary graduates occurs, and so the supply curve shifts to the right (from S_0 to S_1) then the relative employment rate rises (to $(L_G/L_N)_1$) and the relative wage falls. Thus the supply shock dampens down the relative wage of tertiary graduates.

However, lower relative wages need not be the case if demand for tertiary graduates is also rising. If, for whatever reason, employers demand more tertiary graduates then the expansion may not cause a fall in the wage premium that graduates receive. In fact, if demand is increasing faster than supply, the wage premium can increase, i.e. although the number of

[4] These figures were obtained from the relevant OECD Country Background reports. The gross enrolment rate is defined as the number of students enrolled in tertiary education as a percentage of the population of 'official school age students' at that level (defined in report for Croatia). There may be some differences in definition between countries. A further source of information on trends over time (at least for a sub-sample of countries) is CHEPS, International Higher Education Trend Monitor Report. See Kaiser *et al.* (2005).

[5] As computed from National Science Foundation:
http://www.nsf.gov/statistics/seind04/append/c2/at02-33.xls

graduates is rising, graduate-level jobs are increasing at a faster rate and so are commensurate with a higher relative wage.

This is shown in Figure 2: keeping the relative supply curve fixed (schedule S_1) but allowing for such a relative demand shift by moving the demand curve to the right (from D_0 to D_1). In this case, the relative demand shift outweighs the supply shift and the relative wage rises above the initial level to relative wage level $(W_G/W_N)_2$. In this example, the relative wages and employment levels of tertiary graduates are higher after the expansion. An intuitive way of thinking about this supply demand approach is in terms of an economic model where the wages and employment of graduates and non-graduates are the outcomes of a race between supply and demand. That is, demand and supply curves are shifting and the question is which curve has moved the most. In the example of Figure 2, to have generated simultaneously higher wages and employment for the skilled, relative demand must have increased by more than relative supply.

The simple supply-demand framework we have just set out has been widely used in academic research on changing labour market inequality. In fact, large increases in the demand for graduates are the only way to rationalize constant (or increasing) wage premiums in the face of the expansion of tertiary education. Much work has been done to understand what lies behind the increase in demand in the US and the UK. In both countries, wage premiums have risen (or remained constant - in more recent years) despite a massive expansion in the supply of graduates with a tertiary education.

In Table 2, for example, the proportion of graduates grew from 20.8% in 1980 to 34.2% in 2004 in the US.[6] The equivalent figures from the UK were even more dramatic – the growth in graduates was from 5% to 21% over the same time period. But at the same time the relative wages of graduates have risen (very fast in the 1980s, but with no fall in the 1990s despite the supply changes). The only way to reconcile these facts in the standard model is through an outward shift in the relative demand curve for graduates. Put differently, the recent patterns of change showing simultaneously rising relative wages and relative employment of graduates mean that the relative demand for graduates has outstripped the relative supply, despite the latter rising rapidly.

Katz and Murphy (1992) provide a formal analysis of relative supply and demand changes in the US between 1963 and 1987 (updated for more recent years in Autor *et al.* 2005). They examine how far one can go towards explaining changes in relative wages in the US using a simple demand and supply framework. Their work involves estimating the elasticity of substitution between skilled and unskilled labour. They estimate the elasticity to be significant (at around 1.4-1.6), implying that supply increases reduce relative wages (other things equal). In fact, differences in the rate of growth of the supply of college graduates have an important role to play in explaining differences across decades (1960s-1990s) in the evolution of the relative earnings of college graduates. However, demand for college graduates has outstripped supply and hence the wage premium increased substantially over this time period despite the large increase in supply.

A key question in academic research has been to ask what caused the relative demand shift. Various explanations are given but the weight of the evidence is behind what is known as 'skill biased technology change' (for reviews of possible explanations and discussions of the large body of evidence, see for example, Katz and Autor, 1999, or Machin and Van Reenen, 2006). This refers to the introduction of new technologies that are biased in favour of skilled workers. It comes from the hypothesis that employers' demand for skilled workers has

[6] In the US the graduate measure is having a bachelor's degree or higher (i.e. excluding people with some college who do not get a degree).

been shaped by the kinds of technologies that are permeating into modern workplaces. In this changing environment, employers will be willing to pay more to workers who are skilled enough to operate these new technologies whereas less skilled workers will be less valued – and this will be reflected both in wages and in the employment probability. There is good evidence for the importance of skill biased technical change internationally as opposed to competing explanations such as increased globalization (Berman *et al.* 1998, Machin and Van Reenen, 2006).

This literature has not been without controversy. Indeed, the wider consequences for general patterns of change in wage inequality is still being discussed and is a high on the current research agenda (for example, see the recent expansion of work revisiting the area in Autor, Katz and Kearney, 2005a, 2005b, 2006, Lemieux, 2006, and Machin and Van Reenen, 2006). Part of the controversy has been an objection by some (most notably Card and DiNardo, 2002) that skill-biased technology change (sbtc) cannot be the sole explanation for the observed changes. Indeed, there is now more acknowledgment that the simple sbtc explanation needs to be expressed in a more nuanced manner. Most researchers still think sbtc has been the prime driver of the increased demand for skills seen over the longer term. For more recent changes, one needs to look at the nature of jobs done by more and less skilled people, for example with jobs involving more routine tasks being affected by sbtc (e.g. where computers are introduced), whereas other types of job are less likely to be affected (Autor, Levy and Murnane, 2003).

This discussion also makes it clear that adjustment to changing conditions affecting demand and supply can be reflected in employment or unemployment probabilities as well as in wages. In fact, if there are wage rigidities (created, for example, by labour market institutions), adjustment through employment may occur instead of adjustment through wages (Nickell and Bell, 1995). It has been hypothesized that the fall in the relative demand for unskilled labour manifests itself in Anglophone countries as a rise in wage inequality whereas in some countries of continental Europe (e.g. Germany), it is reflected in the rise of unemployment (the 'Krugman hypothesis', Krugman, 1994). Some evidence to support the hypothesis has been found for Germany (Puhani, 2003).[7] This argument is also made by Goux and Maurin (1997) in relation to France.

3.2. Empirical evidence across OECD countries – the wage premium

There are many studies that have analyzed the wage premium (and changes in the premium) associated with tertiary education. As discussed above, the wage premium depends on the relative demand for and supply of tertiary-educated graduates. It is not obvious what will happen to the wage premium of tertiary-educated graduates when supply and demand conditions are changing at the same time. The responsiveness (or elasticity) of the wage graduate premium with respect to demand and supply is not necessarily the same across countries or over different time periods. Thus, the effect of the increasing supply of tertiary-educated workers on their relative wage is an empirical question, which needs to be considered in country-specific studies over different time periods.

We start, very simply, by showing how wage differentials have changed over time for tertiary-educated graduates versus those who have achieved education up to 'upper secondary or post-secondary' (non-tertiary). This is shown for many of the countries included in Table 1 – firstly for the working age population (Table 3a) and then for men and women separately (Tables 3b and 3c).

[7] Bellman and Gartner (2003) find evidence for Germany in the qualification and sector based wage structures, which are consistent with the hypothesis of skill biased technology change.

In the 13 countries for which we have information on relative wages in the late 1990s and early 2000s, we observe an increase in the wage premium for those who have been tertiary educated in all but three countries. This ranges from a small percentage point increase in France (+1), Finland (+2) and Sweden (+3) to a very large percentage point increase in Germany (+19). This suggests that for the most part, an increase supply in tertiary graduates has not led to a reduction in the wage premium – in general the evidence suggests that the 'value of a degree' is still rising in most European countries despite an increase in the supply of graduates (the implication is that demand is rising faster than supply).

There are two notable exceptions: Spain and New Zealand– where the reduction in the wage premium has been 20 and 22 percentage points respectively. It is interesting to note that these two countries were among those with the highest increase in the supply of tertiary graduates between 1994 and 2003 (see Table 1), although demand side changes may also play an important role in explaining changes in the wage premium.[8] When one looks at the decrease in the wage premium by gender, it is clear that both men and women have been affected in these countries – women a little more in Spain and men a little more in New Zealand. Since there is still a positive wage premium for tertiary-educated workers (even though it has declined) then on average demand is greater than supply, and so we cannot speak of 'over-supply' of tertiary-educated workers.

Studies that measure the returns to education are often based on a Mincerian earnings model (Mincer, 1974), wherein 'human capital' is one of several inputs determining wages. A recent (draft) OECD report (OECD, 2006) estimates wage returns to tertiary education for several countries in the OECD. Estimates based on one set of regression results are reported in Table 4 (for men). Here we report only the coefficient on 'attainment of tertiary education'. This can be interpreted as the percentage increase in gross wages estimated to accrue to a man with tertiary education relative to a man with upper secondary education. The estimates are extremely high for all the countries considered, ranging from a wage return of 17 percentage points in the UK to 65 percentage points in Portugal.

There are various methodological concerns in the literature with regard to estimating returns to education (see Card, 1999, for a review). One concern is 'selection' into the labour market. This applies to women in particular, given their higher probability of taking career breaks when children are young. At a point in time, the non-random sample may give rise to misleading conclusions about the relationship between education and earnings. A more general (though related) concern is that the characteristics of those with a high level of education are correlated with important unobserved characteristics that are also determinants of good labour market outcomes (such as high wages). For example, individuals with higher ability might be more likely to enter higher education (leading to higher wages), but may have received a wage premium in any case because of their higher ability. If this is true generally, then it is not clear whether one show interpret the raw wage premium between those with and without tertiary education as a return to extra education or a return to the higher ability of those who enter into higher education.

When one is interested in the change in the wage premium over time, these concerns may be less serious (though they will still be important if there are changes in the type of people

[8] For example, relative demand shifts will also influence the wages of tertiary educated workers vis-à-vis workers with upper secondary/post-secondary qualifications. In New Zealand, economic conditions were very different in the early period compared to the later period. It is not clear whether the apparent reduction in the relative wage of tertiary-educated workers reflects a demand-side or supply-side shock. Also, detailed studies about New Zealand have not found evidence for any statistically significant decline in the wage of tertiary-educated workers in recent years (see appendix).

who enter into tertiary education).[9] Therefore, the simple estimates presented in Table 3 on changes over time are informative. There is an enormous literature which attempts to measure returns to education, taking account of these concerns (see Card, 1999 for a discussion). However, there are fewer such studies that analyse changes in the return to education over time – and fewer still that focus specifically on higher education. We discuss a few studies that attempt to estimate the wage return to higher education at a point in time, or where possible over time, though we make no claim to be comprehensive.[10] Also, some studies are more convincing than others regarding the extent to which they deal with the methodological concerns discussed above.

Outside the US, perhaps one of the most studied countries in this regard has been the UK. One of the most influential analyses estimating the returns to a degree in Britain at a point in time is that of Blundell *et al.* (2000). This study uses data from the National Child Development Survey – a longitudinal survey of all individuals born in Britain in the week 3rd-9th March 1958. The data contain a very rich set of variables on individual's educational qualifications, ability, wages, employment, family characteristics etc. The authors compare the wage returns to a degree for men and women in comparison with a control group who achieved the highest secondary school qualification (one or more A-levels) but no higher education qualification. When they do not control for any characteristics, they estimate a raw wage return of 21% for men and 39% for women, at the age of 33 (i.e. in 1991). When they include controls, returns change to 17% for men and 37% for women.[11]

In the UK, the pattern of change in graduate wage differentials is fairly clear. They rose very sharply in the 1980s, and continued to rise at a lower rate in the 1990s and any growth has stagnated by the 2000s (Machin, 1996, 1999, 2003; Machin and Van Reenen, 2006). A number of studies document rising returns over time from the 1970s to the early 1990s (Harkness and Machin, 1999; Gosling, Machin and Meghir, 2000) and slightly rising or constant returns from the early 1990s to the early 2000s (Chevalier *et al.* 2004; Walker and Zhu, 2003; O'Leary and Sloane, 2004, 2005; McIntosh, 2004). This is the average wage return. Some more debate has emerged in more recent work about certain sub-groups and whether there is any evidence of falling wage returns (which some authors state must happen at some point given the scale of the supply increases). This remains controversial and it is too early days to reach any strong conclusions. There is a little evidence of falls in O'Leary and Sloane (2005) and Walker and Zhu (2005), but Dickerson (2005) reports no change using the same data sources. Moreover reports of falling returns need to be kept in perspective as the size of returns are still substantial in comparison to those with only an upper-secondary education. Card and Lemieux (2001) also focus on cohort-specific rates of return in the United States, United Kingdom and Canada. They show that the almost the entire rise in the earnings gap between those with a college diploma and those with only a high school diploma between the mid-1970s and the late 1990s is attributable to changes in the relative earnings of younger college-educated workers – and this is true in the US, the UK and Canada. They

[9] If tertiary education becomes less elitist over time, then the average measured 'ability' of those with a tertiary education may be declining. This means that the change in the wage premium over time that is attributable to tertiary education may be larger than that implied by the raw data.

[10] The literature of relevance to this general issue is very extensive.

[11] The Blundell at al analysis has been recently replicated for a more recent birth cohort by Bratti *et al.* (2005). They use the 1970 British Cohort, which is a similar longitudinal survey of individuals. In this case, the survey is of all individuals born in Britain between 5th and 11th April 1970. The authors measure wage returns to a degree when the individuals are age 30 (i.e. in 2000). Using comparable controls to Blundell *et al.* (2000), they find wage returns of 15% for men and 23% for women. There are certain issues of comparability that make the cross-time comparison a bit difficult here (especially for women due to the very different employment rates in the two cohorts).

suggest that shifts in cohort-specific supplies of highly educated workers (in addition to steadily increasing demand for educated workers) has an important contributory role in explaining education-related wage differentials in all three countries.

