

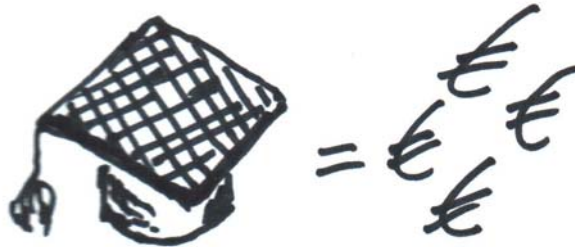
March 5, 2009

RETURNS TO INVESTMENT IN HIGHER EDUCATION

A EUROPEAN SURVEY

by

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**An contribution to the Higher Education Funding Reform Project
CHEPS-led consortium for the European Commission**

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1. Introduction

This paper has been prepared in support of the Higher Education Funding Reform Project undertaken by a CHEPS-led consortium for the European Commission. Its purpose is to provide a concise state of the rate of return estimates to investment in tertiary education based on existing studies carried out in 33 European countries and information on the relative earnings of graduates supplied by national experts from these countries in a questionnaire developed by CHEPS. The findings of this review are mapped into major implications for possible inclusion in the final report of the Funding Reform Project.

2. Data sources

The following data sources have been used to compile the information presented in this paper:

- a) Earlier reviews on the subject by the OECD, the World Bank and independent researchers (such as OECD 2008, Psacharopoulos and Patrinos 2004, Psacharopoulos 2007b).
- b) An update of earlier compilations based on a review of recently published literature found in the ECONLIT database, accessed in February 2009 (www.econlit.org).
- c) Correspondence of the author with researchers in most countries known to be working on the subject for tracing most recent or unpublished papers (European Experts Network on Economics of Education, www.eenee.org).
- d) Answers by national experts to question 51 in the project-specific CHEPS questionnaire, regarding any recent estimates of the returns to investment in higher education or data on the earnings of higher education graduates relative to the earnings of those who did not complete higher education.

Based on the above sources, 50 new references have been added relative to the last update on the subject (Psacharopoulos 2007a) covering virtually all countries in the Funding Project.

3. Concepts

Before presenting the evidence it is important to clarify a number of conceptual and methodological issues. This is because in the literature there are several rate of return species that have been estimated using a variety of techniques (see Annex).

Private returns are based on the costs and benefits of education, as those are realized by the individual student, i.e. how much he/she actually pays out of pocket to attend a higher education institution, relative to what he/she gets back, after taxes, in terms of increased earnings, relative to a control group of secondary school graduates who did not pursue tertiary education studies. This is a private spending efficiency question.

Private rates of return are used to explain the behaviour of students regarding the demand for higher education, or the equity effects of state subsidies to education.

Social returns are based on the costs and benefits of education, as those are realized by the state or society as a whole. The costs are all inclusive, i.e. they refer to what education really costs, rather than just what the students pay out of pocket. Earnings are before tax, as taxes are a zero-sum-game regarding the social calculus. Social rates of return should be based on productivity differentials, rather than earnings. The social returns to education are used to assess the efficiency of public spending on education, and as a guide on whether to expand or contract a particular university faculty.

Narrow vs. wide social returns. Ideally, the benefits part of a social rate of return estimation should include external effects, i.e. benefits realized by others than the individual investor. An externalities-inclusive social rate of return is called “wide”, vs. the “narrow” social rate of return that includes only benefits internalized by the individual. Alas, there are no empirical estimates of wide-social returns to investment in higher education in Europe. (For developments in this respect regarding the lower levels of schooling, see Psacharopoulos 2007a).

Public returns is essentially another name for narrow social returns, the difference being that they take into account the extra taxes generated by the university graduate and his/her social security contributions.

Fiscal returns are based on a narrow measure of costs and benefits – those relating to the public coffer. They can be used to assess how well the Treasury is doing when spending on education. They relate to the country’s public finances and are not estimated as widely as the private or social rates.

Pseudo-returns. The literature contains a plethora of papers purporting to have estimated the returns to education, although the authors have really estimated the wage effect, i.e., the earnings advantage of a particular graduate. A proper rate of return estimation should also take into account the cost incurred for achieving that advantage.

Out of the above species, the vast majority of the applied literature contains estimates of private and narrow social rates of return. The OECD used to estimate fiscal returns, but stopped doing so in 2006. From that year onwards the OECD estimates public returns.

