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What is the Private Return to Tertiary Education? New Evidence from 21 OECD Countries

by
Romina Boarini *and* Hubert Strauss*

This article provides estimates of the private Internal Rates of Return to tertiary education for women and men in 21 OECD countries, for the years between 1991 and 2005. IRR are computed by estimating labour market premia on cross-country comparable individual-level data. Labour market premia are then adjusted for fiscal factors and costs of education. We find that returns to an additional year of tertiary education are on average above 8% and vary in a range from 4 to 15% in the countries and in the period under study. IRR are relatively homogenous across genders. Overall, a slightly increasing trend is observed over time. The article discusses various policy levers for shaping individual incentives to invest in tertiary education and provides some illustrative quantification of the impact of policy changes on those incentives.

JEL Classification: I21, I22, I28, J24

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* Boarini: OECD Economics Department (e-mail: romina.boarini@oecd.org); Strauss: European Investment Bank (e-mail: strauss@eib.org). The authors would like to thank Jean-Philippe Cotis, Jørgen Elmeskov, Michael Feiner, Giuseppe Nicoletti and Joaquim Oliveira Martins for their comments and inputs. Christine de la Maisonneuve's statistical assistance is gratefully acknowledged. The views expressed are those of the authors and do not necessarily represent those of the OECD or its member countries.

Internal rates of return (IRR) to education are a standard measure of the profitability of additional years of schooling. IRR estimates have increasingly relied on a sound analytical framework accounting for many different kinds of lifetime economic benefits and costs of schooling, including, among others, the well-known Mincerian wage premia. This article builds on such recent developments (de la Fuente and Jimeno, 2005) and on new estimates of wage premia (Strauss and de la Maisonneuve, 2009) to provide IRR estimates for men and women in 21 OECD countries covering the time period 1991 to 2005.

The main contribution of this paper is the use of cross-country comparable basic components of IRR, including labour market premia estimated on individual-level data sets, fiscal and social benefit parameters based on various OECD tax and benefit models, and higher education cost estimates from the OECD Education Data Set. The paper focuses on tertiary education decisions and thus provides IRR estimates specifically referring to an additional year of schooling beyond the upper-secondary degree.

We find that the cross-country average of the baseline IRR is above 8% in the period under scrutiny, and essentially varies in a range from 4 to 15%. IRR are relatively homogenous across genders. Overall, a slightly increasing trend is observed over time. At the end of the 1990s and in the early 2000s, IRR increased more markedly in Ireland and Canada, while they started declining in United Kingdom. Labour market premia turn out to be the main drivers of IRR, often irrespective of education costs. Beyond labour markets, return to schooling depends (positively) on average tax rates and the share of students' time worked; and (negatively) on marginal tax rates, study duration and tuition fees.

The article is organised as follows. Section 1 presents the analytical framework and discusses in detail the assumptions made in computing IRR. Section 2 elaborates on the construction of the basic components of IRR, namely labour market premia, fiscal and social benefit parameters and private costs. Section 3 shows estimates of IRR in the baseline scenario and in a number of alternative scenarios. It compares IRR estimates with those from previous studies and discusses their interpretation and their limitations. Section 4 illustrates the sensitivity of IRR by simulating changes in labour market outcomes and policy parameters. Section 5 concludes.

1. Methodological approaches to computing private returns to schooling

1.1. Education as an investment

According to human capital theory (Becker, 1967) individuals are supposed to undertake education up to the point where the present value of expected benefits from additional schooling is equal to that of its direct and indirect costs (*i.e.* tuition fees and foregone earnings). Education should increase the productivity of individuals, and more skilled workers are therefore expected to command higher salaries if labour markets are perfect and labour is paid at its marginal value.