Brunello *et al.* (2000) note that relative little is known about the evolution of the 'college wage' gap in continental Europe and seek to remedy this by using two cohorts of males in ten European countries from the early-mid 1980s to mid-late 1990s. In the time period considered, the college wage gap (measured as the difference in wages of those with tertiary education and those with upper secondary education) increased in Denmark, Portugal, the UK, Italy, Switzerland and Finland, remained relatively stable in France, Germany and The Netherlands, and declined in Austria. They find that the findings of Card and Lemieux (2001) do not apply to most of these countries: the growth of the college wage gap has not been limited to the younger cohort with the exception of Austria, Switzerland, The Netherlands, and possibly the UK. There is evidence that in a number of European countries, the college wage gap has risen at least as fast for the older cohort as for the younger cohort. The estimated growth in the college wage gap varies considerably between countries and is shown to be negatively correlated with changes in relative supply and positively correlated both with the index of between industry demand shocks and with the rate of productivity growth. In other words, the growth in the college wage premium has been lower in countries with a relatively greater expansion in the supply of college graduates (other things equal) and higher in countries with an increase in the demand for college graduates. Institutional changes are also relevant: in particular, there is evidence that countries which have experienced declines in union density or the degree of centralisation in wage bargaining or employment protection measures have also had a faster growth in the college wage gap. They further illustrate results by making comparisons between particular countries. For example, relative supply changes have been smaller and productivity growth much faster in Portugal than in The Netherlands. Brunello *et al.* (2000) find that the relative contribution of demand changes has been particularly significant for Portugal. Comparing France and Britain, they find that relative demand shocks have contributed equally to the increase in the growth of the college wage gap in both countries. However, institutional changes have contributed to higher growth of the gap in Britain and lower growth of the gap in France.[12]

The experience of Central and Eastern European countries over the last 15 years is especially interesting given the dismantling of the Communist regime in the early 1990s. As discussed by Svejnar (1999), *a priori*, one might expect an increase in wage returns to education as demand for education can be reflected in the market (as opposed to being regulated by the government). However, there is also a competing hypothesis – namely that human capital and experience gained under communism may not be very useful in a market economy. If correct, the rate of return to education should fall from the pre-transition to the transition period. In his review of studies (for the Czech Republic, Slovakia, East Germany, Bulgaria and Poland), Svenjar (1999) reports that evidence suggests the opposite (with the exception of East Germany and possibly Bulgaria). Similar results are found for Estonia (Noorkoiv *et al.*, 1997). Thus, in general, returns to education increased in the transition period. As noted by Jurajda (2003), while a large body of empirical literature documents the rise in returns to education occurring during early pro-market reforms, there is little evidence on late-transition (pre EU-accession) returns to education. In his paper, he gives particular attention to the quantification of the Czech-college/high school wage gap. Key findings are that this gap is much higher in the Czech Republic than comparable gaps in Austria and Germany, both of which have relatively similar educational systems and enrolment patterns. Furthermore, there is no evidence of differential returns by cohort - returns are similarly high for workers who were aged between 11 and 17 at the time of the breakdown of communism.

[12] Specifically, the UK experienced a decline in centralisation and the highest reduction in union density over the sample period. Employment protection increased in France whereas it remained constant in the UK.

There is also evidence that the gap has increased between 1998 and 2002. Jurajda suggests that these findings may reflect a shortage in the supply of college places (also consistent with the fact that tertiary education institutions are very over-subscribed). Another study where returns are estimated for the late 1990s is that by Campos and Jolliffe (2004) in relation to Hungary. They find a general increase in the returns to education over time (1986-1998), which is especially marked for general secondary, college and university education. No change in returns is reported for vocational education. On the other hand, they find that returns for those who received their education post-1989 have fallen since 1995, which they interpret as evidence for falling school quality.[13] Sheidvasser and Benítez-Silva (2000) estimate returns to education in Russia between 1992 and 1999. In contrast with earlier studies, they find that returns to education are low and are unchanged over this time period.[14] Results are interpreted as evidence that the supply of education is high in relation to demand. They show that the Russian population acquire more education on average than people in other countries (as is also reflected in Table 1 with regard to tertiary education) and that the quality of education in Russia appears to be relatively high (Russian secondary school students perform well in international tests).

Table 5 reports briefly on other results found for countries where something can be said about the evolution of returns to education (particularly higher education) in recent years. Studies are reported for Australia, China, Greece, Japan, Korea, Mexico, New Zealand, Norway, Portugal, Spain and Sweden. They suggest that returns have been either increasing for recent years (China, Greece, Mexico, Portugal, Sweden and perhaps New Zealand) or remained stable (Australia, Japan and Norway). However, some decline in the returns to schooling has been suggested for Spain and Korea.

Kim and Topel (1995) analyse what happened to wage differentials following Korea's rapid industrialisation from 1970 to 1990. In this time period, there was a very substantial upgrading of skills in the workforce. The number of high school and college graduates increased by 30 percentage point. They comment that these changes make those in developed countries appear glacial, and minor by comparison. They find that as high school and college graduates became more plentiful, their relative wages fell by more than half. This is not to say that the wage premium ceased to exist – their analysis still shows a positive wage premium to tertiary-education – but that the price fell as a consequence of the large increase in supply. Since a positive wage premium exists, it is not valid to talk of 'over-supply' of tertiary-educated graduates, even in this context. Furthermore, note that in Table 3a, the wage premium has increased in the last few years.

More generally, while evidence on wage returns to higher education varies across countries, in general it appears that returns have increased or remained stable, despite the expansion of tertiary education. Thus, at least so far, there is no evidence of there being an 'over-supply' of tertiary education. Nor, at least to date, is there evidence that the value of a degree is declining. Indeed the positive returns to tertiary-level education suggest that continued growth in the supply of tertiary-educated graduates is something to be welcomed and encouraged. It could be argued that 'under-supply' of tertiary education is the problem rather than 'over-supply'. For example, in a report about the situation in Australia, Birrell and Rapson (2006) argue that a serious 'mismatch' has developed between the supply of tertiary-educated graduates and demand in the labour market: there are simply not enough graduates and there is plenty of scope to increase the proportion of young people studying in both the

[13] There are reports of declining expenditure on education post-1989; teachers needing to take on second jobs and declining academic performance. The authors do not comment on the possible deterioration of quality within higher education institutions.

[14] Sheidvasser and Benítez-Silva (2000) explain differences with other studies because they have better data and use a more credible methodology (they deal with 'selection' into schooling).

higher education and vocational training sectors.[15] Reingerg and Hummel (2002) predict that there will be a shortage of workers with an academic higher education in Germany in the future because of the retirement of older workers, who account for a significant proportion of the highly skilled workforce and the recent slowing down of trends in educational participation.

However, given the large expansion of tertiary education, there will be greater variation in the earnings of graduates (largely induced by greater variation in their personal characteristics).[16] As graduates study a wider range of subjects and attend a larger number of institutions, this will also lead to greater variation in graduate earnings. In sections 4.3 and 5, we discuss available evidence on the extent to which subject of degree and institution attended affects the returns to a tertiary education. There is also some evidence on returns by class of degree. For example, using UK data, Naylor *et al*. (2003) find that while for earlier cohorts there was no statistically significant premium associated with the class of degree awarded, a significant differential has developed and grown over time. One hypothesis is that as the population of graduates has grown, greater importance is attached by employers to the signal emitted by a graduate who has performed well in university (Bratti *et al*. 2005).

3.3 Empirical evidence – employment and unemployment probabilities

The 'value' of tertiary education is not only reflected in the wage but also in the probability of finding employment. In Tables 6a-6c, we observe the employment and unemployment rates of graduates of tertiary education and those who achieved 'upper secondary and post-secondary non-tertiary education' for 21 countries in 1991 and 2003. This is first shown for the working age population (Table 6a; Figure 3), before it is shown separately for men and women (Tables 6b and 6c respectively). In almost all countries, the employment rate is considerably higher for graduates of tertiary education than those educated up to upper/post secondary (non-tertiary) for both time periods. With regard to change over time, in 13 of the 21 countries there has been relatively little change, with the difference between the employment rates of the two categories changing by less than 2 percentage points. Those countries with a larger change are more often those where the gap has narrowed – Australia (6%), Iceland (5%), Korea (4%), New Zealand (8%), Portugal (3%) and The Netherlands (5%). In contrast, the gap has opened out more noticeably for Poland (6%), followed by Spain (3%). Thus, in general, there has been some catch-up in the employment probability of the less educated group (although the tertiary educated continue to have a much higher probability of being in employment).

In 1991, the unemployment rate of those educated to tertiary level was lower than those educated to upper/post secondary in most countries. However, there are a few countries where the difference in unemployment probabilities was very small (Greece, Japan, Korea, Mexico and Switzerland). The change over time is less pronounced than that described for employment probabilities in terms of percentage points but is quite striking when one views the change over time relative to the starting point (in 1991). Since that time, the gap has narrowed quite substantially in 9 countries (Australia, France, New Zealand, Norway, Portugal, Spain, The Netherlands, UK, US) and opened out quite substantially in 6 (Belgium, the Czech Republic, Germany, Greece, Japan, Poland). Hence, there is no common trend in

[15] The authors attribute insufficient enrolment as partly arising from an effective cap on the number of places for domestic students in recent years. They recommend an increase in the availability of higher education places in locations and disciplines suited to prospective student preferences and employer needs, as well as a more supportive stance on the provision of student financial assistance.

[16] For example, as tertiary-level institutions expand, becoming less elitist, they will have a larger intake of people with different abilities and social backgrounds. This generates increased dispersion in earnings (though it does not suggest that the value of a degree is any different conditional on prior ability or social background).

the change across these countries. However, the probability of unemployment is lower almost everywhere conditional on having a tertiary qualification. As discussed by Wasmer *et al.* (2006), 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 their unemployment rate.

As discussed above, adjustment to relative demand and supply of educated workers can occur through employment/unemployment probabilities as well as through wages and it has been suggested that 'quantity' adjustments are more important in continental Europe than in Anglophone countries, given greater wage rigidities in the former countries (see discussion of Krugman hypothesis above). Dolado et al (2000), noting decline in the return to higher education in Spain, suggest that educational attainment has kept on rising in response to the higher probability of finding a job rather than any expectation of a wage premium.

Goux and Maurin (1997) explore the high relative increase in the demand for qualified workers in France. They find that much of this can be explained by change in the (domestic) demand across different sectors (from manufacturing to services). Givord (2005) comments that the relative employment situation of workers without qualifications continued to deteriorate in the late 1990s.

4. Labour Market Consequences of the Changing Nature of Supply

4.1 Jobs Done by Tertiary Graduates (and Associated Wage Differentials)

It is difficult to find information about the jobs done by tertiary graduates such that classifications are consistent for different countries. Even for particular countries, it is difficult to find information on how graduate occupations have changed over time and wage differentials vis-à-vis non-graduates.[17] In this section, we focus on the US and the UK where data sets allow us to perform this analysis. However, when considering the related issue of fields of study (Section 4.3), the available literature allows us to comment on a number of other countries.

For the US, we use the Current Population Survey for 1983 and 2002 (Table 7a, 7b). Table 7a shows the occupations of those who have been educated to tertiary-level. In 1983, the largest share were in services (30%) followed by Managerial (20%), Science and Engineering (12%), Construction/manufacturing (12%), Educators (10%), Law and other professional (9%), Technicians (5%) and Agricultural (2%). By 2002, the main change was an increase in the share classified as Managerial (up 6 percentage points to 26%) and Science and Engineering (up 3 percentage points to 15%) and a corresponding decrease in Services (down by 6 percentage points to 24%) and Construction/Manufacturing (down by 3 percentage points to 9%). There was also a 1 percentage point change in those classified as Law and Other Professional (an increase) and those classified as Technicians (a decrease).

With regard to gender differences, in 1983 tertiary-educated men were more likely to be classified as Managerial (23% of men; 14% of women) and Construction/manufacturing (18% of men; 4% of women) and less likely to be classified as Educators (6% of men; 16% of women) or in Services (24% of men; 40% of women), with smaller differences between the other categories. By 2002, the gender gap in those classified as Managerial and Services had

[17] The European Community Household Panel allows one to categorize graduates into broad occupational groupings. We did perform an analysis of these data, but sample sizes are small, which is particularly problematic when trying to compare the wages of graduates and non-graduates in different occupations. The European Labour Force Survey might enable such an analysis. However, this is a large undertaking, which is beyond the scope of the current study.

much reduced due to a large increase in the percentage of women classified as Managerial (27% of men; 24% of women) and a large reduction in the percentage of women classified as in Services (21% of men; 27% of women).

Table 7b shows the wage differentials in these occupations for men and women, comparing the tertiary educated to high school graduates. With the exception of agriculture, those educated up to tertiary-level receive higher pay than high-school graduates both in 1983 and in 2002. The differential has also increased over that time period in all categories with the exception of Construction/manufacturing, where it has remained unchanged. The largest increase has been in the sectors of expansion: Managerial; Science and Engineering (except for a very large increase in the relative wage paid to female technicians with a tertiary education). For women, the relative pay increase has been quite low for those in Services (up 6 percentage points) in contrast to that for men where the increase has been quite high (up 19 percentage points).

Thus, there has been a change in the sectors that male and female tertiary educated graduates have been attracted to. The increase in supply of the highly educated working in occupations classified as 'Managerial' or 'Science and Technology' has not been accompanied by a decrease in the wage received relative to those educated to a lower level and working in these sectors. This does not suggest an 'over supply' of the highly skilled within these occupations. The fact that the wage differential between these educational categories continued to widen despite the increase in the supply of tertiary educated graduates shows that the relative demand for the tertiary educated increased faster than relative supply over this time period.

4.2 Over-education and Skill mismatch

It sometimes takes a long time for some (usually less well performing) graduates to find jobs after leaving tertiary education and even then, some graduates are not observed in jobs that appear to be well matched to their qualifications. At the same time, shortages in certain sectors are reported.[18]

An empirical literature has developed that attempts to measure this, and the (sometimes misused) terms of 'over-education' and 'under-education' have emerged. The former arises if an individual holds higher qualifications than required by his/her job whereas the opposite applies for the 'under-educated'. There are different ways of measuring over- and under-education. One approach is based on the views of 'work-study experts', who determine the skill needs of an individual's occupation. Another approach is to use surveys of job holders to ascertain their view of the qualifications needed to do a job. A third approach is to calculate the average education levels in an individual's occupation (where the 'over' or 'under' education of an individual is assessed in relation to the average). Groot and Maassen van den Brink (2000) give a detailed discussion of measurement issues. There is an obvious problem in that the human capital acquired in general academic programmes may not map on to the requirements of jobs in a way that is easily quantifiable (e.g. analytical ability developed in general university courses). Furthermore, it is possible that additional (general) human capital is not strictly necessary for doing a particular job but makes the job-holder more productive in a given task. Hence, there are important conceptual difficulties with this literature.

[18] Sectors where 'shortages' are identified vary across countries, but in several countries health care is identified as a relevant sector in this regard (The Netherlands, Belgium, Australia, Sweden). Engineering is also a sector in which 'shortages' are often reported (Belgium, Australia, New Zealand), though certainly not everywhere ('surpluses' are reported in Sweden) – OECD Country Background reports.

In the UK, data from the 2001 Skills Survey suggests that 37% of the UK workforce is 'over-educated' whereas 18% are 'under-educated' (Green and McIntosh, 2002). This issue is also apparent in other countries, as shown in Table 8. For Britain, indications are that the extent of 'over-education' has increased over time - by about 7 percentage points since the mid-1980s (McIntosh, 2005).