4. Evidence on rates of return

The evidence on rates of return is presented in several steps. Table 1 shows a master compilation of private and social rates of return in the countries of the project for the latest year available. This is a grand inventory on the availability of the returns to higher education in Europe. Returns to investment in higher education were identified in 31 out of the 33 countries of the project, the two exceptions being Malta and Lichtenstein.

In compiling these rates, preference has been given to those that are based on the elaborate method (see Annex). If the Mincerian method was used in the source paper, I

have estimated the returns to higher education as the difference between the higher education and upper secondary coefficients of the extended earnings function, divided by the number of years of higher education – typically four in most countries. When returns were presented separately for males and females, the average returns are presented in order to summarize the information.

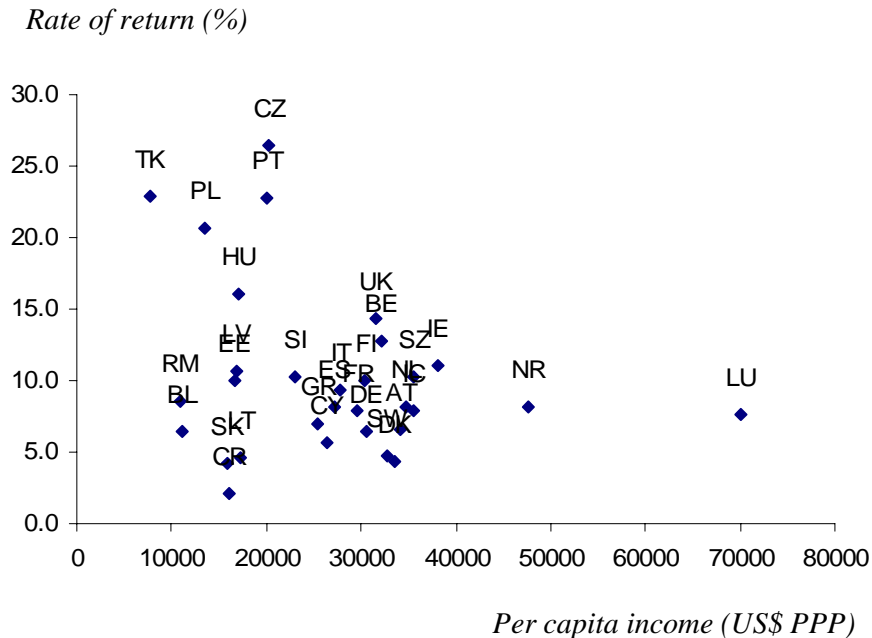
Table 1. Private and social returns to higher education in 33 countries, latest year

Country	Year	Private (%)	Social (%)	Source
Austria	1997	6.6		Fersterer (2003), Table 2
Belgium	2004	12.7	10.6	OECD (2008), Tables A10.2 and A10.6
Bulgaria	1993	6.5		Giddings (2002), Table 4
Croatia	2004	2.1		Vujcic and Sosic (2009), Table 3.
Cyprus	1979	5.6	7.6	House and Stylianou (1981), Table VI-3
Czech Rep.	2004	26.5	8.9	OECD (2008), Tables A10.2 and A10.6
Denmark	2004	4.3	1.5	OECD (2008), Tables A10.2 and A10.6
Estonia	2003	10.0		Torgo (2007), Appendix C
Finland	2004	10.0	6.9	OECD (2008), Tables A10.2 and A10.6
France	2004	7.9	7.4	OECD (2008), Tables A10.2 and A10.6
Germany	2004	6.4	8.4	OECD (2008), Tables A10.2 and A10.6
Greece	2005	7.0		Mitrakos et al. (2008), Table 5
Hungary	2004	16.8	16.0	OECD (2008), Tables A10.2 and A10.6
Iceland	2003	7.9	7.7	OECD (2006b), p. 108
Ireland	2004	11.0	11.3	OECD (2008), Tables A10.2 and A10.6
Italy	1995	9.3		Brunello et al. (2000), Table 11
Latvia	2002	10.6		Hazans (2005), Table 3.2
Liechtenstein				No data
Lithuania	2000	4.6		Hazans et al. (2003), Table A3.13
Luxembourg	1996	7.6		Heinrich (2005), Tables III, IV
Malta				No data
Netherlands	1996	8.1		Heinrich (2005), Tables III, IV
Norway	2004	8.1	4.1	OECD (2008), Tables A10.2 and A10.6
Poland	2004	20.7	14.6	OECD (2008), Tables A10.2 and A10.6
Portugal	2004	22.7	11.2	OECD (2008), Tables A10.2 and A10.6
Romania	2000	8.5		Andren et al. (2005), Table 3
Slovak Rep.	1992	4.2		Newell and Reilly (1999), Table 3
Slovenia	2004	10.2		Polanec and Ahcan (2007), Table 7
Spain	2004	8.2	5.8	OECD (2008), Tables A10.2 and A10.6
Sweden	2004	4.7	3.7	OECD (2008), Tables A10.2 and A10.6
Switzerland	2004	10.3	2.0	OECD (2008), Tables A10.2 and A10.6
Turkey	2005	22.9		Tansel (2008)
UK	2004	14.4	6.5	OECD (2008), Tables A10.2 and A10.6
Average		10.2	7.9	