Against this background, it has often been claimed that schooling decisions are endogenous and depend on the levels of innate ability, taste for schooling, access to funds

and the possible interaction of all these factors (Card, 1999). While in principle these factors may raise or lower the incentive to invest in education,[1] their net total effect is bound to be an empirical question; however, many studies find an only slight over-estimation of the "true" effects of schooling (around 10% of wage premia; Card, 1999).[2] Based on these findings, and due to data limitations, this paper does not take into account ability in estimating returns (unlike, *e.g.* Vella and Gregory, 1996). We assume the ability bias to be small and argue that the results are a reasonable approximation of the average return to schooling, even though they might slightly overestimate this average return if the schooling decision is endogenous to individual innate abilities. However, our IRR estimates neglect the earnings dispersion within a given educational level that is due to heterogeneity in ability, personal discount rates and other unobservable characteristics.

Another criticism of human capital theory is that individuals would not invest in education to increase their potential productivity, but rather to send a signal of their ability. In empirical studies signalling effects are, however, found to be rather small (less than 1%; Harmon *et al.*, 2003). Furthermore, from the perspective of guiding the individual decision to invest in human capital, the signalling effect is irrelevant, as individuals need a degree to signal their higher productivity; hence, whether the higher salary results from inherent ability or received education becomes immaterial. From the point of view of policy makers, it will, however, make a difference to know whether benefits from additional education stem from the value added of the education system itself or are partly due to students' innate abilities.

Another common assumption when computing returns to education is that benefits and costs are only pecuniary. While research has increasingly argued that education yields broader advantages to individuals (*e.g.* social prestige, better health, lower propensity to commit crimes, etc.; see Grossman, 2005), a sound empirical assessment of these non-pecuniary advantages is still lacking. In particular, the issue of measurement of these benefits is still largely debated, especially in the context of cross-country comparative work. For these reasons, this article takes into account only pecuniary benefits.

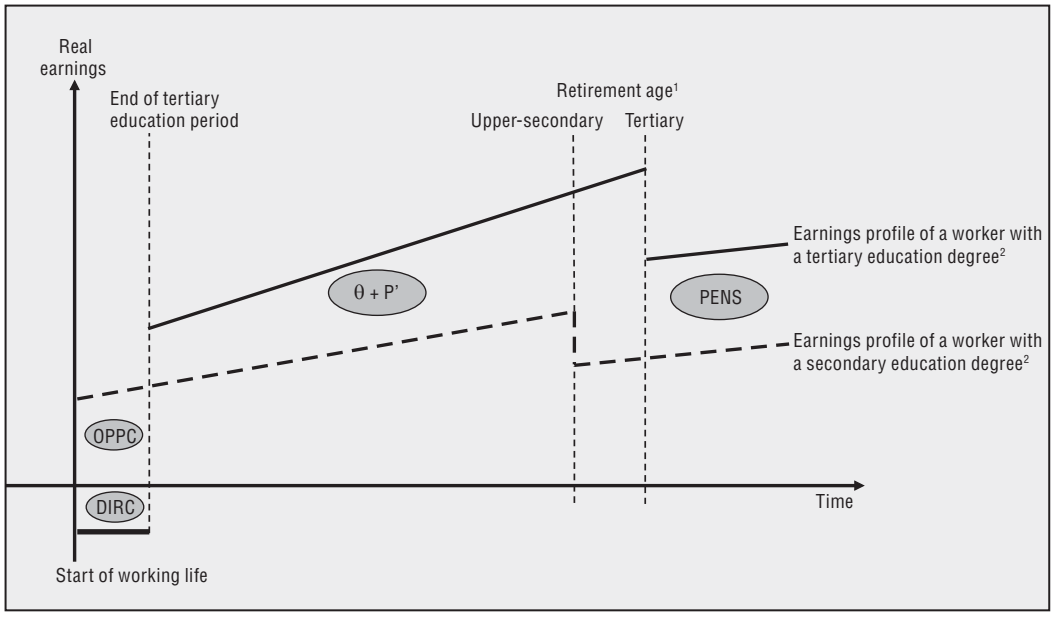
Many techniques of computing returns to education exist (see Psacharopoulos and Patrinos, 1994, Psacharopoulos, 1995, and Heckman *et al.*, 2005, for a review), but the most common are the discount method and the Mincerian approach. Heckman *et al.* (2005) have shown that these two approaches produce similar results under stringent assumptions.[3] In the discount method IRR summarise how profitable it is to undertake an additional year of schooling on the basis of the relevant stream of benefits and costs associated with it. The discount method has, however, some limitations since it often relies on average earnings across educational groups, without further controls for other individual characteristics. By contrast, the Mincerian approach relies on the econometric estimation of earning functions, based on individual-level data (see Mincer, 1974, and Harmon *et al.*, 2003, for a review). While this method has the merit of singling out the part of the earnings variance that is due to education, it clearly neglects the cost of education, as well as the taxes and social benefits that workers pay/receive over the life cycle.[4]