As discussed by Wasmer *et al.* (2006), mismatches do 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 at the same educational level. Similarly, 'under-educated' workers might compensate this lack of education with other forms of human capital such as firm specific training and be best suited for their jobs. In other words, the education level of a worker is not the only attribute that makes him/her well matched to a job. The employer observes the education level of the worker in combination with the worker's other characteristics whereas those who measure 'over' or 'under' education are only considering one dimension of the 'match'. In this sense, raw statistics of 'over' and 'under' education are difficult to interpret.

Apparent mismatch may partly be a temporary phenomenon as a consequence, for example, of lack of good information by graduates and employers and constraints on worker mobility (Jovanonvic, 1979). To the extent that this is the case, mismatch would be expected to disappear with time as graduates find more appropriate jobs or they are promoted to a level within a given job (having acquired relevant on-the-job experience) that is commensurate with their level of qualification. However, Albrecht and Vroman (2002) and Dolado *et al.* (2004) show how mismatch can be a long-lasting phenomenon in matching models with job and worker heterogeneity, where high skilled workers can compete with low skilled workers for low skilled jobs. Such circumstances can arise when demand or supply conditions change rapidly, in a way that is not easily matched by the other side of the market. In other words, rapid structural change and limited adaptability of workers with different skills can lead to a situation where workers of a particular skill group can end up working in the 'wrong' sector.

Although there is only limited evidence on the permanence or otherwise of 'over-education' (McIntosh, 2005), a few studies for the UK suggest that a significant proportion of the 'over-educated' remain so defined many years after graduating. Dolton and Vignoles (1997) show that of those graduates who were 'over-educated' in their first job following graduation, two-thirds were still 'over-educated' six years later. In a longitudinal survey, Battu *et al.* (1999) found that 30% of the cohort was 'over-educated' 1 year, 6 years and 11 years after graduation (i.e. at all points in the survey). In the study by Sloane *et al.* (1999), over-educated workers who moved jobs did not result in an improved job match according to the qualifications.

Wasmer *et al.* (2006) look at the issues of over-qualification and skill mismatch using the European Community Household Panel for France, Germany, Italy, Spain and the UK. The measures of over-qualification and skill mismatch are based on two questions asked to individuals in the survey. To illustrate what exactly is meant by 'over-qualification' and 'skill mismatch' they give the following example: if an individual with a PhD in mathematics is working as a university professor, she would be classified as 'non-over-qualified and well matched'. However, if she were working as a research assistant she would be classified as 'over-qualified and but correctly matched' (in the sense that she does have education and training sufficient for the job but her qualification suggests she could work at a higher level). If she worked as the CEO of a multinational firm, she would be classified as 'non-over-qualified and mismatched' because her formal qualifications do not provide the education required for the job, yet she is not 'over-qualified'. Finally, if she were working as an electrician, she would be classified as 'over-qualified and mismatched'. In this case, her

education does not provide the knowledge required in this job and her qualification suggests she should be eligible to apply for a 'higher status' job. In cross-country analysis, they find that the incidence of being 'non-over-qualified and well matched' increases with age and is less common for individuals with a tertiary degree in all countries.

In regressions that control for sector, occupation, and year (as well as some personal characteristics), Wasmer *et al.* (2006) find that the probability of being over-qualified declines with labour market experience in all countries, which goes in line with a transitory interpretation of the incidence of over-qualification. There are important cross-country differences – of the countries considered, the probability of being over-educated is lowest in Italy and highest in the UK.

They also investigate the link between over-qualification, mismatch and wages. They do this by estimating standard wage equations (in a Mincerian framework) with a control for whether the worker is 'over-qualified'. The estimated wage differential is with respect to workers in the same country and year. Regressions also control for gender, marital status, household size, experience, and labour market history (in terms of unemployment). The regression results suggest that being over-qualified does have a wage penalty but the size of this penalty is relatively small (1% lower wages). The authors then re-estimate these regressions but distinguish between the various types of over-qualification and mismatch. They find that skill mismatch has a high wage penalty. On the other hand, if an individual does have appropriate skills but is over-qualified for his/her job, there is no wage penalty to 'over-qualification' in France, Germany or the UK. In other words, there is a wage penalty when there is no correspondence between the skills acquired in formal education and the skills required for a particular job (e.g. a Mathematics graduate working as an electrician); but controlling for this, there is no additional impact of being 'over-qualified' (e.g. an individual with a university degree working in a non-graduate job).[19] However, a wage penalty is found in this case in Spain and Italy. The authors argue that this and other evidence for Spain is consistent with the view that in this country, the expansion of tertiary education has not been sufficiently accommodated by an increase in the demand for skilled jobs (Dolado *et al.* 2004).

Wasmer *et al.* (2006) are also the first to look at the incidence of over/under education in a transition economy – Poland, in this case.[20] They find that the incidence of over-education has increased over the survey period (from about 12% of the workforce in 1997 to 16% in 2003) and is associated with skill mismatch. However, in this context, they conclude that over-education can largely be thought of as a transitory phenomenon, probably arising due to imperfect information and mobility.

Hence, the extent to which 'over-education' is seen as a transitory phenomenon varies both across studies and countries. However, one generalization which can be made is that the fact of observing 'over-qualified' individuals in the workforce does not mean that there is over-supply of tertiary educated graduates. If there were over-supply, relative wages and employment probabilities would fall to the level of their closest substitutes – and this has not happened, as discussed in Section 3. Wasmer *et al.* (2006) imply that it is skill mismatch rather than over-qualification that is the more serious issue, and that the two are correlated. McIntosh (2005) also links skill mismatch with over-qualification for jobs, saying that the real

[19] Note that there may well be personal attributes of workers correlated with both wages and 'skill mismatch' that are not controlled for in the regression (e.g. inherent ability). In this case, the coefficients on 'skill mismatch' can not be interpreted as a causal relationship.

[20] They use the Polish Labour Force Survey, 1997-2003. The measure of 'over-education' is derived by the worker's education in relation to the average educational attainment within his/her occupation. The sample used is full-time employees (age 15-65), excluding agriculture. Wage regressions are estimated controlling for region, sector, firm size and various personal characteristics includes age, year of education, marital status.

problem may be that graduates do not have the skills required by employers and thus they may be measured as 'over-qualified' for the jobs that they are able to get.

In the UK, it would seem (on the basis of Employer Skills Surveys)[21] that it is middle-level jobs, such as skilled manual occupations and associate-professional jobs, such as technicians and engineers, where there is a shortage of specific technical and practical skills, as well as a lack of more generic skills across a range of occupations. McIntosh (2005) argues that this accords well with what we know about qualification attainment in the UK, where the proportion of the population achieving vocational qualifications lags behind both France and Germany, although it is more comparable with regard to the achievement of general qualifications. This also holds true for younger cohorts. A problem in the UK is that there has been a proliferation of vocational qualifications, which has led to a system little understood by employers (Machin and Vignoles, 2005). Criticisms are usually directed at below tertiary-level qualifications (i.e. up to and including level 2 rather than level 3).The latest reforms to try to tackle this have been announced in the 14-19 Education and Skills White Paper (DfES, 2005). The aim is to have a smaller and better understood range of vocational qualifications that will have credibility with employers.

While the shortage of individuals with good vocational qualifications is a major policy issue in the UK, it is interesting to note a rather different argument made by Wasmer *et al.* (2006) in relation to Europe as a whole vis-à-vis the US. They find that the difference in tertiary education between the US and Europe can mostly be attributed to the lack of supply of general and advanced research programmes in Europe. This may matter for economic growth. Wasmer *et al.* (2006) discuss Kumar and Krueger's (2003, 2004) view that the education system in Europe provides a relatively more specialised curriculum as compared to the US. The argument is that this is a source of growth differential between the two areas as the US is able to cope with new technologies in a more reactive way. Wasmer *et al.* (2006) examine this argument in the context of two Eastern European countries - Poland and Estonia – by investigating the effect of two macro economic shocks: the transition to the market economy in the early 1990s and the Enlargement in the late 1990s. The idea is that such large shocks provoke a lot of labour turnover and sector reallocation of workers. If it is more beneficial to have general skills than specific skills, then workers with the latter skills should benefit less (or suffer more) from mobility. Using the Labour Force Survey from these two countries, they test whether workers holding a vocational qualification suffer higher wage losses (or lower wage gains) than similar workers with more general human capital (secondary general). Their evidence is supportive of the hypothesis – they find sizable differences between the two types of worker, suggesting that human capital specificity can be an important limitation in periods of rapid structural change.

This discussion suggests a trade-off between an emphasis on highly specialised education and more general education programmes (as in the US). The former ensures the availability of highly skilled labour trained for specific tasks, at the cost of limited adaptability in the face of major structural change. The latter implies less specificity, but a greater ability to react to changing economic conditions. Arguments put forward by Wasmer *et al.* (2006) and Krueger and Kumar (2003, 2004) suggest that more general education is of greater value to an economy. The argument is supported at a micro-level in the sense that returns to academic qualifications are generally found to be higher than returns to vocational qualifications. Such findings raise questions about the structure of education in many European countries, where students are forced to choose between a general (academic) route and a vocational route at an early age, with limited transferability between the two sectors and perhaps insufficient

[21] The Employer Skills Survey (cited by McIntosh 2005) is based on a structured sample of telephone interviews with 5 or more employees in the nine English regions. The 2002 survey was based on 4,000 such interviews. The survey is designed to investigate the extent, causes and implications of skill deficiencies in England. Further detail can be found in Hillage *et al.* (2002).

'general education' within the vocational route. In fact, on the basis of cross-country evidence in Europe, Bassanini *et al.* (2006) argue that countries with less stratified schooling systems have endowed workers with more versatile skills, who need less training to adapt to technical progress than their counterparts in countries with more stratified schooling systems.[22]

A question that arises is the balance between employer provided training and that provided by institutes of tertiary education (usually publicly provided). The former is likely to have a role in addressing concerns about 'skill mismatch'. If the skills required are specific to the firm, then it is clear that such training should be provided by the firm and not by the public sector. However, if the skills required are more general and transferable across firms, there is some ambiguity about whether it is optimal for firms to provide training (or at least the 'socially optimal' level of training) to their workers. This is one of the issues addressed in a detailed study about workplace training in Europe by Bassanini *et al.* (2006). They discuss the implications of different types of market structure (i.e. competitive versus imperfectly competitive) for how much training profit-maximising firms will seek to provide – showing, for example, that in the case of imperfectly competitive markets, firms will provide a higher amount of more general training. It is interesting to note the very different view of tertiary education that is taken in Japan (Goodman and Yonezawa, 2005). Fewer Japanese students go on to post-graduates studies than for example, in the US and the UK. In part, this has been interpreted as reflecting the reluctance of Japanese employers to hire those who are already so qualified that they may be difficult to train in the company's specific ways of doing things.

With regard to descriptive statistics of training across Europe, indicators shown by Bassanini *et al.* (2006) suggest much heterogeneity across Europe in the extent of work-based training (i.e. average training participation and average annual hours of training per employee). Relative to the US, some European countries appear to perform 'better' -– the UK France and Scandinavian countries have both higher participation and higher annual hours of training. The rest of Europe, including the countries in the 'olive belt' (Greece, Italy, Portugal and Spain) do 'worse' than the US and is somewhat closer to the new entries from Eastern Europe. There are many questions of policy relevance that cannot yet be answered on the basis of existing research (such as whether there is enough employer-based training; how well policies work in raising productivity). Compared to the US, there are few evaluation studies of training policy in Europe and more needs to be done in terms of access to data and in terms of serious policy evaluation. One of the conclusions of the report is that governments have an important role to play in improving information about training opportunities, setting appropriate legal frameworks and ensuring portability of skills.

4.3 Field of Study

One possibility for reports of skill shortage is that individuals are not studying the right type of graduate studies (whether this education is general/academic or vocational). In other words, the choice of higher education made by individuals does not correspond to the needs of the labour market in terms of field of study.

There are relatively few academic studies that estimate returns to higher education by subject of degree – especially when we are most interested in change over time. One of the few such studies is by Machin and Puhani (2006a, 2006b) who investigate this issue for the UK, France and Germany. Their main focus is on the gender wage gap. According to their evidence, a stylized picture in all three countries would characterize men as predominant in

[22] However, this is not the main focus of their study. A more detailed research project would be needed to investigate this issue more thoroughly.

engineering and related fields whereas women are predominant in education and language studies. Because men are more highly concentrated in financially rewarding subjects, subject of degree can explain a significant share of the gender wage gap among graduates in all of these countries (Machin and Puhani, 2003). When looking at changes over time, they find that women in Britain have made more headway into studying degrees with a higher pay-off than has been the case in France or Germany.

Tables 9a and 9b show statistics based on an update of their work (Machin and Puhani, 2006b), which also includes the US. Table 9a shows the percentage of male graduates by degree type in 1993 and 2000, together with the estimated wage return to subject of degree in each period (where Arts is the omitted category). Table 9b shows the same for women. Degree type is defined within four broad categories: Arts; Science/Engineering/Technology; Social Science; Rest/Combined (including Medicine, Education).

If we consider the evidence for men in Table 9a, we can infer that Arts had the lowest relative return within all countries in both time periods.[23] The differential in earnings between having an Arts degree and having some other type of degree is much larger than the earnings differential between the other degree types (i.e. Science/Engineering/Technology; Social Science; Rest/Combined). This is true in both time periods.

Science/Engineering/Technology had the highest return in Britain, Germany and the US in 1993 and by 2000, this had increased in all three countries (although only marginally in the US). In France, there was a higher relative return to Social Science and Rest/Combined in 1993. By 2000, Rest/Combined still had the highest differential, followed by Science/Engineering/Technology and then Social Science. France is the only country where the earnings differential for Arts graduates improved between 1993 and 2000 (even though the earnings premium was still lower than that for other subjects).

To some extent, the ranking of subjects in terms of the wage premium is reflected in the percentage of male tertiary graduates taking subjects in these areas. Science/Engineering/Technology is the largest single category in Britain, France and Germany (where they account for about 40% of graduates). In the US, this is not the case, where the percentage of graduates with Social Science as a degree is much higher (42% compared to 24% in Science/Engineering/Technology in 1993). The smallest category of male graduates in 1993 is accounted for by Arts. However, despite relatively high returns in Science/Engineering/Technology and relatively low returns in Arts, there was very little change in the classification of graduates between 1993 and 2000. The percentage of male graduates with an Arts degree reduced by 1 percentage point in Germany and the US, increased by 1 percentage point in Britain and remained the same in France. The percentage of male graduates with a degree in Science/Engineering/Technology stayed the same in Britain, and increased by 1, 2 and 5 percentage points in the US, Germany and France respectively.