There are a number of observations stemming from the inventory in Table 1:

- There are more private returns estimates relative to social rates. This is because the estimation of social rates of return is more demanding, requiring direct cost data by level of education.
- Consistent with previous compilations, the private returns exceed the social returns, by 2.3 percentage points in this case.
- All returns (private or social) exceed any reasonable opportunity cost of capital, say 5%.
- The returns are highest in “new countries” such as the Czech Republic, Poland, Hungary and Turkey, and lowest in Scandinavian countries such as Denmark and Sweden.
- Consistent with previous compilations, there is a negative (although weak in this case) inverse relationship between the returns to education and the country’s per capita income (Figure 1).

Figure 1. The returns to higher education and per capita income



Source: Table 1 and World Bank (2009)

The returns shown in Table 1 are not strictly comparable across countries as they are based on a variety of data sets and estimating methodologies. Therefore, Table 2 presents another compilation with strictly comparable rates of return, although referring to only a subset of countries in the Funding Project.

Table 2. Returns on most recent and comparable data (%)

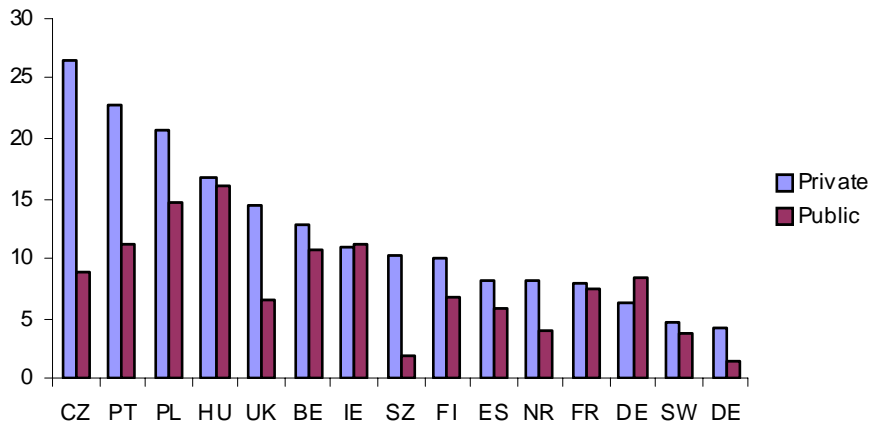
Country	Private	Public
Czech Rep.	26.5	8.9
Portugal	22.7	11.2
Poland	20.7	14.6
Hungary	16.8	16.0
UK	14.4	6.5
Belgium	12.7	10.6
Ireland	11.0	11.3
Switzerland	10.3	2.0
Finland	10.0	6.9
Spain	8.2	5.8
Norway	8.1	4.1
France	7.9	7.4
Germany	6.4	8.4
Sweden	4.7	3.7
Denmark	4.3	1.5
Average	12.3	7.9

Source: OECD (2008), Tables A10.2 and A10.6.

The compilation depicted in Figure 2 confirms the wider patterns observed on the basis of Table 1 and reinforces the difference between private and social rates, now being 4.4 percentage points on average. The difference between the private and social rates of return is an indication of the degree of public subsidization of higher education.

Figure 2. Private and public rates of return to investment in higher education

Rate of return (%)



Source: Table 2.

Of particular interest to researchers has been the over time change of the returns to education. Table 3 reports that out of the 16 countries for which there is evidence for more than one point in time, the returns to higher education have been rising. And in the two countries that the returns have been falling, the decline is negligible. Such trend means that the demand for higher skills outpaces the increased supply of graduates in the market place.