1.2. The analytical framework

This article essentially follows the approach developed in de la Fuente and Jimeno (2005) in combining the discount method and the estimation of Mincerian wage premia and other labour market premia from micro-level data (see Boarini and Strauss, 2007, for a formal presentation of the model).

Agents are assumed to choose the optimal level of schooling by maximising the present value of lifetime expected after-tax income, net of the direct costs entailed by education: IRR is indeed the discount rate equating the *marginal benefit* to the *marginal cost* (see Figure 1 for a stylised illustration). The marginal benefit from education can be decomposed into three components: the *net wage premium*, defined as the increase in wages entailed by an additional year of schooling and holding constant the employment probability; the *net employability premium*, given by the increase of the employment probability associated with an additional year of schooling, and holding wage constant; and the *pension premium*, *i.e.* the discounted value of higher retirement benefits due to higher lifetime labour earnings resulting from an additional year of schooling. The marginal cost of education is given by two components: the *opportunity cost of schooling*, *i.e.* the foregone earnings and labour-market experience due to continued schooling, and the *direct cost* of schooling borne by the agent, essentially given by tuition fees.

Figure 1. **Individual returns to tertiary education illustrated**



Notes: DIRC: Direct costs of tertiary education.
OPPC: Opportunity costs of not starting to work after secondary education.
θ + P': Wage and employability premia associated with tertiary education (net of taxes and benefits).
PENS: Retirement premia for tertiary education workers (net of taxes).
1. Assuming the same length of working life.
2. Assuming partial indexation of pension benefits.

In contrast to de la Fuente and Jimeno (2005), the baseline IRR constructed here does not include the possibility of students' part-time work, though alternative estimates of IRR under common assumptions on duration and reward of students' work are provided below.[5] The other assumptions are in line with de la Fuente and Jimeno (2005): the wage premium is an increasing and time-invariant function of schooling; the experience premium is constant across schooling levels (it is supposed to be a function of potential experience rather than actual years of employment and should grow at a constant rate over time); the employment probability is an increasing and time-invariant function of schooling; and individuals receive out-of-work benefits if unemployed and pay taxes on

either labour income or unemployment benefits, depending on their labour market status. Both benefits and taxes are constant over the life cycle but vary with schooling. The length of the working life is the same across levels of schooling. Some of these assumptions are relatively strong and have notably been rejected by empirical evidence on national samples (*e.g.* time-invariance of schooling premium in the United States; see Heckman *et al.*, 2005). However, these assumptions had to be made in absence of cross-comparable, sufficiently long panel data sets.

Moreover, as in de la Fuente and Jimeno (2005), the various IRR ingredients are either estimated on individual-level data through multivariate regressions (labour market premia) or drawn from various OECD tax and benefit models. In the latter case, tax and benefit parameters are those of a representative agent in the economy at 100% of average earnings (AE).