Similarly to estimates for men, we can infer that an Arts degree has the lowest relative rate of return for female graduates (Table 9b). This is true both in 1993 and 2000 for all countries, although the difference between the returns to an Arts degree and the returns to another type of degree are not generally as large for women as they are for men. For women, the estimated rate of return is not always highest for graduates with a degree in Science/Engineering/Technology. This is only the case in the US and (for 2000) in Germany. In Britain in the earlier period, female graduates received the highest return for a degree in the Rest/Combined category. In contrast, returns for Science/Engineering/Technology and Social

[23] Some studies report a zero wage return for Arts and Humanities in the UK relative to non-graduates: see, *inter alia*, Powdthavee and Vignoles (2006).

Science were only slightly higher than that for an Arts degree. By 2000, the earnings premium had increased enormously relative to an Arts degree for all the other degree types. For France in the earlier time period, there was a much larger differential than in Britain between the earnings premium for an Arts degree and that for another degree type – but very little to choose between the non-Arts categories. By 2000, the situation of Arts graduates had improved (though the earnings premium was still much lower than for the other subjects) and differentials had widened a little between the earnings premium available for non-Arts subjects ('Rest/Combined' had the highest premium). In Germany, the earnings premium for Science/Engineering/Technology and Social Science were close in magnitude in 1993 and little changed over time (the premium for Social Science reduced by 2 percentage points). The premium for 'Rest/Combined' reduced by half between the two years, bringing it closer in line with that for other non-Arts subjects by 2000. In the US, there is a substantial difference between the earnings premium accruing to an Arts degree and that for Science/Engineering/Technology (which has the highest premium) and Social Science. However, there is a smaller difference between the earnings premium for an Arts degree and the premium available for Rest/Combined. There has been a modest change over time, reflecting an improvement in the premium available for Arts graduates.

When one looks at the percentage of women graduating in different subject areas, it is interesting to note that in 1993, the highest single category of female graduates was Arts in Britain and France, despite much lower relative returns in France and a small negative differential in Britain at this time. There has been some change in the popularity of this degree type over time - it has declined by 6 percentage points in Britain (from 33 to 27%) and 3 percentage points in France (from 35% to 32%). In all countries but France, the smallest single category of female graduates is in Science/Engineering/Technology, where there has been very little change in classification over the years considered. However, in other cases, there have been bigger relative shifts. In Britain and Germany, the percentage of female graduates classified with 'Rest/Combined' increased by 8 and 6 percentage respectively. The relative rate of return to this degree classification declined in both countries over the time period. In France and the US, the percentage of female graduates classified with a degree in Social Science increased by 8 and 4 percentage points respectively. In France, the relative rate of return to this subject decreased whereas it remained unchanged in the US.

From this study, we can conclude that in the four countries considered returns to a university degree are lowest for Arts subjects and whereas they are higher for other subjects, often highest (at least for men) in Science/Engineering/Technology. This study illustrates that there can be large differences in the rate of return across subject area. However, it would appear that although there is some reaction to changes in relative returns, this only occurs slowly (although changes might appear more dramatic if only younger cohorts of workers were considered). Interesting insights on the responsiveness of graduates to changing labour market conditions are explained by Goodman and Yonezawa (2005) in relation to Japan. Like most of East Asia, the tertiary sector is dominated by private institutions that charge fees. It is reported that as the job market for graduates became increasingly tight during the 1990s, students became more selective about what they studied and more demanding about what they got for their money. Institutes of higher education were reported as having been exposed to increasing pressure to respond to these demands, creating 'Faculty Development programmes' to review their teaching. Many students dropped out of university or attended vocational schools alongside or after university to make themselves more attractive to employers.

Regarding estimated returns to degree subject, this is an area that requires much further work for different countries – especially if we are interested in comparing returns across countries or over time. However, some of the findings by Machin and Puhani (2006a, 2006b) are consistent with what is known about other countries. For example, in Sweden, humanities

is one of the subjects for which the lowest return has been estimated (the others include religious studies, psychology and mathematics/natural sciences) whereas civil engineering is included as one of the subjects for which returns are highest (the others include medicine, business, economics, law).[24] In Estonia, the best salary prospects are in the social sciences, business and law, science and technology.[25] In Spain, Oliver *et al.* (1999) show that double digit rates of return are found for degrees classified as technical, business, engineering, law and economics, health related sciences, whereas the returns to most other types of degree range from 6.4 to 8.2%. However, a negative return is estimated for graduates with degrees classified as 'other social sciences and humanities'. In Australia, Borland (2002) shows that estimated returns are relatively high for business and administration and engineering graduates whereas they are relatively low for graduates in the fields of society and culture and science. In Portugal, engineering degrees are best rewarded, whereas human and social sciences (other than economics) have the lowest return (Pereira and Martins, 2002). In the Czech Republic, variation in the return to a field of study is given by Munich *et al.* (2005) for each level of education under Communism (1989) and Transition (1996). They find that for university-educated men, all premiums almost doubled in size between 1989 and 1996. The high outlier is law, where returns rose by a factor of almost 3 whereas the returns of those trained in health, teaching and 'other social branches' did not change over time.

4.4 Shortage of Science and Technology Graduates?

The previous section described evidence of large returns to Science/Engineering/Technology degrees relative to other subjects (especially for men). The existence of this large differential illustrates the high value placed on the field by employers and indicates high relative demand for graduates with this field of study. This might be interpreted as a 'shortage' of Science and Technology graduates.

Indeed, shortages are reported in several countries – Belgium, Australia, New Zealand (OECD Country Background Reports). In the UK, the Employers Skill Survey suggests that there is a lack of science, mathematics and engineering degrees being obtained, leading to technical skill shortages in associate professional jobs (McIntosh, 2005). Also, Dolton and Vignoles (2000) note that graduates with engineering, technical or science degrees are less likely to be 'overeducated' than graduates in social sciences, arts and languages.

There are big differences between countries in the proportion of graduates who qualify with a degree in Science and Technology. This is illustrated in Table 10, using data from the National Science Foundation (NSF). Comparing across continents in 2000, Asia has the highest percentage of graduates with Science and Technology degrees (32%), which is just above the Europe (28%) and considerably above North America (18%), South America (22%) and Oceania (22%). Within Asia, China has a particularly large share of graduates with a degree in Science and Technology (53%). In fact, even though there is over twice as many graduates in the European Union as there is in China, the number of graduates with a Science and Technology degree in China is four-fifths of that in the European Union. In comparison to the European average, European countries with a relatively high share of such graduates (for 'long' courses, i.e. > 5 years) include Finland (36%), France (51%), the Czech Republic (45%) and Hungary (92%). For 'short courses' (i.e. less than 5 years), Germany (46%) and Austria (45%) stand out. European countries where the proportion of Science and Technology graduates for both short and long courses are particularly low (i.e. in single figures) include Albania, Bulgaria, and Estonia. Within America and Oceania, there is less deviation from the average than in the European case. Countries with a relatively high share of such graduates include Mexico (29%) and Chile (26%).

[24] Wadensjo (1991), as cited in the OECD country report for Sweden.
[25] OECD Country Background Report.

Changes over time in the proportion of first university degrees classified as 'Science and Technology' are available for a few countries using data from the National Science Foundation (the definition includes social science). Statistics are presented in Figure 4 for China, Japan, South Korea, the US and the UK for years between 1975 and 2000-02. The proportion of first university degrees classified as 'Science and Technology' has been consistently higher in China and Japan than it has been in the US. This has also been the case in South Korea (though to a much smaller extent), and trends have been diverging in recent years, with the proportion rising in South Korea and maintaining its flat trend in the US. The country with the greatest shift over time has been the UK, where one sees a sharp downwards shift in the early 1990s (such that the proportion of Science and Technology graduates is very similar to that in the US). Closer examination suggests that this is probably due to the granting of university status to polytechnics in 1992 (i.e. they would have been excluded from the data series prior to this time), and to the implication that such institutions do not award such a high proportion of degrees in this subject area.

The European Commission (2003) report on the growth in the number of Science and Engineering graduates in a number of countries for the periods 1994-96 and 1998-2000 (definition excludes social science). This is shown in Figure 5. Comparing the EU-15, the US and Japan, the average annual growth rate in the earlier period was 2% in the EU compared to just under 1% in the US and a small negative growth rate in Japan. In the more recent period, the average annual growth rates for the EU-15 and the US are more similar (2.5-3%) and lower for Japan (about 1%). Within Europe, there are big differences in the annual average growth rate between countries and (at least for some countries) between the different time periods. Countries that stand out as having had an extremely high annual growth rate (i.e. over 10%) are Sweden, Luxembourg, and Spain for the later period and Spain and Italy for the earlier period. Countries where the growth rate has been negative and below -1% (from -4 to -8%) are Germany in the earlier period and The Netherlands, Denmark and Austria in the most recent period.

Even though the EU has a better performance than the US in terms of Science and Engineering graduates, it lags well behind the US in terms of the proportion of researchers in the labour market. This is shown in Figure 6 for the EU-15, the US, Japan and some countries within the EU (as shown by the European Commission, 2003). It is in the context of catching up with the US and Japan that a potential 'shortage' is discussed in the European Report on Science and Technology Indicators (European Commission, 2003).

Nonetheless, there are claims of a 'shortage' in the US. Freeman (2005) notes that economists have struggled to interpret claims that the US had a shortage of scientific and engineering workers since the 1950s, when such claims first surfaced: in any market-clearing transaction where wages equilibrate demand and supply, there can be no 'shortage' or 'surplus'. Interpretations include that by Arrow and Capron (1959) who see shortages as the result of sluggish wage adjustment; Stigler, who sees shortages as reflecting rapid changes in wages; Freeman (1975, 76) who stresses the cyclic natures of shortages and surpluses in the context of a cobweb model of market adjustment. With regard to engineers (the largest Science and Engineering occupation), Freeman (2005) states that tight labour markets generate large increases in supply that depress the labour market approximately 4-5 years later (although this happens in other fields as well).

Freeman (2005) reports levels and rates of change in pay from the Census of Population. He shows that scientists and engineers earn less than law and medical school graduates and that the rate of increase in earnings for science and engineering in the 1990s fell short of the rates of increase for doctors and lawyers and for persons with bachelor's degrees. However, relatively weak labour market prospects have not prevented a huge flow of immigrants to the

US to specialize in these areas. This is rationalized because US citizens and other permanent residents have access to jobs in more lucrative areas whereas for many foreign-born students or workers, obtaining an S&E education or job is their ticket to the US job market. Hence, the steady flow of immigrants is one reason for why wages are not higher for S&E graduates in the US. Freeman (2005) argues that there is no evidence of a shortage of S&E workers (despite claims to the contrary by employers) and suggests that the real concern is that the US has an adequate supply of scientists and engineers only because of the sizeable influx of foreign-born students and employees. This could be a risk because any interruption in the flow of immigrant scientists and engineers would certainly harm US research and development.

In a report about the apparent scarcity of science and engineering students in the Netherlands, Noailly *et al.* (2005) also discuss the paradox of employers' claims of a shortage of S&E graduates and evidence provided by labour market indicators, which suggests a weakening of the relative position of graduates in science and engineering. Like Freeman (2005), they argue that the internationalization of the labour market for science and engineering graduates might be part of the explanation for this 'puzzle'.

Wasmer *et al.* (2006) also discuss the increasing international mobility of highly skilled professionals, scientists and engineers. They argue that most of the flow has been missed by EU countries and captured by the US and that even within the EU, the mobility of highly skilled workers across countries has been very small. They establish that while the EU12 and the US both seem to have the ability to attract foreign-born college graduates in higher proportion to the average foreign-born, the US seems to have the ability to attract the most educated (those who end up making major contributions to science). They also look at the direct exchange of graduates between Europe and the US and suggest that this illustrates a 'brain-drain' from Europe to the US as opposed to a 'brain exchange'. They conclude that overall in the 1990s, Europe clearly lost the competition to attract international brains and had a substantial outflow of its own 'brains' to the US. Perhaps this partly explains the apparent 'shortage' of science and technology graduates in Europe (though this is something that requires much further research).

One question is whether the loss of S&E graduates really matters. It is claimed that an inadequate number of highly qualified Science and Technology personnel would be a serious obstacle to the growth and expansion of the EU into a knowledge-based economy (European Commission, 2003). But what is the evidence for this? Wasmer *et al.* (2006) attempt to quantify the impact of highly educated workers on technological and scientific progress, where the latter is measured by innovation (using patents as a proxy). They find that highly skilled workers, especially those attracted from abroad have had a very significant impact on innovation. European countries that are losing many highly educated professionals to the US, not attracting many of them from the rest of the world and not spending enough on R&D may be accumulating a lag in innovative potential in science and technology which could lead them behind in productivity growth.

5 How does type of institution matter?

Countries differ across a number of dimensions regarding institutional type. Some have 'unitary' systems whereas others have 'binary' systems. As described by Teichler (1999), the former are clearly dominated by a single university-type institution characterized by 'academic' approaches and at most comprising small segments of other institutions and programmes. He classifies Austria, Italy and the UK (since the 1990s) as being in this category. On the other hand 'binary' systems are characteristed by a duality of academically orientated programmes and institutions on the one hand and others that emphasise a 'vocational' or 'applied' nature of their programmes. He classified Germany, The Netherlands

and Finland (more recently) in this category. Other very important differences between countries in this regard are the extent to which institutions are public or private; centralized or decentralized; consisting of new or long-established institutions.

Institutional change in the last 15 years has been very pronounced in countries that have experienced major political change – federalization in Belgium; decentralization of power in Korea; and most especially the collapse of communism in Central and Eastern European countries. In all these countries there have been legal changes in how higher education institutions operate. They have in common the fact that higher education is more decentralized than it used to be, giving institutions greater autonomy. In some cases, the number of higher education institutions has increased dramatically. In Croatia, the number increased from 63 registered institutions in 1993 to 102 registered institutions in 2003 (primarily due to an increase in the number of non-university institutions). In Estonia, there has been some instability in the number of institutions – declining by a fifth between 2002/03 and 2004/05 (from 49 to 39) following legislation that increased quality and financial requirements.[26] In Korea, the number of institutions increased from 265 in 1990 to 419 in 2004. During the period of military rule in Chile (1973-1990), reforms to the higher education system occurred (in 1980) that led to the proliferation of new private institutions. By 2000, the private sector had captured 71% of total enrolment in higher education (Matear, 2006). In fact, East Asia as a whole is very different from other continents in having a tertiary-education system that is dominated by the private sector (Goodman and Yonezawa, 2005).