Table 3. Over time change in the private returns to higher education

Country	Year	Rate of return (%)	Change (% points)	Source
Austria	1981	2.4	4.2	Fersterer et al (2003), Table 2
	1997	6.6		
Bulgaria	1986	6.3	0.03	Giddings (2002), Table 4
	1993	6.5		
Croatia	1996	2.3	-0.2	Vujcic and. Sosic (2009), Table 3
	2004	2.1		
Cyprus	1994	5.7	3.0	Eliophotou (2008), Table 2, (expected returns)
	2004	8.7		
Czech Rep.	1984	0.4	2.3	Newell and Reilly (1999), Table 3
	1992	3.8		
Greece	1994	6.3	2.7	Prodromidis and Prodromidis (2008), Table 5
	1999	9.0		
Hungary	1986	6.2	5.0	Campos and Jolliffe (2003), Table 2
	1998	11.2		
Ireland	1994	11.9	-0.9	McGuinness et al. (2008), Table 6
	2001	11.0		
Latvia	1997	9.9	0.7	Hazans, M. (2005), Table 32
	2002	10.6		
Poland	1998	6.8	2.0	Strawinski, P. (2007), Table 6
	2004	8.8		
Romania	1952	3.1	5.4	Andrén et al. (2005), Table 3
	2000	8.5		
Slovakia	1984	2.3	1.9	Newell and Reilly (1999), Table 3
	1992	4.2		
Slovenia	1994	8.9	1.3	Polanec and Ahcan (2007), Table 7
	2004	10.2		
Spain	1981	7.5	6.0	Lassibille and Gomez (1998), Table 5
	1991	13.5		
Sweden	1992	4.6	1.7	Gustavsson and Österholm (2006), Table 3
	2001	6.3		
Turkey	1987	14.0	8.9	Tansel (2008)
	2005	22.9		

Table 4 reports the returns for different levels of tertiary education. There is not much variation in such returns, indicating a kind of equilibrium across levels. The rate of return to a first degree is 1 percentage point higher than the short cycle of tertiary education, while there are small diminishing returns to obtaining further degrees.

Table 4. Private returns to investment in tertiary education by degree type (%)

Country	Non-university	First university degree	Master's	Doctorate
Austria	8.0	7.3		
Belgium	7.1	9.0		
Denmark	5.2	10.1		
Finland	11.4	14.6		
France	18.9	13.4		
Germany	12.7	9.6		
Greece	5.9	7.0	9.9	7.6
Ireland	10.0	15.7		
Norway	8.6	12.5		
Slovenia	15.0	11.8	13.9	12.1
Sweden	5.4	6.8		
Sweden		6.4		12.0
Turkey	11.5	19.7	7.7	
UK	9.3	15.9		
Average	10.4	11.4	10.5	9.9

Source: Belgium from Nonneman and Cortens (1997), Table 3, Greece from Mitrakos et al. (2008), Slovenia from Polanec and Ahean (2007), Table 8, Turkey from Tansel (2008), all other countries from Martin (1998), Table 7.

There is very limited evidence on the returns to different higher education faculties. The pattern shown in Table 5 is very mixed. However, the lowest returns refer to agriculture and the highest to education and medicine.

Table 5. Private returns by university faculty (%)

Faculty	Greece	Slovenia	UK
Agriculture	4.4	10.5	
Medical Related	7.7	18.0	17.4
Sciences	8.0	12.3	12.5
Maths and Computing			21.1
Engineering	6.4	11.0	15.8
Architecture			12.8
Social Sciences	5.4	13.0	12.5
Business and economics	6.5		13.9
Arts		11.1	4.1
Education	9.4	9.7	19.4

Source: Greece from Mitrakos et al. (2008), Table 5, Slovenia from Polanec and Ahean (2007), Table 8, UK from O'Leary and Sloane (2005), Table 6.

According to the last OECD estimates of fiscal returns, public expenditure on higher education is being recovered through the higher tax revenue from those who graduate and have higher incomes. As shown in Table 6, the result in all countries is a gain from the fiscal view point (Table 6).

Table 6. Fiscal rates of return to higher education (%)

Country	Rate of return
Belgium	5.6
Denmark	4.8
France	6.7
Finland	4.8
Italy	9.5
Netherlands	10.7
Norway	4.1
Sweden	1.7

Source: OECD (2005), p. 143, Tables A9.7 and A9.8, males.

5. Earnings differentials

Loosely, the earnings difference between a university graduate and a secondary school graduate could be considered as a “return to education”. Such statement is not exactly accurate, as it omits the costs the graduate and society incur in order to generate the earnings differential – a consideration that is taken into account in a proper rate of return calculation.