2. Computation of IRR components

2.1. Estimation of labour market premia: The use of individual-level data

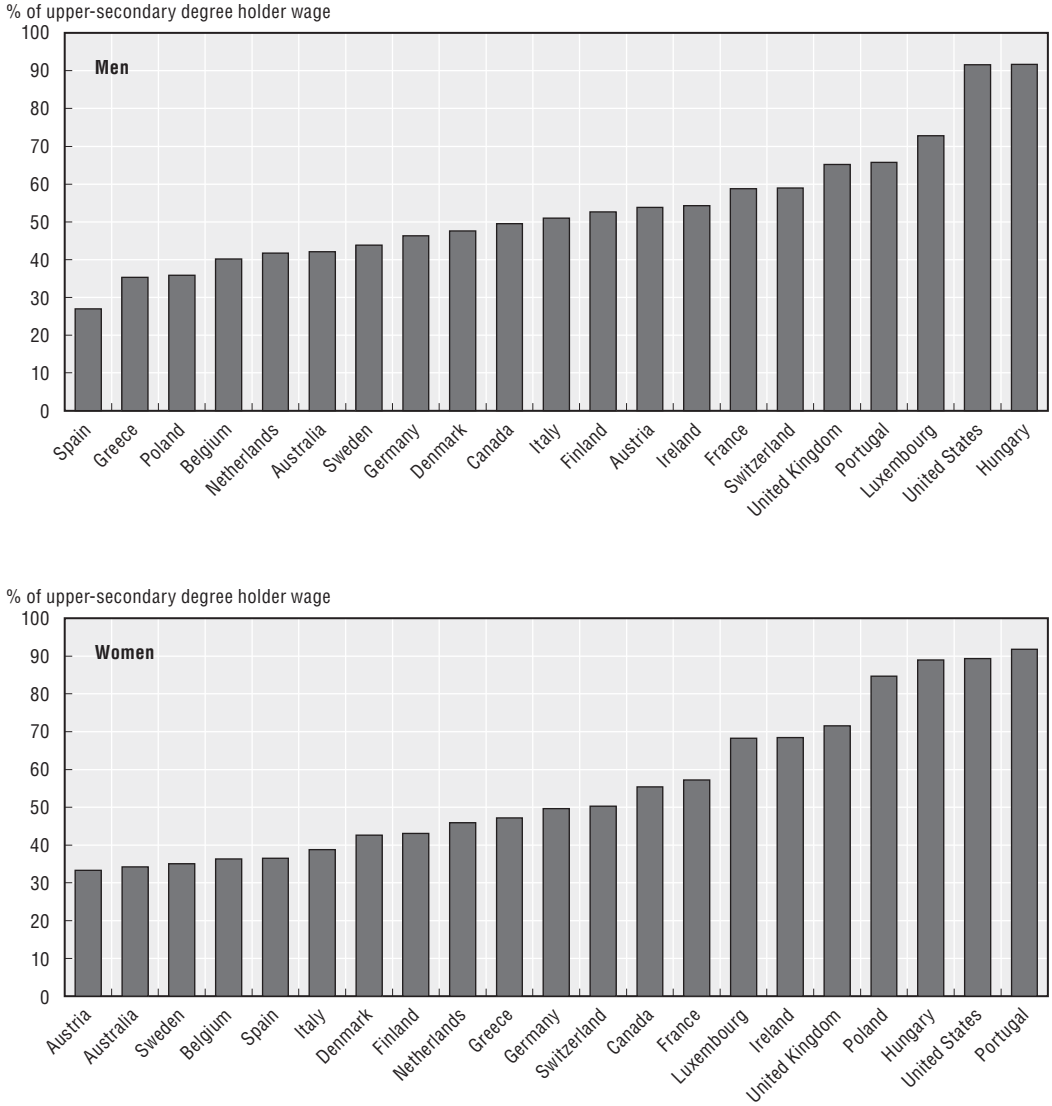
Labour market premia are computed using individual-level data from cross-country comparable household survey data sets (see Annex 1 in Boarini and Strauss, 2007). This kind of data allows estimating premia to education through multivariate regressions, controlling for individual heterogeneity with respect to a number of characteristics. Labour market premia are estimated country by country and period by period for three educational attainment levels (less than upper-secondary degree, upper-secondary degree, tertiary education). Labour market premia are also estimated separately for men and women.[6]

2.1.1. Wage and experience premia[7]

The wage premium on tertiary education and the labour market experience premium are obtained by regressing the log of gross hourly labour earnings on the level of educational attainment and on the number of years of labour market experience, as in the standard Mincerian approach. In the absence of relevant information on actual labour market experience, regressions make use of years of *potential* experience, proxied as the difference between current age and age at labour market entry. In addition, the estimation of wage and experience premia controls for a number of individual characteristics that potentially affect earnings but are not directly related to tertiary education. These include gender, marital status, job tenure, the type of work contract and working in the public *versus* the private sector. The estimates also control for the size of the production unit ("plant size") in which individuals are employed and over- or under-qualification for the job.[8]