It is often noted that graduate outcomes seem to be correlated with type of institution along one or more of these dimensions. For example, in the Netherlands, university graduates have a salary which is, on average, 30% higher than graduates from institutions offering 'professional higher education'. Newspaper reports in Poland suggest that graduates from some higher education institutes have fewer problems in finding a job than others (which appears to be related to the Press rankings of institutions or faculties). In Korean society, 'graduates from prestigious universities hold all the important positions in society' whereas provincial universities and two-year colleges (comprising 60% of tertiary education institutions) have great difficulty in attracting students and the graduates of such institutions find it more difficult to secure employment; in New Zealand, the average annual income of university students is 1.4 times higher than those from institutes of technology and polytechnics; in Japan, salary differences by institution type have been noted, and these seem to show an increasing trend.[27] In Chile, it has been argued that many private universities provide a lower quality university education, which impacts negatively on future graduate prospects in the labour market and potential earnings (Matear, 2006).

Differences in the earnings of graduates who attend different institutions may have a number of explanations. One of the most difficult issues is how to separate the effect of institutional type from the fact that students with very different characteristics may choose to attend different types of institution. For example, higher ability students are more likely to attend higher quality institutions – in this case, it is difficult to know whether to attribute any institution-related premium to higher ability of the student or to the institution he/she attends. If institutions differ according to the type of education provided (e.g. academic versus vocational), differences in the 'higher education institution' premium may reflect differences in how the labour market rewards different types of education rather than reflect anything about the quality of the educational establishment.

[26] Information on the number of institutions in Croatia, Estonia and Korea come from OECD Country Background reports.

[27] Information on the apparent premium to institutions comes from OECD Country Background Reports for The Netherlands, Poland, Korea, New Zealand and Japan.

In a context where participation in tertiary education has greatly expanded and (in many cases) the number of institutions has increased, there are concerns about whether the quality of education received has been deteriorating. There is little empirical evidence to comment directly on this question. However, if employers perceive recent graduates to be of 'lower quality', this should be reflected in the wage returns to higher education. We have seen in the above sections that the wage return to tertiary education has remained high or increased in most countries despite the expansion of tertiary education and in many countries (where evidence is available) this is true of younger cohorts as well as older cohorts. Available evidence on returns to tertiary education in countries where there has been major political reform (as referred to above – often involving important changes in higher education, including the establishment of new institutions) do not seem to be different from other countries in this respect. However, the issue of the role of institutional quality in explaining wage returns to higher education (as well as changes over time) has been very little researched. One would expect wage returns to vary by the quality of institute attended – to the extent that this is understood and rewarded in the labour market by employers.

The academic literature on whether quality of higher education institute matters has mostly been limited to the US. The key issue is how to identify the effect of institutional quality given that students are not randomly sorted across institutions. For example, students of high ability may select (and be selected) into the more elite institutions. If such students earn more in the future, it is not easy to distinguish how much of this is due to the fact they attended higher quality institutions or how much of it is due to their higher average ability. The economics literature on this subject tries to address this issue. It is mainly US-based, where there is by now a fairly large number of studies. The early literature is summarized by Brewer and Ehrenberg (1996). More recent studies include Black and Smith (2006, 2004), Black, Kermit and Smith (2005), Dale and Krueger (2002).

In general, this literature finds evidence for a positive effect of measures of 'college quality' on the subsequent wages of graduates. However, this conclusion is not unanimous and there are a number of controversial issues. One issue is how to measure 'quality'. Most studies rely on a single proxy variable for college quality, typically a measure of the average ability score of those attending the institution (the average SAT score). Black and Smith (2006) call this practice into question – their estimates suggest that such studies understate the wage effects of college quality. However, they also show that the measure most often used is the more reliable signal about college quality. Another controversial issue is how to control for the other attributes of college entrants (such as ability). Most studies rely on a 'selection on observables' assumption, which means that students are selected into institutions on the basis of variables observed by the analyst. Thus, if students were selected into college solely based on measured ability (e.g. the average SAT score), it would be sufficient to control for this in a regression estimating the effect of 'college quality' on earnings. In this case, there would be no confounding of the effect of college quality on earnings with the effect of characteristics important in determining a student's presence in a high quality institution. However, if other student characteristics are important in determining either their choice of institution or how they are selected by institutions, then the problem is not so easily resolved. For example, if student motivation is very important in determining how they are selected (or select themselves) into higher education institutions, then it will be hard to separate the effect of 'high motivation' and high quality institution on future wages. Moreover, 'motivation' is not observed in data sets.

Most studies rely on a 'selection on observables' approach, either in the context of linear regression models or by using propensity score matching (see Black and Smith, 2004). This approach is justified by authors on the basis that they have a rich set of conditioning variables. Black *et al.* (2005) is a recent example of this approach to estimate returns to college quality for men and women in the period from 1987 to 1998 in the US. They find economically

important earnings effects of college quality for men and women, as well as effects on educational attainment, spousal earnings and other demographic factors. They find that effects remain roughly constant over time and result primarily from effects on wages rather than from effects on hours of work. They use a college quality index based on three underlying factors: faculty salaries, freshman retention rates and the average SAT score of entering students. Their findings are in contrast to Dale and Krueger, who find that students who attended more selective colleges earned about the same as students of seemingly comparable ability who attended less selective schools. Although Dale and Krueger also use a 'selection on observables' assumption, the information they have at their disposal is unusually detailed – they know not only where students attended, but which institutions they applied to and the result of their application. They show how this knowledge may help to capture the effect of variables not observed to the analyst (e.g student motivation). Even though they find no average effect of 'college quality' (as measured by average SAT scores of students) on earnings, they do find a heterogeneous return – children from low-income families earn more if they attend selective colleges. Furthermore, they find that higher college resources (as proxied by tuition costs or expenditure) are reflected in earnings. Thus, their findings are not wholly at odds with those reported in other studies.

Black *et al.* (2005) point out that findings of positive effects of college quality on earnings are not surprising, until one reflects on similar studies for schools, where it is difficult to find a relationship between school resources and educational attainment (Hanushek, 2003). They conjecture that the difference in the effectiveness of inputs results from differences in market structure – the higher education market is increasingly competitive in the US while the primary and secondary school market is less so. Therefore, they suggest that finding of positive returns to 'college quality' in the US literature may not generalize to countries with highly centralized university systems. This is something about which there is almost no empirical evidence.

One of the few related studies attempts to look at this issue in the UK (Chevalier and Conlon, 2003), where quality is measured by whether the university is part of an elite group of older universities ('the Russell Group'). Their findings do suggest some positive effect of institutional quality on later earnings. However, the estimates are imprecisely determined and sensitive to specification.

Lindahl and Regnér (2005) look at this question for Sweden. They use detailed administrative data that allow one to control for unobserved family and neighbourhood characteristics. They find significant 'within family' effects on earnings, i.e. a premium that appears to differ between siblings depending on where each person went to college. They find that this 'college effect' is correlated with teacher quality, as measured by the proportion of teachers with a doctoral degree. Thus, the paper contributes to the evidence base that college quality is important and has a payoff in the labour market. However, as acknowledged by the authors, a question that arises concerns the mechanism which leads siblings to choose different institutions. A crucial assumption is that this choice is not driven by another unobserved characteristic which also affects earnings. As siblings can differ in ability, (which is not controlled for) this may be a serious issue. Also, it would be useful to know whether characteristics other than the proportion of teachers with a doctorate are correlated with the college premium since highly qualified teachers may select to work in 'good colleges'.

In summary, on the whole, available evidence suggests that college quality has an effect on earnings. However, this is an area where much more evidence is needed, especially for countries outside the US.

6 Conclusions and Implications

In this report we have set out to produce an evidence base about the impact of the expansion of tertiary education systems on labour markets. One clear conclusion is that the evidence base is much better developed in some areas and for some countries. Returning to the main questions posed in the introduction to this report the main conclusions are as follows:

- Despite very rapid expansions of the tertiary education sectors in many countries, and the resultant big increase in the supply of tertiary graduates, evidence does not suggest over-supply of tertiary graduates because the average wage gap between graduates and non-graduates remains high. This is because relative demand has shifted by at least as much as relative supply as employers increasingly demand tertiary level qualifications among their workforce. In fact, in most countries, the premium attached to a tertiary education has continued to increase or has remained stable despite large increases in supply. Even in the few countries where there has been substantial decline in the wage premium (Spain, New Zealand and Korea) there is still, on average, a large wage premium for having a tertiary-level education. Given the positive relationship between education and economic growth, and the fact that returns to tertiary-level education are strongly positive (and not falling in most countries), there is a good argument for continuing to expand tertiary-level education.[28] This could be achieved by public provision of more places in tertiary-level education. Where capacity constraints are not the issue, then an important matter for investigation is why more young people do not pursue tertiary-level education. One possibility is the cost both in terms of student fees (where these apply) and the opportunity cost (i.e. the earnings students – and possibly their families – must forgo while undertaking tertiary education). Where such constraints exist (most likely for students from poor social backgrounds), there is a good case for bursaries. Another possibility is that there is insufficient information available to potential students about the returns that might be gained from pursuing a tertiary-level education (or returns in certain subject areas). In this case, the appropriate policy response would be to provide this information.

- The increased supply of tertiary graduates has changed labour markets but probably by stimulating extra demand for such workers, an especially important consideration given the evidence that skill-biased technology change has become increasingly important for labour market outcomes (see Acemoglu, 2002a, 2002b, and Machin and Manning, 1997).

- There is evidence that field of study matters, but there is still not a large body of evidence here. Existing evidence remains limited to a few studies in a few countries, especially on changes over time. The evidence which does exist suggests a high level of heterogeneity in returns to tertiary-level education by subject of degree. For example, low (sometimes negligible) returns have been found for qualifications in 'Arts and Humanities' in a number of countries. This raises the question as to why people continue to pursue such qualifications. There are various possible explanations[29]: one is that wages do not capture important aspects of the 'value' of the degree for individuals – for example, higher education has a 'consumption' value as well as a value in the labour market; jobs have non-pecuniary aspects that make them attractive to individuals. Secondly, students may not be well enough informed

[28] Wasmer *et al.* (2006) point out that tertiary-education is under-financed in Europe relative to the US. The share of GDP devoted to higher education is three times lower in Europe than in the US.

[29] There is always a possibility that studies which estimate the returns to degree subject do not deal adequately with 'selection' by subject of degree. This means that there might be individual characteristics correlated with wages and degree subject that are unobserved by the analyst but effect the relationship (e.g. if high ability students are more likely to choose law than humanities, returns to the former will be higher because of the higher average ability of law students and not only because of any actual higher return to a law degree). Collection of very detailed data on student characteristics is the best way to avoid such problems.

about the likely returns to subject of degree. In the latter, case, the policy implication is to provide better information. There is also an argument for permitting university fees (where they exist) to differentiate between subject area and/or to provide bursaries which are differentiated by subject area. Then individuals will have an additional incentive to enter areas in which relative labour demand is particularly high and to avoid subject areas where there is possible 'over-supply'. Such policies require good information on the actual returns to subject of degree. Therefore, this is an area where data collection and analysis should be a priority.

- It would appear that concerns about 'over-education' are largely misplaced, in part because of a rather confusing and sometimes unclear literature on the subject. Labour market indicators suggest that average returns to 'tertiary-level' education are strongly positive (and not falling in most countries). There are also significant difficulties in interpreting studies that purport to show 'over-education'. However, there do appear to be problems with graduates not always having the skills required by employers. This is evident in employer surveys and in some data analysis which shows a negative wage premium associated with 'skill mismatch'. One response to this is to make sure that vocational courses meet the requirements of employers and to ensure that the accreditation system is appropriate. However, it would be unwise to emphasis acquisition of highly specific skills at the expense of general education. A few strands of the literature suggest that 'general education' is of greater economic value and produces workers with more versatile skills. This is a challenge to whole education structures rather than only tertiary-level education since in many countries students are forced to make a decision between 'general' and 'vocational' education before they reach the stage of entering tertiary education.

- There is also a question of the balance between employer-provided training and that provided by institutes of tertiary education. Employers have a role in addressing concerns about 'skill mismatch'. A study on employer training in Europe by Bassanini *et al.* (2006) shows that employers have an incentive to provide high levels of general training (as well as firm-specific training) in certain market conditions. However, there are several questions of policy relevance that cannot be answered by existing research (e.g. is there enough employer-provided training?) and there needs to be more evaluation studies of training policies. One conclusion of this review is that governments have an important role to play in improving information about training opportunities, setting appropriate legal frameworks and ensuring portability of skills.

- There is evidence of shortages of science and technology graduates, in part because the demand for them has been rising so fast that the supply increases have not kept pace. There is evidence of much international mobility among science and technology graduates. The market is such that these graduates will not stay in countries or continents (i.e Europe) when conditions of employment are better elsewhere. There are legitimate concerns about a potential negative impact on R&D and productivity growth.

- The quality of tertiary education institutions does matter for labour market outcomes, but this is also an area where cross-country evidence is somewhat sparse. Almost all the studies about this are in a US context. It has been suggested that the findings of US studies may not be generalisable to countries with highly centralised university systems. Therefore, this is another area where data collection and analysis ought to be prioritized.