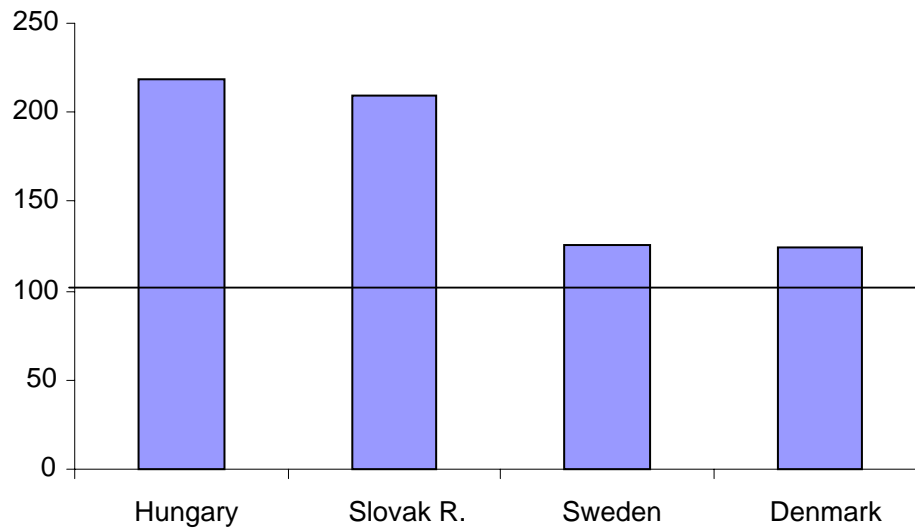
Table 7 shows the earnings advantage of university graduates over a control group of secondary school graduates. Given that earnings differentials are an input to the rate of return estimates presented earlier, the pattern in Table 7 reflects the rate of return pattern, i.e. the earnings advantage of university graduates is highest in the “new countries” and lowest in the Scandinavian countries (Figure 3). On average, university graduates have a 61% earnings advantage over secondary school graduates. Such differential helps explain the unabated demand for university entry.

Table 7. Earnings premium of tertiary over secondary education graduates

Country	Year	Premium index (secondary school graduates = 100)
Hungary	2006	219
Slovak Rep.	2002	209
Latvia	2002	200
Slovenia	2004	198
Estonia	2002	189
Lithuania	2002	186
Czech Rep.	2006	183
Portugal	2005	177
Poland	2006	173
Ireland	2004	169
Italy	2004	165
Germany	2006	164
UK	2006	159
Austria	2006	157
Switzerland	2006	156
Finland	2004	149
France	2004	149
Turkey	2005	149
Netherlands	2002	148
Luxembourg	2002	145
Belgium	2005	133
Greece	2006	132
Spain	2004	132
Norway	2005	129
Cyprus	2002	126
Sweden	2005	126
Denmark	2004	125
Average		161

Source: Cyprus, Estonia, Lithuania, Latvia and Slovakia from Eurostat (2005), Greece based on Mitrakos et al. (2008), Table 3. All other countries based on OECD (2008), Table A9.1a.

**Figure 3. The earnings advantage of graduates in four countries
(Index base: secondary school graduates = 100)**



Source: Table 7.

Table 8 shows that the earnings advantage of university graduates has been maintained over time, and that it is increasing in most countries. The average annual increase has been about two percentage points per year.

Table 8. Annual change of tertiary education earnings premium, 1997-2006 or latest data

Country	Time period	Annual premium change (in percentage points)
Austria	2005-2006	5.0
Belgium	2000-2005	1.0
Czech Rep.	1997-2006	0.4
Denmark	1997-2005	0.2
Finland	1997-2004	0.1
France	1997-2006	0.0
Germany	1997-2006	3.4
Hungary	1997-2006	4.4
Ireland	1997-2004	2.9
Italy	1998-2004	6.5
Netherlands	1997-2002	1.4
Norway	1997-2005	-1.0
Poland	2004-2006	5.0
Portugal	1997-2005	-0.1
Spain	1997-2001	-2.4
Sweden	1997-2006	-0.4
Switzerland	1997-2006	0.4
Turkey	2004-2005	8.0
UK	1997-2006	0.7
Average		+1.9

Source: Based on OECD (2008), Table A9.2a.

6. Equity

Beyond the private and social efficiency questions, the returns to education can be used to answer equity questions. Unfortunately, the literature on the subject is not as rich in Europe as it is in the United States. In the latter there has been increased earnings inequality between 1973 and 2005, and this has been attributed to the increase in the returns to investment in higher education (Lemieux, 2006). This in turn is due to the increased demand for skilled workers (Chilhui et al. 1993, Hauser et al. 1973).

What we do know in Europe, is that higher socioeconomic (SES) students, as measured by the education of their parents, have a much better chance of entering higher education (*OECD, 2001*).