Regression results of the wage equation are in line with priors for most variables. The Mincerian coefficient of tertiary education attainment, the gross wage premium, is found to be 55% on average and to vary widely across countries (between 27 and 92%; see Figure 2 and Strauss and de la Maisonneuve, 2009, for more details).[9] Women's tertiary wage premia are higher than men's in 9 of 21 countries, the difference being significant in Poland and Portugal, and moderate in Canada, Greece, Ireland, Spain and the United Kingdom. By contrast, male graduates appear to get significantly higher wage returns than their female counterparts in Australia, Austria, Finland and Italy. The tertiary education wage premium for men is the highest in Hungary (92%) and the lowest in Spain (27%). For women, wage premia are highest in Portugal (92%) and lowest in Austria (33%).

Figure 2. **Gross wage premia from tertiary education,[1] 2001[2]**

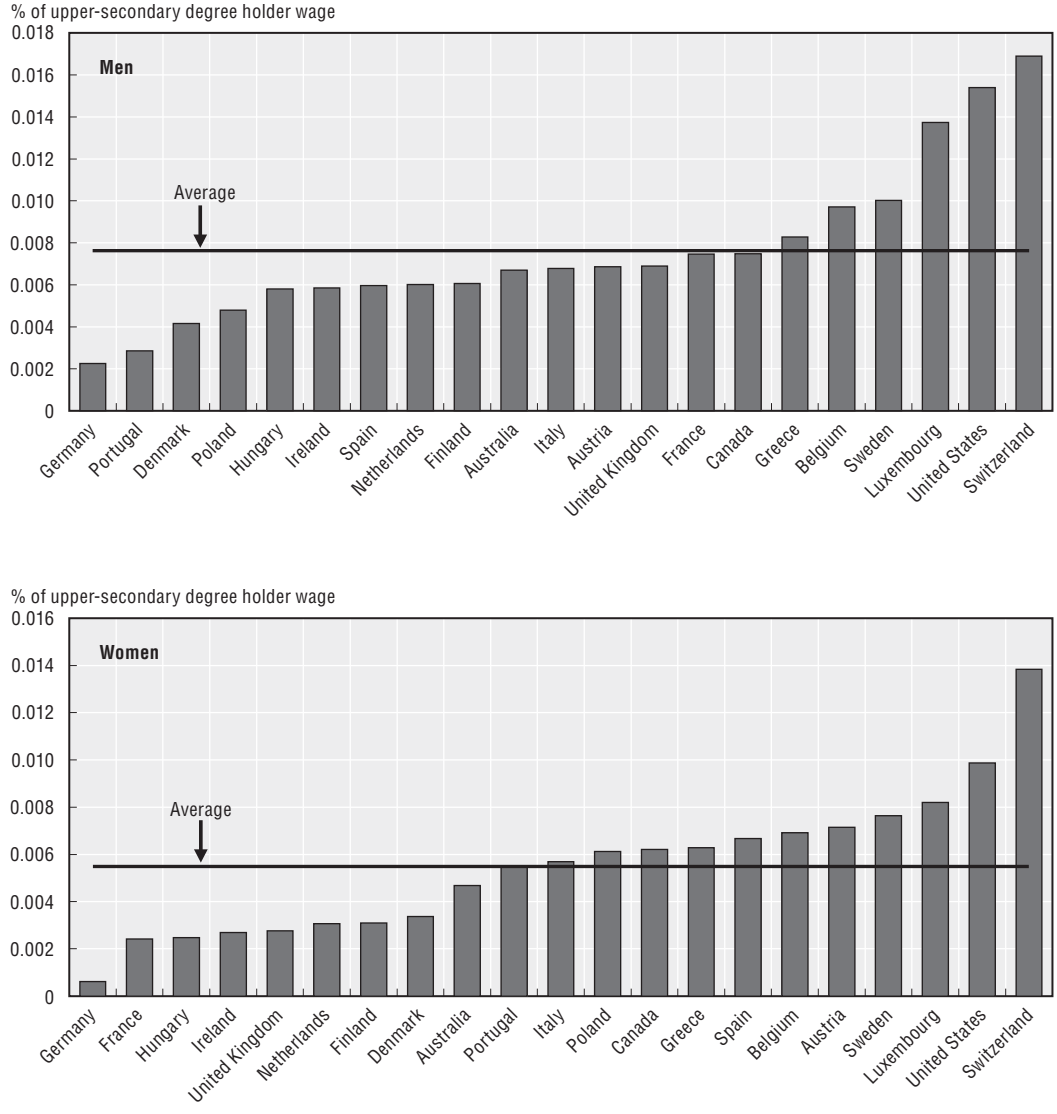


1. Estimates of the increase in gross hourly earnings relative to a worker with a secondary education degree, controlling for individual characteristics other than education attainment.
2. Except for Hungary 1997 and Poland and Switzerland 2000.

Source: The European Community Household Panel (ECHP), the Consortium of Household Panels for European Socio-Economic Research (CHER), the Cross-National Equivalent File (CNEF), the Household Income and Labour Dynamics in Australia Survey (HILDA) and OECD calculations.

The experience premium per year of accumulated labour market experience also shows large cross-country variation (Figure 3): it is the lowest in Germany (with the gender mean slightly above zero) and the highest in Switzerland (with the gender mean at 1.54%). Part of this variance could be explained by the role played by job tenure (*i.e.* experience specifically accumulated within a firm) in some labour markets, suggesting that firm-specific skills are more strongly rewarded than general labour market skills in these countries. Indeed, the coefficient of job tenure tends to be high where the experience premium is low, and *vice versa*. Finally, the experience premium is lower for women than for men. This might be partly due to the fact that most women in the sample have less seamless work histories than

Figure 3. **Experience premia from tertiary education, 2001**[1]



1. Except for Hungary 1997 and Poland and Switzerland 2000.

Source: The European Community Household Panel (ECHP), the Consortium of Household Panels for European Socio-Economic Research (CHER), the Cross-National Equivalent File (CNEF), the Household, Income and Labour Dynamics in Australia Survey (HILDA) and OECD calculations.