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Figure 1 – The Effect of Supply Increases in a Competitive Market

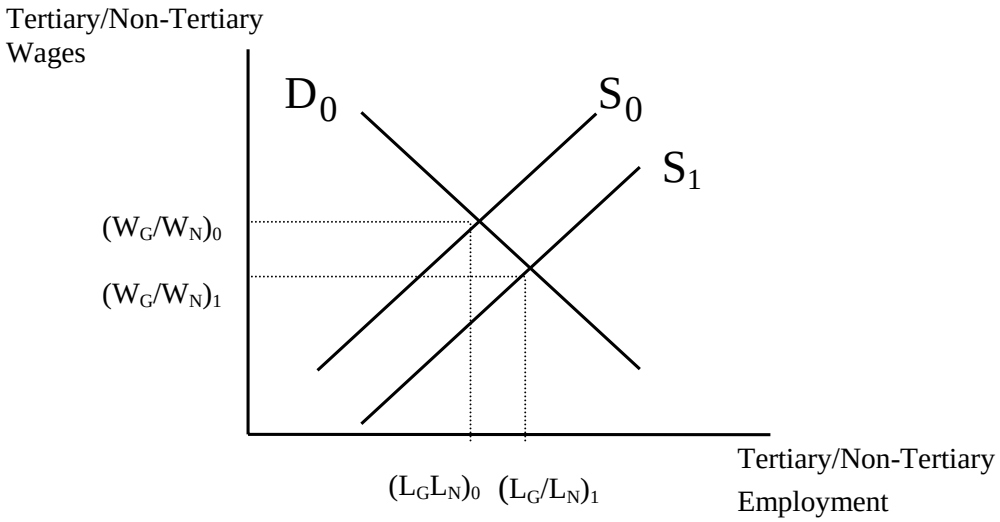


Figure 2 – Incorporating Relative Demand Increases

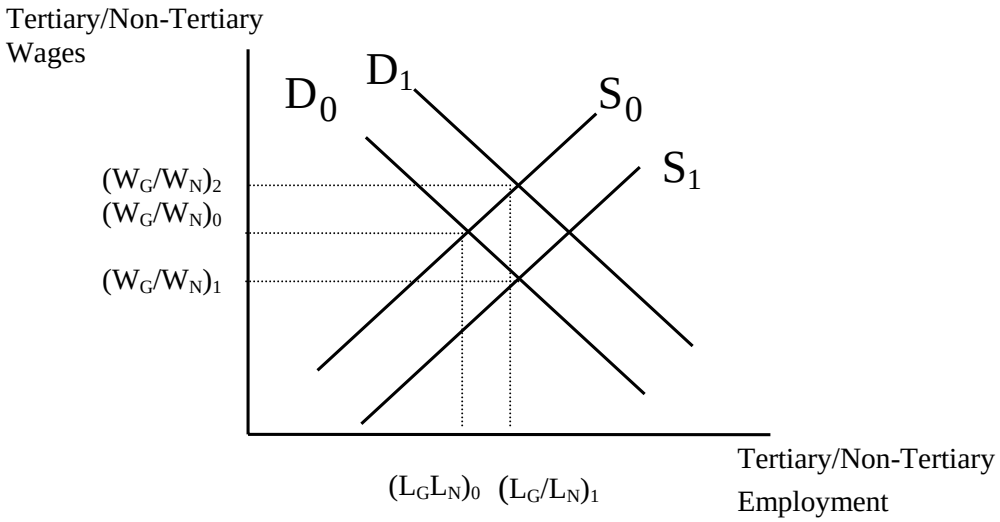
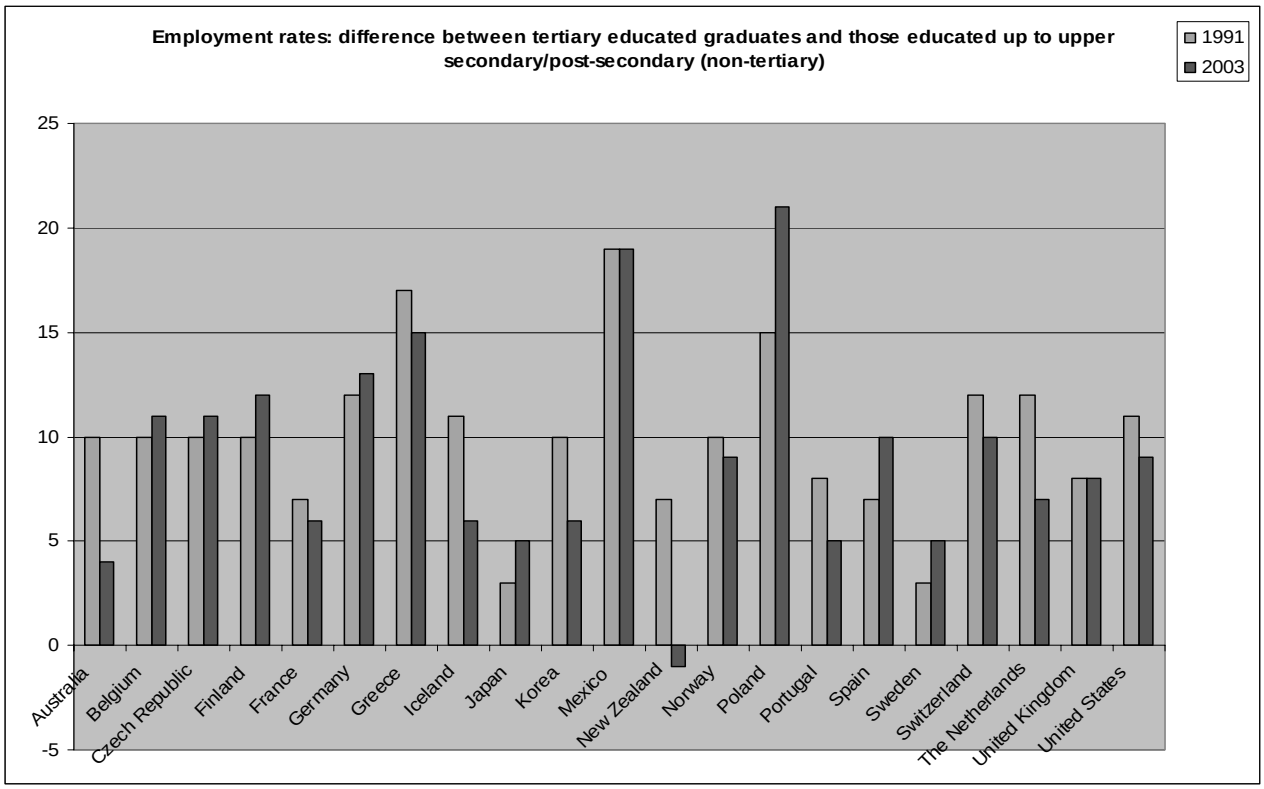


Figure 3


Employment rates: difference between tertiary educated graduates and those educated up to upper secondary/post-secondary (non-tertiary)
1991
2003
25
20
15
10
5
0
-5
Australia
Belgium
Czech Republic
Finland
France
Germany
Greece
Iceland
Japan
Korea
Mexico
New Zealand
Norway
Poland
Portugal
Spain
Sweden
Switzerland
The Netherlands
United Kingdom
United States

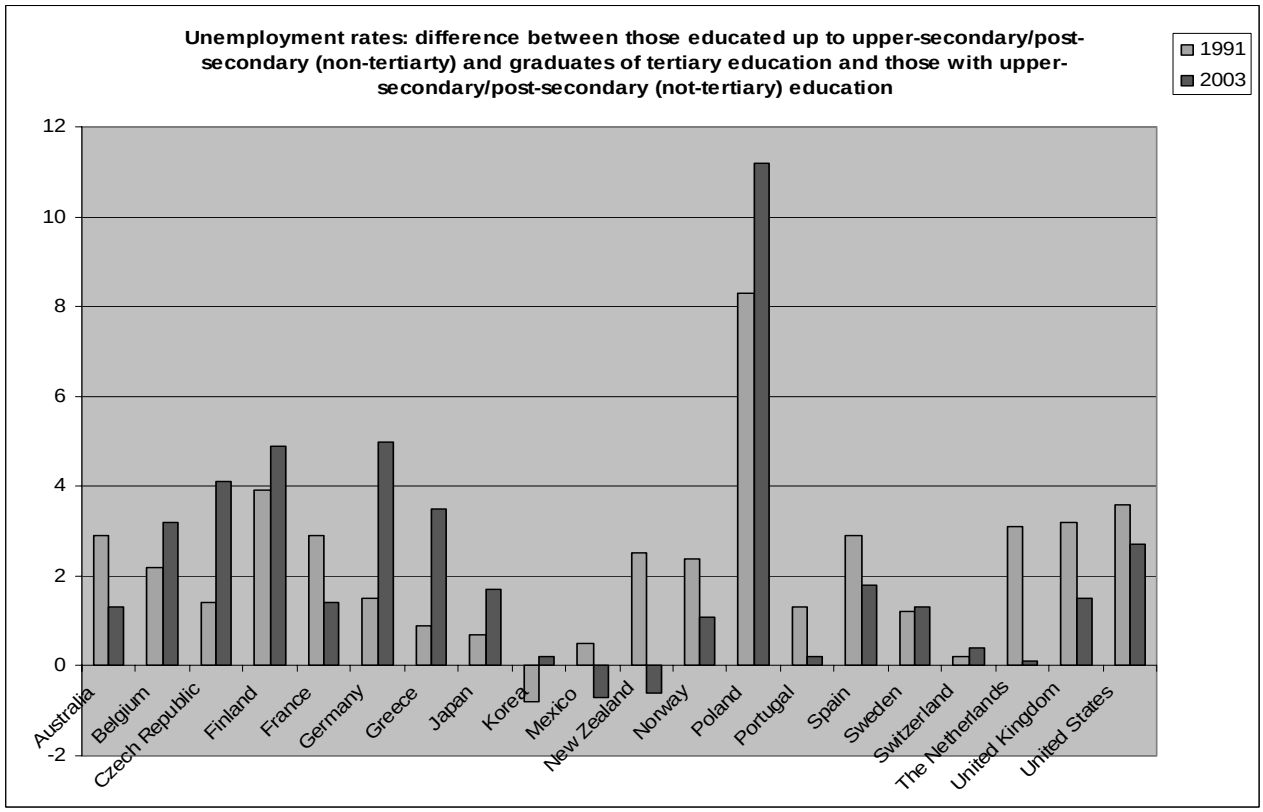
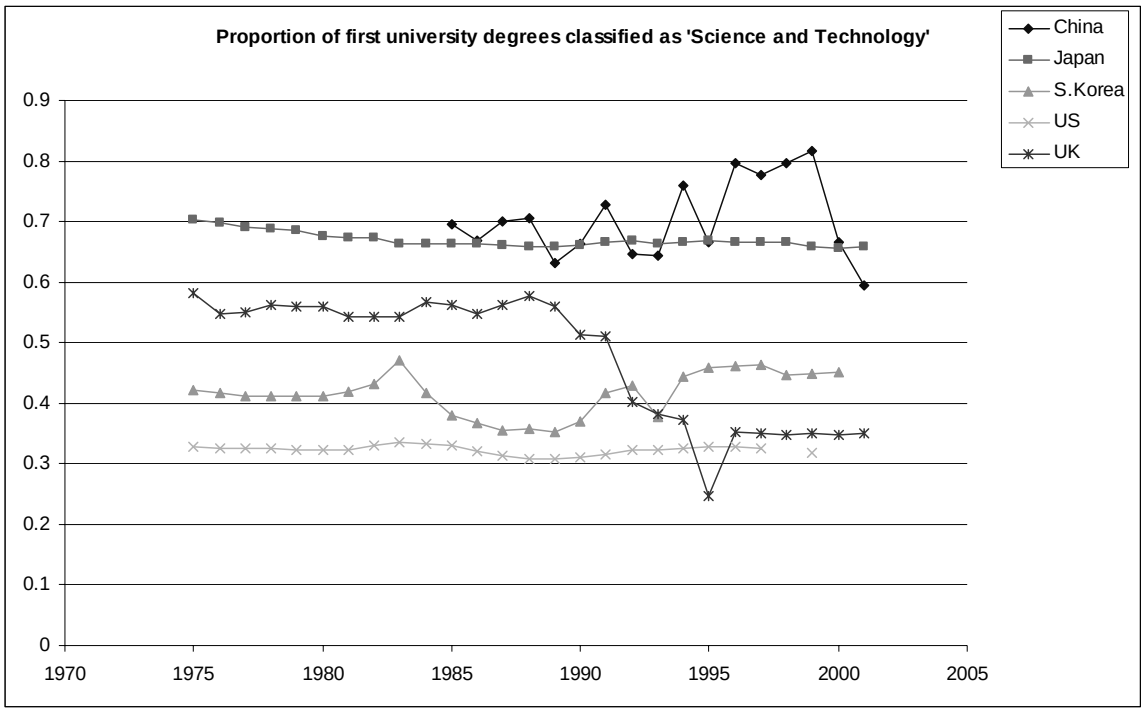
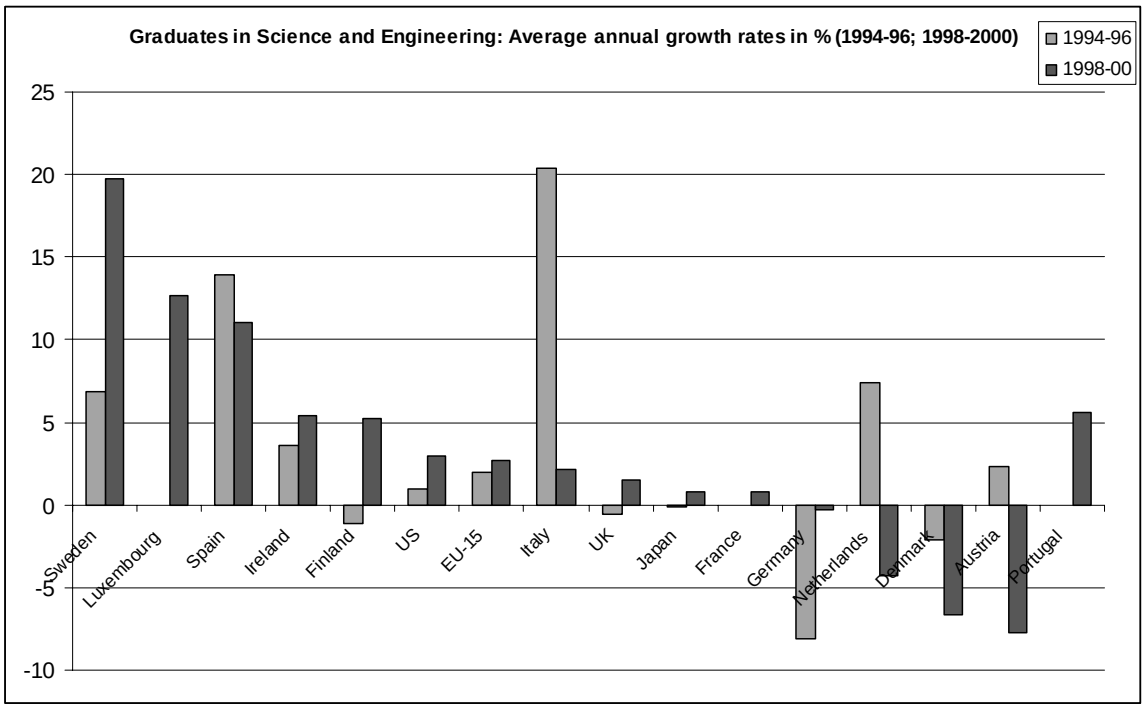

Unemployment rates: difference between those educated up to upper-secondary/post-secondary (non-tertiarty) and graduates of tertiary education and those with upper-secondary/post-secondary (not-tertiary) education
1991
2003
12
10
8
6
4
2
0
-2
Australia
Belgium
Czech Republic
Finland
France
Germany
Greece
Japan
Korea
Mexico
New Zealand
Norway
Poland
Portugal
Spain
Sweden
Switzerland
The Netherlands
United Kingdom
United States