Higher education students come from a higher socioeconomic status relative to the rest of the population. The representation index shown in Table 9 is the ratio of the proportion of students whose father has a university degree and the proportion of university degree holders in the population. A value of 1 means equal representation. The higher the index, the more “inequitable” the system. One reason for such differentiation is that those coming from higher SES families are better able to pay and prepare for university entry.

Table 9. Representation of university students by father’s SES

Country	Higher SES representation index
Germany	2.1
Spain	1.5
France	2.0
Ireland	1.1
Italy	1.8
Netherlands	1.6
Austria	2.6
Portugal	5.4
Finland	1.8

Source: Eurostudent (2005).

Returns to education by SES can be estimated by using the full discounting method within groups of people of different socioeconomic background. A second best is using the Mincerian earnings function, adding an SES independent variable, or interacting it with higher education.

The available literature is not very forthcoming on the returns to higher education by socioeconomic background, although there exist several estimates for the returns to education on average by SES. If the returns in general are increasing by the level of SES, the same pattern should be observed if the researchers had broken down the sample by SES and estimated the returns to higher education within SES groups. Table 10 shows that in several countries those coming from a superior socioeconomic background enjoy much higher returns.

Table 10. Returns to education by socioeconomic status (%)

Ed. Level/ Country	Lower SES	Higher SES
<u>Overall</u>		
Greece	4.8	5.7
UK	3.1	8.4
<u>Post-compulsory</u>		
Spain	4.3	6.6
<u>Higher education</u>		
France	16.3	20.9

Source: Patrinos (1992, 1995), Spain from Mora (1999).

Papanicolaou and Psacharopoulos (1979) in the UK, Patrinos (1995) in Greece, Mora (1999) in Spain and Ichino and Winter-Ebmer (1999) in Germany included an SES and education interaction term in the Mincerian earnings function have found a positive coefficient. This means that a higher SES is associated with a higher rate of return to investment in education.

Socioeconomic privilege confers many direct benefits, both through a home culture which tends to reinforce the goals of formal education and through the capacity to fund access to education in private schools and post-compulsory education (Dearden, 1998; McPherson and Schapiro 1991, 2000).

Particularly in the post-compulsory phase, systems of educational finance also have an impact on outcomes by virtue of how they distribute the costs of human capital investment between different parties. Overall outcomes for any individual depend not only on the benefits of educational attainment, but also on how much of the cost of that education is born by the individuals who benefit.

Overall, the expansion of tertiary education in OECD appears to have had little impact on the *relative* prospects of young people from less advantaged backgrounds. This is hardly a surprising finding. Parental and school influences are extremely important determinants of participation at post-compulsory level. In most countries tertiary education requires prior qualifications -- generally at upper-secondary level -- so that attainment in the compulsory phase of education, as much as anything which occurs subsequently, is a key to tertiary participation. Therefore, the expansion of capacity at the tertiary level will not, in itself, have much impact on these factors. The challenge to public policy of delivering equality of opportunity in tertiary education is sizeable, and falls not only on the system for tertiary education itself, but also on support for children and their families, reaching back to pre-schooling and into compulsory and upper-secondary schooling.

7. Implications

There are a number of implications stemming from the above survey:

- In spite of the large growth of university graduates, the fear of unemployment and overeducation might be exaggerated. As evidenced by the figures presented above, higher education in Europe continues to be a profitable investment opportunity, both privately and socially.
- The size of the narrow social returns to investment in higher education means that the sector is underfunded. Such statement would be reinforced in case wide social rates of return were available.
- The size of the private returns to education means that part of the increased funding could come from private sources, such as increased student fees. This statement is reinforced by the regressive incidence of public financing of higher education systems.
- Regarding equity concerns, higher education public funding should not be equal across the board, e.g. tuition free for all students, regardless of their socio-economic background. Students from low-income families could receive a subsidy while others would have to pay the full cost of their education. The evidence shows that such cost would be recovered later in life through their higher earnings.

In today's world there is an inertia syndrome in the public funding of education. Most education budgets are managed by inertia, i.e., allocations in a given year are more or less equal to last year's allocations adjusted for inflation. This is tantamount to the absence of any policy to serve society's efficiency and equity objectives. As knowledge progresses on what are the most effective ways to improve social welfare by education, so policies should be continuously fine-tuned to the most effective modes of public funding.

Publicizing evidence of the kind presented above might tilt the public opinion and political will towards more efficient and equitable university funding policies.