Figure 4



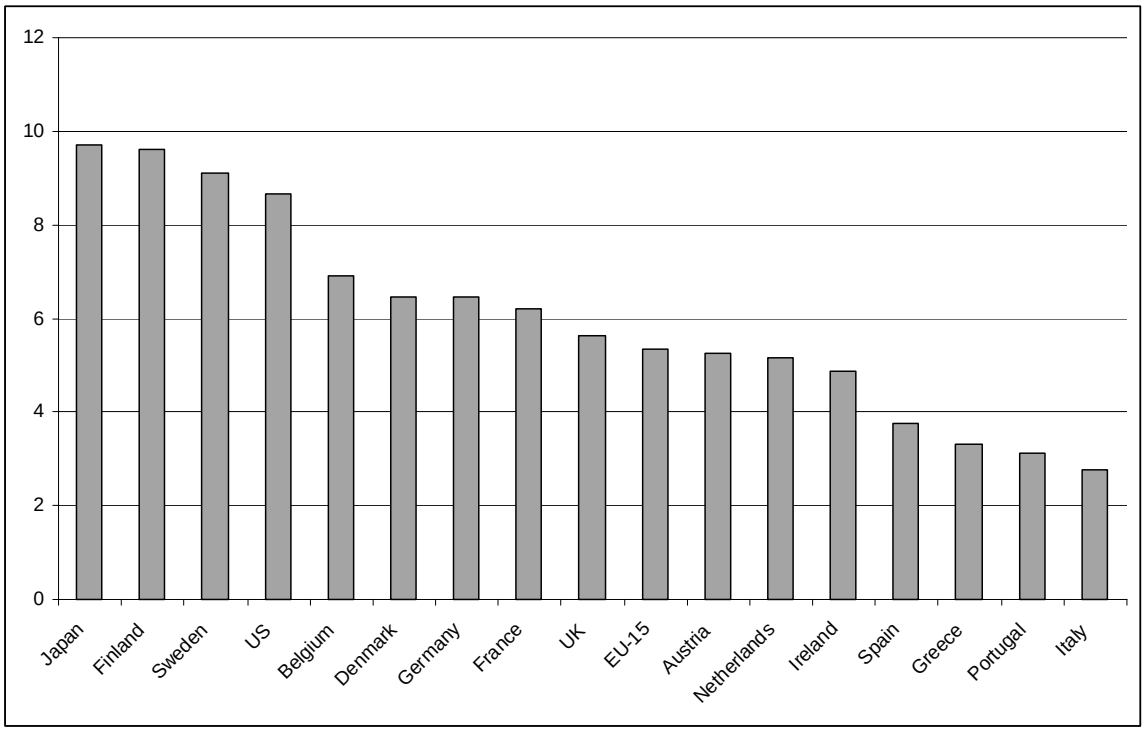
Source: National Science Foundation
http://www.nsf.gov/statistics/seind04/append/c2/at02-33.xls

Figure 5



Source: European Commission (2003). European Report on Science and Technology Indicators, Fig. 4.1.9

Figure 6: S&T researchers per 1000 labour force (1999)



Source: European Commission, 2003. Figure 4.1.2.

Table 1: Percentage of Population (aged 25-64) That Has Attained Tertiary Education – Changes Over Time

	1994	2003
Australia	23	31
Belgium	22	29
Chile*	12	13
China		
Croatia**		15
Czech Republic	10	12
Estonia		
Finland	21	33
France	17	23
Germany	23	24
Greece	18	18
Iceland		26
Japan		37
Korea		29
Mexico		15
New Zealand	21	31
Norway	27	31
Poland		14
Portugal	10	11
Russian Federation*	44	54
Spain	15	25
Sweden	26	33
Switzerland	21	27
The Netherlands	21	24
United Kingdom	21	28
United States	32	38

Source: OECD Education at a Glance
* Data for the earlier time period come from UNESCO. The base year is 1995 for Chile and 1995/96 for the Russian Federation.
** Data comes from OECD Country Background Report

Table 2: Aggregate Trends in Graduate/Non-Graduate Employment and Wages, UK and US

	UK		US	
	% Graduate Share of Employment	Relative Weekly Wage (Full-Time)	% Graduate Share of Employment	Relative Weekly Wage (Full-Time)
1980	5.0	1.48	20.8	1.41
1985	9.8	1.50	24.2	1.53
1990	10.2	1.60	25.7	1.60
1995	14.0	1.60	31.8	1.65
2000	17.2	1.64	31.8	1.69
2004	21.0	1.64	34.2	1.66
Changes:				
1980-2004	16.0	.16	13.4	.25
1980-1990	5.2	.12	4.9	.19
1990-2000	7.0	.04	6.1	.09
2000-2004	3.8	.00	2.4	-.02

Notes: UK - derived from General Household Survey (GHS) and Labour Force Survey (LFS); US derived from Current Population Survey data. UK Updated from Machin and Vignoles (2005). Sample is all people aged 18-64 in work and earning, except for relative wages which are defined for full-time workers. The relative wage ratios are derived from coefficient estimates on a graduate dummy variable in semi-log earnings equations controlling for age, age squared and gender (they are the exponent of the coefficient on the graduate dummy).

Table 3a: Wage Differentials – Tertiary Versus Upper Secondary and Post Secondary Non Tertiary (= 100) – Changes Over Time: 1997-2003 (except where indicated)

	1997	2003
Australia	124	133 *(2001)*
Belgium		130
Chile		
China		
Croatia		
Czech Republic	179	
Estonia		
Finland	148	150 *(2002)*
France	149	150 *(2002)*
Germany	134	153
Greece		
Iceland		
Japan		
Korea	135 *(1998)*	141 *(2003)*
Mexico		
New Zealand	148	126
Norway	138	135 *(2002)*
Poland		
Portugal	176	
Russian Federation		
Spain	149	129 *(2001)*
Sweden	129	132
Switzerland	152	156
The Netherlands	141	148 *(2002)*
United Kingdom	153	162
United States	168	172

Source: OECD Education at a Glance

Table 3b: Wage Differentials for Men – Tertiary Versus Upper Secondary and Post Secondary Non Tertiary (= 100) – Changes Over Time: 1997-2003 (except where indicated)

	1997	2003
Australia	136	142 *(2001)*
Belgium		132
Chile	178	
China		
Croatia		
Czech Republic		
Estonia		
Finland	159	163 *(2002)*
France	158	159 *(2002)*
Germany	130	150
Greece		
Iceland		
Japan		
Korea	132 *(1998)*	127
Mexico		
New Zealand	148	132
Norway	138	138 *(2002)*
Poland		
Portugal	178	
Russian Federation		
Spain	154	138 *(2001)*
Sweden	135	140
Switzerland	134	136
The Netherlands	139	143 *(2002)*
United Kingdom	147	151
United States	168	177

Source: OECD Education at a Glance

Table 3c: Wage Differentials for Women – Tertiary Versus Upper Secondary and Post Secondary Non Tertiary (= 100) – Changes Over Time: 1997-2003 (except where indicated)

	1997	2003
Australia	137	146 *(2001)*
Belgium		132
Chile		
China		
Croatia		
Czech Republic	170	
Estonia		
Finland	143	146 *(2002)*
France	146	146 *(2002)*
Germany	131	
Greece		145
Iceland		
Japan		
Korea	141 *(1998)*	176
Mexico		
New Zealand	143	132
Norway	140	140 *(2002)*
Poland		
Portugal	168	
Russian Federation		
Spain	145	125 *(2001)*
Sweden	125	132
Switzerland	146	153
The Netherlands	143	155 *(2002)*
United Kingdom	167	180
United States	166	167

Source: OECD Education at a Glance

Table 4: Coefficient on tertiary attainment for from Mincerian wage equations (OECD, 2006)

Country	Estimated coefficient on 'tertiary attainment'
Austria	0.30
Belgium	0.30
Denmark	0.24
Finland	0.31
France	0.27
Germany	0.23
Greece	0.26
Ireland	0.37
Italy	0.28
The Netherlands	0.27
Portugal	0.65
Spain	0.28
UK	0.18
US	0.25

Source: OECD (2006), The Policy Determinants of Investment in Tertiary Education: Data and Methodological Issues. Table 5.
Notes: Dependent variable is log gross wages (2001) Males only.
Regressors include gender, age, marital status, whether working in public sector; whether working part-time; tenure of current job; contract type.
The return is estimated relative to an individual with upper secondary education
All coefficients are statistically significant at 1% level

Table 5: Findings from selected studies on the evolution of returns to higher education

	Return to HE	**Note**
Australia	High rate of return to HE (12-15%) in 1997 according to Borland *et al.* (2000) that is comparable with that found in for 1989/90 in another study (Malagen, 1994)	Malagen (1994) finds a rate of return of 13.5%.
China	High rate of return to HE (11-13%) that has increased over time (Heckman and Li, 2003)	Heckman and Li (2003) estimate the return to college education in 2000 for young people in urban areas of six provinces of China. They conclude that returns have increased over time based on comparisons with earlier studies.
Greece	Tsaklogou and Cholezas (2005) estimate wage returns to years of education between 1974 and 1999. Returns reduced in the 1980s before reverting about a decade later and then increased in the 1990s (although the estimated return to a year of education never fell below 5%).	Tsaklogou and Cholezas argue that changes in the institutional framework are an important component – changes in the administration of the minimum wage and policy changes following the election of a Socialist government led to a more compressed wage structure in the 1980s but were reversed in the 1990s, when the labour market was also gradually liberalised and there was an influx of low-skilled immigrant workers. As a result, wage differentials across skill levels rose and private returns to education increased accordingly.
Japan	Katz *et al.* (1995) show that in the 1980s, the college wage premium increased slightly and moderately for new entrants	The changes in the education and gender wage differentials in Japan in the 1980s are qualitatively similar to analogous changes in the US, though much smaller in magnitude. The analysis is from 1974 to 1990.
Korea	Kim and Topel (1995) show that the rapid skill upgrading of the workforce between 1970 and 1990 led to a reduction in wage inequality (i.e. the college and high-school wage premia fell).	Very rapid expansion of education led to a large reduction in the wage premia of highly educated workers. However, it should be noted that there is a positive wage premium to college education – though this is smaller than in the US.
Mexico	With the exception of one year (1996), Cortez (2001) finds a clear tendency for the wage premium at the lower end of the distribution to decline while the premium for college education improved.	Cortez (2001) estimates Mincerian wage equations for Mexican workers between 1984 and 1996, during which time there was an expansion of tertiary education. Results are consistent with Lopez-Acevedo (2001), who argues that the shift in demand towards high-skilled workers was not met by a commensurate increase in the supply and that this can be attributed to the rapid rate of skill-biased technical change.
New Zealand	Premium to HE reflected in income, which has increased over time (Maani, 1999; Penny 2005). Manni and Maloney (2004) use a different data set and find no evidence that rates of return changed between 1997 and 2002	Manni (1999) uses census data on total income. Benefits of HE considered from 1981 to 1986. Penny (2005) replicated analysis up to 2001. Manni and Maloney (2004) use the Household Labour Force Survey Income Supplements.
Norway	Modest rate of return to a year of college (4-6%), stable over time (Hoegeland *et al.*, 1999); Aakvik *et al.* (2003) find strongly non-linear returns to education. In particular, the returns to upper secondary school and shorter programs at regional colleges, together with masters programs at universities have high wage returns	Hoegeland *et al.* (1999) look at education-earnings profiles in 1980 and 1990. Aakvik *et al.* (2003) have an identification strategy which is based on educational reforms in Norway between the 1960s to the 1990s.
Portugal	Cardoso (2004) find that the premium to a university degree increased over the period 1986 to 1999; Pereria and Martins (2002) show that returns to education in Portugal are high by European standards (particularly for higher education).	Cardoso's findings support that shown in other work for the 1980s and early 1990s: Machado and Mata (2001), Cardoso (1999), Hartog *et al.* (2001).

Table 5: Findings from selected studies on the evolution of returns to higher education (continued)

	Return to HE	**Note**
Spain	Oliver *et al.* (1999) show high rates of return to a university degree in Spain (estimated for 1990) Dolado *et al.* (2000) suggest that there is a deceleration in the returns to schooling. Relative wages for educated workers have, if anything, become stagnant over the last decade.	Oliver *et al.* (1999): The estimated return varies greatly depending on subject of degree. Dolado *et al.* (2000): Due to new organizational structures implied by information technologies, more educated workers have 'crowded out' older, less educated people from their traditional jobs. This, together with characteristics of collective bargaining in Spain have led to a decline in the returns to higher education.
Sweden	Gustavsson (2004) finds that the university wage premium has increased noticeably between 1992 and 2001.	Changes in the university wage premium match closely to changes in relative supply until the mid 1990s. From then on, the university wage premium increased at the same time as the relative supply of university educated individuals. This suggests that Sweden has seen an accelerated relative demand for university-educated workers in recent years.

Table 6a: Employment and Unemployment Rates by Education – Changes Over Time, 1991-2003 (except where indicated)

	Men and Women							
	Employment rates				Unemployment rates			
	Upper Secondary and Post Secondary Non-tertiary		Tertiary		Upper Secondary and Post Secondary Non-tertiary		Tertiary	
	1991	2003	1991	2003	1991	2003	1991	2003
Australia	71	79	81	83	6.8	4.3	3.9	3.0
Belgium	75	73	85	84	4.2	6.7	2.0	3.5
Chile								
China								
Croatia								
Czech Republic	82 (‘95)	75	92 (‘95)	86	2.1 (‘95)	6.1	0.7 (’95)	2.0
Estonia								
Finland	78	73	88	85	7.3	9.2	3.4	4.3
France	78	76	85	82	6.6	7.5	3.7	6.1
Germany	74	70	86	83	4.7	10.2	3.2	5.2
Greece	62 (‘95)	67	79	82	9.0 (‘95)	9.1	8.1 (’95)	5.6
Iceland	89 (‘98)	89 (‘02)	100 (‘98)	95 (‘02)		2.6 (‘02)		
Japan	76 (‘98)	74	79 (‘98)	79	3.3 (‘98)	5.4	2.6 (’98)	3.7
Korea	70	70	80	76	1.9	3.2	2.7	3.0
Mexico	63 (‘95)	63	82 (‘95)	82	5.2 (‘95)	1.9	4.7 (’95)	2.6
New Zealand	73	82	80	81	7.3	2.9	4.8	3.5
Norway	80	80	90	89	4.4	3.6	2.0	2.5
Poland	70 (‘95)	62	85 (‘95)	83	11.1 (‘95)	17.8	2.8 (’95)	6.6
Portugal	84	82	92	87	4.5	5.1	3.2 (’95)	4.9
Russian Federation								
Spain	72	72	79	82	12.2	9.5	9.3	7.7
Sweden	91	81	94	86	2.3	5.2	1.1	3.9
Switzerland	80	80	92	90	1.5	3.3	1.3	2.9
The Netherlands	73	80 (‘02)	85	87 (‘02)	4.6	2.2 (‘02)	1.5	2.1 (’02)
United Kingdom	78	80	86	88	6.5	3.9	3.3	2.4
United States	74	73	85	82	6.5	6.1	2.9	3.4

Source: OECD Education at a Glance

Table 6b: Employment and Unemployment Rates by Education – Changes Over Time, 1991-2003 (except where indicated)

	Men							
	Employment rates				Unemployment rates			
	Upper Secondary and Post Secondary Non-tertiary		Tertiary		Upper Secondary and Post Secondary Non-tertiary		Tertiary	
	1991	2003	1991	2003	1991	2003	1991	2003
Australia	81	87	88	89	6.5	3.6	3.7	3.2
Belgium	87	82	91	87	2.0	5.4	1.5	3.5
Chile								
China								
Croatia								
Czech Republic	87 (‘95)	84	93 (‘95)	92	1.7 (‘95)	4.3	0.5 (‘95)	1.8
Estonia								
Finland	81	75	90	87	9.1	9.5	4.1	4.2
France	87	82	90	86	5.0	6.1	2.8	5.8
Germany	83	75	90	86	3.7	10.5	2.5	4.7
Greece	83 (‘95)	84	86	86	6.0 (‘95)	5.8	5.7 (‘95)	4.0
Iceland	95 (‘98)	93 (‘02)	98 (‘98)	97 (‘02)				
Japan	93 (‘98)	89	95 (‘98)	93	3.4 (‘98)	5.5	2.1 (‘98)	3.5
Korea	92	86	93	90	2.1	3.5	2.8	3.1
Mexico	90 (‘95)	93	91 (‘95)	91	6.3 (‘95)	2.2	4.5 (‘95)	2.7
New Zealand	82	90	87	87	7.7	3.2	5.5	3.3
Norway	85	83	93	91	4.8	4.0	2.3	2.6
Poland	77 (‘95)	68	88 (‘95)	85	9.6 (‘95)	16.3	2.8 (‘95)	6.6
Portugal	88	84	94	89	4.7 (‘95)	4.2	3.5 (‘95)	4.4
Russian Federation								
Spain	87	85	86	87	7.3	6.0	5.8	5.4
Sweden	92	83	95	86	2.7	5.5	1.2	4.9
Switzerland	94	89	96	93	0.8	3.1	1.3	2.9
The Netherlands	86	87 (‘02)	92	91 (‘02)	2.5	1.7 (‘02)	3.6 (‘95)	2.0 (‘02)
United Kingdom	86	85	92	90	6.8	4.1	3.1	2.7
United States	83	79	91	87	7.2	6.7	3.2	3.6

Source: OECD Education at a Glance

Table 6c: Employment and Unemployment Rates by Education – Changes Over Time, 1991-2003 (except where indicated)

	Women							
	Employment rates				Unemployment rates			
	Upper Secondary and Post Secondary Non-tertiary		Tertiary		Upper Secondary and Post Secondary Non-tertiary		Tertiary	
	1991	2003	1991	2003	1991	2003	1991	2003
Australia	54	66	73	78	7.7	5.7	4.3	2.8
Belgium	62	63	78	80	7.5	8.5	2.7	3.5
Chile								
China								
Croatia								
Czech Republic	77 (‘95)	66	89 (‘95)	79	2.7 (‘95)	8.5	1.0 (‘95)	2.3
Estonia								
Finland	74	71	87	83	4.9	8.8	2.7	4.4
France	68	69	79	78	8.9	9.4	4.8	6.4
Germany	63	64	78	78	6.0	9.9	4.7	6.0
Greece	42 (‘95)	51	71	77	14.2 (‘95)	13.8	11.4 (‘95)	7.6
Iceland	80 (‘98)	84 (‘02)	92 (‘98)	93 (‘02)				
Japan	61 (‘98)	60	61 (‘98)	64	3.1 (‘98)	5.3	3.5 (‘98)	4.1
Korea	41	52	50	56	1.5	2.6	2.0	2.8
Mexico	55 (‘95)	55	67 (‘95)	70	4.6 (‘95)	1.7	5.0 (‘95)	2.4
New Zealand	61	72	75	77	6.5	3.5	4.1	3.7
Norway	74	76	87	86	3.9	3.1	1.5	2.4
Poland	63 (‘95)	55	82 (‘95)	81	13 (‘95)	19.7	2.8 (‘95)	6.7
Portugal	80	79	91	86	6.4	6.0	3.0 (‘95)	5.2
Russian Federation								
Spain	53	59	71	76	21.5	14.3	13.6	10.1
Sweden	89	79	94	86	1.8	4.8	1.1	2.9
Switzerland	67	73	83	83	2.3	3.4	1.2	3.0
The Netherlands	58	72 (‘02)	74	82 (‘02)	8.2	2.8 (‘02)	3.9	2.3 (’02)
United Kingdom	69	74	79	85	6.1	3.5	3.7	1.9
United States	66	68	79	77	5.7	5.4	2.6	3.1

Source: OECD Education at a Glance

Table 7a: Occupations of Tertiary Educated – Changes Over Time From US Current Population Survey

	Men and Women		Men		Women	
	1983	2002	1983	2002	1983	2002
Managerial	20	26	23	27	14	24
Science and Engineering	12	15	13	16	11	15
Educators	10	10	6	6	16	16
Law and Other Professional	9	10	9	9	8	10
Technicians	5	4	4	4	6	5
Service	30	24	24	21	40	27
Construction/Manufacturing	12	9	18	14	4	2
Agricultural	2	2	3	2	1	1

Source: Current Population Survey microdata.

Table 7b: Wage Differentials for Occupations of Tertiary Educated Relative to High School Graduates (HS Grad = 100) - Changes Over Time From US Current Population Survey

	Men		Women	
	1983	2002	1983	2002
Managerial	151	177	151	171
Science and Engineering	163	192	168	193
Educators	111	126	139	142
Law and Other Professional	124	146	149	160
Technicians	131	146	108	147
Service	109	128	109	116
Construction/Manufacturing	111	111	109	109
Agricultural	74	86	78	91

Source: Current Population Survey microdata

Table 8: 'Over-Education' and 'Under-Education'

Country	Incidence of over-education	Incidence of under-education
The Netherlands (1995)	24%	12%
Spain (1990)	28%	11%
Portugal (1992)	33%	38%
USA (1976)	33%	20%

Source: Hartog (2000)

Table 9a: Tertiary graduates - men

	% tertiary graduates by degree type		Estimated wage return (relative to Arts)	
	1993	**2000**	**1993**	**2000**
Britain				
Arts	14	15	--	--
Science/Engineering/Technology	39	39	0.18	0.25
Social Science	29	29	0.12	0.21
Rest/Combined (incl. Medicine, education)	17	17	0.17	0.17
Observations	2,153	9,420	1,357	2,868
France				
Arts	13	13	--	--
Science/Engineering/Technology	37	42	0.31	0.20
Social Science	29	32	0.37	0.18
Rest/Combined (incl. Medicine, education)	21	13	0.40	0.24
Observations	576	4,892	353	3,470
Germany				
Arts	7	6	--	--
Science/Engineering/Technology	41	43	0.19	0.25
Social Science	28	26	0.15	0.20
Rest/Combined (incl. Medicine, education)	24	25	0.18	0.20
Observations	13,479	14,980	11,257	12,358
United States*				
Arts	13	14	--	--
Science/Engineering/Technology	24	25	0.34	0.35
Social Science	42	41	0.30	0.34
Rest/Combined (incl. Medicine, education)	21	20	0.17	0.16
Observations	78,087	50,926	60,433	36,557

* Data in later period refers to 2003

Source: Machin and Puhani (2006b)

Notes: Wage returns are estimated from Mincerian wage equations, where controls include age, age squared, industry, region, and dummies for part-time and public sector employment (in Britain, it was not possible to control for public-sector employment).

Data sources are the German Labour Force Survey; The French Labour Force Survey (for the later period); the Formation et Qualification Professionnelle (for the earlier period in France); the UK Labour Force Survey (for the later period); the General Household Survey (for the earlier period in the UK); the National Survey of College Graduates in the US.

There are some data quality concerns regarding the French data for 1993.

Table 9b: Tertiary graduates – women

	% tertiary graduates by degree type		Estimated wage return (relative to Arts)	
	1993	**2000**	**1993**	**2000**
Britain				
Arts	33	27	--	--
Science/Engineering/Technology	17	15	0.02	0.16
Social Science	30	29	0.02	0.10
Rest/Combined (incl. Medicine, education)	20	28	0.08	0.18
Observations	1,337	7,291	631	1,881
France				
Arts	35	32	--	--
Science/Engineering/Technology	21	20	0.21	0.12
Social Science	26	34	0.22	0.08
Rest/Combined (incl. Medicine, education)	18	14	0.20	0.14
Observations	411	4,262	186	2,544
Germany				
Arts	16	13	--	--
Science/Engineering/Technology	12	12	0.09	0.09
Social Science	26	23	0.07	0.05
Rest/Combined (incl. Medicine, education)	46	52	0.14	0.07
Observations	7,068	8,844	3,266	4,461
United States*				
Arts	19	17	--	--
Science/Engineering/Technology	8	10	0.21	0.18
Social Science	27	31	0.17	0.14
Rest/Combined (incl. Medicine, education)	46	42	0.06	0.02
Observations	56,599	40,113	36,654	24,300

* Data in later period refers to 2003

Source: Machin and Puhani (2006b)
Notes: results across countries and gender may be influenced by the fact that the ratio of males to females who work full-time differs between countries and time periods. Also see notes under Table 4a.

Table 10: Number of First University Degrees, 2000

	All first university degrees	All Science & Engineering (S&E)	Excluding Social Science	% S & E (excluding Social Science)
Asia	2,528,607	1,176,103	819,900	32%
China (2001)	567,839	337,352	302,085	53%
Japan (2001)	542,314	359,019	137,719	25%
South Korea	209,747	96,859	85,093	41%
Europe	2,348,771	836,456	663,216	28%
European Union	1,330,025	477,973	370,227	28%
Austria (short)	1,662	744	744	45%
Austria (long)	13,470	4,434	3,377	25%
Belgium (long)	22,526	8,211	5,815	26%
Denmark (1998)	11,951	4,962	3,037	25%
Finland (short)	13,441	4,662	4,464	33%
Finland (long)	11,828	5,521	4,202	36%
France (short)	226,314	91,030	59,973	26%
France (long)	49,002	25,130	25,130	51%
Germany (short) (2001)	56,681	25,868	25,808	46%
Germany (long) (2001)	121,937	39,295	31,471	26%
Greece (long)	18,556	4,576	4,355	23%
Iceland (short)	1,318	354	232	18%
Ireland	18,669	6,636	5,846	31%
Italy (short)	11,568	3,729	3,670	32%
Italy (long)	139,109	53,534	39,072	28%
Netherlands (short)	66,932	17,586	12,125	18%
Netherlands (long)	2,877	607	607	21%
Portugal (short)	2,587	425	393	15%
Portugal (long)	23,482	7,823	4,138	18%
Spain (short)	87,464	23,302	23,302	27%
Spain (long)	120,114	42,511	28,536	24%
Sweden (short)	32,573	11,475	9,583	29%
Sweden (long)	1,524	379	101	7%
United Kingdom[a] (2001)	274,440	95,180	74,250	27%
European Free Trade Association	41,449	11,005	7,765	19%
Norway (short)	17,959	3,166	1,402	8%
Norway (long)	4,462	1,694	1,414	32%
Switzerland (short)	7,648	2,488	2,365	31%
Switzerland (long)	11,380	3,657	2,584	23%
Central/Eastern Europe	977,297	347,478	285,224	29%
Albania (long)	4,350	436	307	7%
Armenia (long)	10,206	1,343	N/A	N/A
Bulgaria	20,166	4,798	892	4%
Croatia	8,847	3,003	2,787	32%
Czech Republic (short)	10,010	3,484	1,656	17%
Czech Republic (long)	15,534	7,550	6,948	45%
Estonia	2,272	289	202	9%

Table 10: Number of First University Degrees, 2000 (continued)

	All first university degrees	All Science & Engineering (S&E)	Excluding Social Science	% S & E (excluding Social Science)
Georgia	19,797	4,824	4,714	24%
Hungary (short)	30,320	4,320	4,320	14%
Hungary (long)	16,658	17,364	15,341	92%
Latvia (short)	9,051	2,374	1,232	14%
Latvia (long)	9,114	1,695	862	9%
Lithuania	11,617	3,983	3,453	30%
Macedonia[b]	3,180	943	875	28%
Poland (1996)	147,536	43,304	29,162	20%
Romania (short)	39,013	11,899	9,870	25%
Romania (long)	27,631	8,479	7,015	25%
Russia (long) (1999)	554,814	216,017	183,729	33%
Serbia-Montenegro[b]	12,545	4,477	4,154	33%
Slovak Republic (short)	5,226	851	775	15%
Slovak Republic (long)	14,903	4,630	4,398	30%
Slovenia	4,507	1,415	1,189	26%
America	1,907,776	622,870	363,477	19%
North America	1,531,958	500,391	281,257	18%
Canada	116,160	53,307	26,647	23%
Costa Rica	4,393	1,074	810	18%
Cuba	16,769	3,374	2,966	18%
Mexico	135,233	42,049	38,711	29%
Nicaragua (1997)	6,282	1,965	1,689	27%
United States	1,253,121	398,622	210,434	17%
South America	375,818	122,479	82,220	22%
Argentina (1996)	37,878	16,106	8,781	23%
Bolivia	15,341	5,115	4,118	27%
Brazil (1996)	245,401	78,049	50,628	21%
Chile (1996)	23,010	10,531	6,015	26%
Colombia (1996)	54,188	12,678	N/A	N/A
Oceania	133,713	34,188	28,862	22%
Australia (short)	106,985	28,737	24,000	22%
Australia (long)	5,760	1,122	941	16%
New Zealand (short)	17,177	3,529	3,121	18%
New Zealand (long)	3,791	800	800	21%

Source: As derived from National Science Foundation (selected countries)
http://www.nsf.gov/statistics/seind04/append/c2/at02-33.xls

Note: Science and Engineering degrees (excluding social science) include natural, agricultural, and computer sciences; mathematics; and engineering. Data for first university degrees use the International Standard Classification of Education (ISCED 97), level 5A.

[a] Includes former colleges and polytechnics. Data for the United Kingdom were revised. Data are now rounded to the nearest 10. Detail may not sum to total because of rounding. Ratios are based on unrounded data.
[b] Engineering degrees are long.
See NSF website for further details.