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Annex. Data and estimation procedures

The data used for estimating a rate of return to investment in education depend on the type of the returns one is interested in. Private and fiscal rates can be estimated on the basis of observed after-tax earnings in all sectors of the economy and the cost of education to the individual.

In a social rate of return calculation, the costs include the state's or society's at large spending on education. This includes the rental of public school buildings and teachers' salaries. Gross earnings (that is, before taxes and other deductions) should be used in a social rate of return calculation, and such earnings should also include income in kind where this information is available.

A key assumption in a social rate of return calculation is that observed wages are a good proxy for the marginal product of labor. This could be the case in a competitive economy using data from the private sector. Civil service pay scales are irrelevant for a social rate of return calculation as they are unlikely to represent marginal productivity. The pay of civil servants, however, should be used in calculating the private returns to education, as it reflects what people actually get, regardless of productivity.

The "social" attribute of the estimated rate of return refers to the inclusion of the full resource cost of the investment (direct cost and foregone earnings). Ideally, the social benefits should include non-monetary or external effects of education -- for example, lower fertility or lives saved because of improved sanitation conditions followed by a more educated woman who may never participate in the formal labor market. Given the scant empirical evidence on the external effects of education, social rate of return estimates are usually based on directly observable monetary costs and benefits of education.

Since the costs are higher in a social rate of return calculation relative to the one from the private point of view, social returns are typically lower than a private rate of return. The difference between the private and the social rate of return reflects the degree of public subsidization of education.

The benefits of education are typically classified into a four-cell matrix, as shown in Table 1 (McMahon 1997, Wolfe and Zuvekas 1997, Villa 2000). The easiest to document benefits are those in the northwest quadrant, namely private benefits that manifest themselves in the labor market and can be measured in monetary terms. The hardest to document benefits are those in the southeast quadrant, namely the social benefits that are not directly observed or measured in monetary terms.

Table A-1. A classification of the benefits of education

Benefits type	Private	Social
Market	Employability Higher earnings Less unemployment Labor market flexibility Greater mobility	Higher productivity Higher net tax revenue Less reliance on government financial support
Non-market	Better consumer efficiency Better own and family health Better children quality	Reduced crime Less spread of infectious diseases Lower fertility Better social cohesion Voter participation

Sample selection should be random, i.e. being representative of the population as a whole. Data should refer to the individual person, rather than tabulated mean earnings by level of education, as was practiced in the early days of the economics of education. Individual earnings allow for the control of covariates, i.e. factors correlated with education that affect earnings, e.g. differential ability or socioeconomic background.

Randomly generated data, along with covariates, is the exception rather than the rule. It is problematic when the estimated rates of return are based on a survey of firms – rather than households – because firm-based samples are highly selective. In order to control survey costs, such samples focus on large firms with many employees. Second, the questionnaire is typically filled by the payroll department rather than by the individual employee. Typically, this approach leads to the use of samples concentrated only in urban areas.

Data generated by virtue of natural experiment are much better relative to econometric control for covariates, e.g. identical twins separated early in life and receiving different amounts of education. Or, because of a military draft legislation, or month-of-the-year birth date, some people received different levels of schooling than others.

Another problem occurs when rate of return estimates are based on samples that include civil servants. On average, the inclusion of civil service pay flattens the earnings differentials giving lower returns among those working in the public sector (Psacharopoulos, 1983). Of course, in many countries – although fewer now than in the past – the majority of university graduates end up in public sector employment. However, civil-service-pay based rate of return estimates are useful in private calculations regarding the incentives set by the state to invest in education.

Beyond education, there is large list of factors that may affect earnings, such as differential ability. The undisputable and universal positive correlation between education and earnings can be interpreted in many different ways. The causal issue on whether education really affects earnings can only be answered with

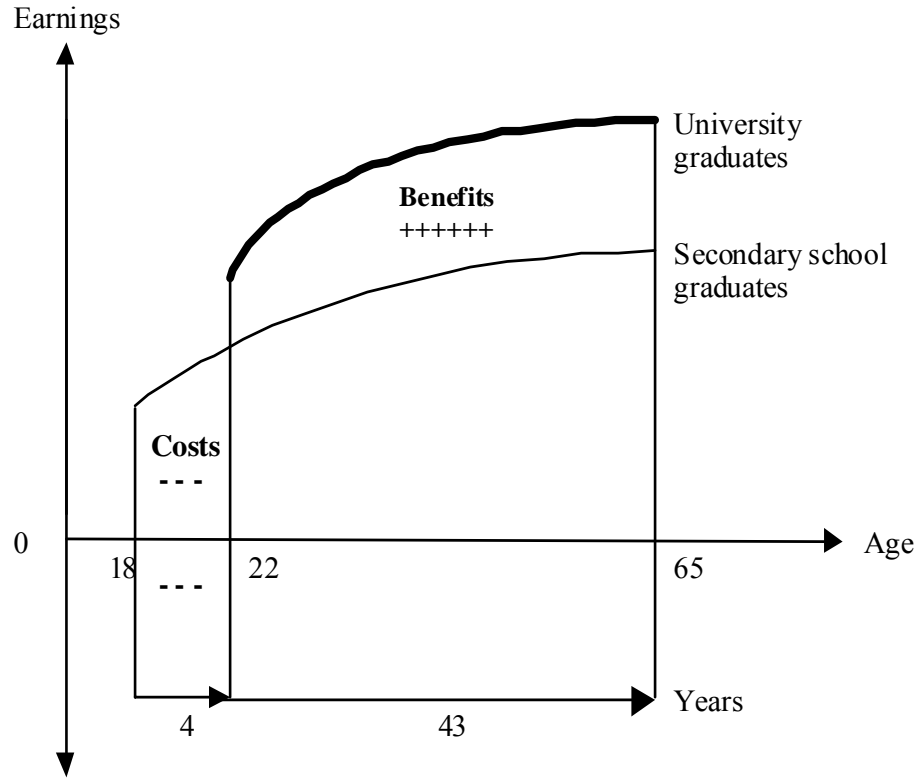
experimental data generated by assigning at random different people to various levels of education. Given the fact that moral and pragmatic considerations prevent the generation of such pure data set, researchers have used indirect inferences or natural experiments. Examples of a natural experiment in this context is identical twins who were separated early in life and received different amounts of education (as to control for differences in genetic ability) or differential date of birth and eventual educational attainment. Estimates of the returns to education based on twins samples have corroborated the statistically significant link between education and earnings (Ashenfelter and Krueger 1994, Ashelfelter and Rouse 1998).

Out of the above data sources, household surveys have been dominant in the applied literature. Correcting for covariates is only found in a few studies in Europe relative to more abundance in the United States.

Estimation

In the empirical literature, two main methods have been used in arriving at rate of return estimates: the “full-discounting” or “elaborate” method, and the “Mincerian” earnings function method. Historically, the elaborate method was used in the beginning of the economics of education in the early sixties, followed by the Mincerian method in the seventies. Both methods try to map observed data, as those illustrated in Figure A-1, to a rate of return formula (Psacharopoulos and Mattson, 1998).

Figure A-1. Stylized age-earnings profiles



The “full-discounting” or “elaborate” method, consists in calculating the internal rate of return based on individual age-earnings profiles that vary over time (t), i.e.,

$$\sum_{t=m+1}^n \frac{(W_u - W_s)_t}{(1+r)^t} = \sum_{t=1}^m (W_s + C_u)(1+r)^t,$$

where (r) is the discount rate that equates the benefits from the extra education (proxied by earnings differentials in the economy), to the sum of opportunity costs (foregone earnings of the student while studying), and the direct resource costs of schooling at a given point in time. Thus, $(W_u - W_s)_t$ is the difference in earnings between two levels of education. W_u is the annual earnings of a more educated person.

The “Mincerian earnings function” method starts by fitting a regression to the data in the form

$$\ln W_i = \alpha + \beta_p D_p + \beta_s D_s + \beta_u D_u + \gamma_1 EX_i + \gamma_2 EX_i^2 + \varepsilon_i$$

where EX stands for years of labor market experience, defined as $Age - S - School\ starting\ age$, and D is a 0-1 dummy variable corresponding to the

subscripted level of schooling (Mincer 1974). The private rate of return to higher education can then be calculated from the earnings function by the following formula,

$$r_u = \frac{\beta_u - \beta_s}{S_u - S_s}.$$

The discounting of actual net age-earnings profiles is the most appropriate method of estimating the returns to education because it takes into account the most important part of the early earnings history of the individual. However, this method requires comprehensive data – one must have a sufficient number of observations in a given age-educational level cell for constructing "well-behaved" age-earnings profiles (that is, not intersecting with each other).

The advantage of the Mincerian way of estimating the returns to education is that it can smooth out and handle incomplete cells in an age-earnings profile matrix by level of education. The disadvantage, of course, is that it requires a sample of individual observations, rather than pre-tabulated mean earnings by level of education.

Out of the above methods, the Mincerian one has been prominent in the applied literature.