men. As a consequence, the variable "potential experience" measures women's actual experience with greater error – and in most cases overstates it more strongly – than is the case for men's actual experience, leading to lower coefficients.

Tertiary education premia are found to be fairly stable over time, particularly so in the second part of the period studied, *i.e.* between 1997 and 2001. However, over the period 1994-2001 upward trends are observed in Ireland, Denmark and Portugal (women) and to a lower extent in Greece, Germany (women), Italy (men) and the United States (men). Downward trends are recorded for Austria, Spain (excluding the end of the period), Portugal (men) and, to a slightly lesser extent, the United Kingdom (women). The premium on labour market experience is found to be very stable over time for both genders (see Table 6 in Strauss and de la Maisonneuve, 2007).

2.1.2. Employability premia

In addition to wage premia, the benefits of higher education usually include a lower unemployment probability. To take into account the possible selection bias[10] occurring from the fact that the unemployment probability can be estimated only for labour market participants, we use a two-step method (Heckman, 1979; Heckman *et al.*, 2005a). The first step determines the probability of participating in the labour market. The second step determines the probability of being employed given the probability of participating. The participation and employment propensities are supposed to be a function of individual characteristics, such as educational attainment, gender, age (quadratic specification),[11] marital status and presence of children in the household (see de la Fuente and Jimeno, 2005, and Ciccone *et al.*, 2006). The participation equation also includes controls for discouraged-worker effects (experience of long-term unemployment) and regional dummies for some countries.[12]

Results of estimations show that participation and employment probabilities are correlated (*i.e.* there is indeed selection) only in some countries and in some years.[13] The estimates are in line with expectations for most variables (see Boarini and Strauss, 2007, for a discussion). Education increases both the probability of participating in the labour market and that of finding a job. While for most countries one cannot reject the hypothesis that the impact of education on the employment probability is linear, there are a few exceptions (*e.g.* in Finland and the Netherlands, where further upgrading from upper-secondary to tertiary education increases the employment probability by more than upgrading from primary to secondary education).

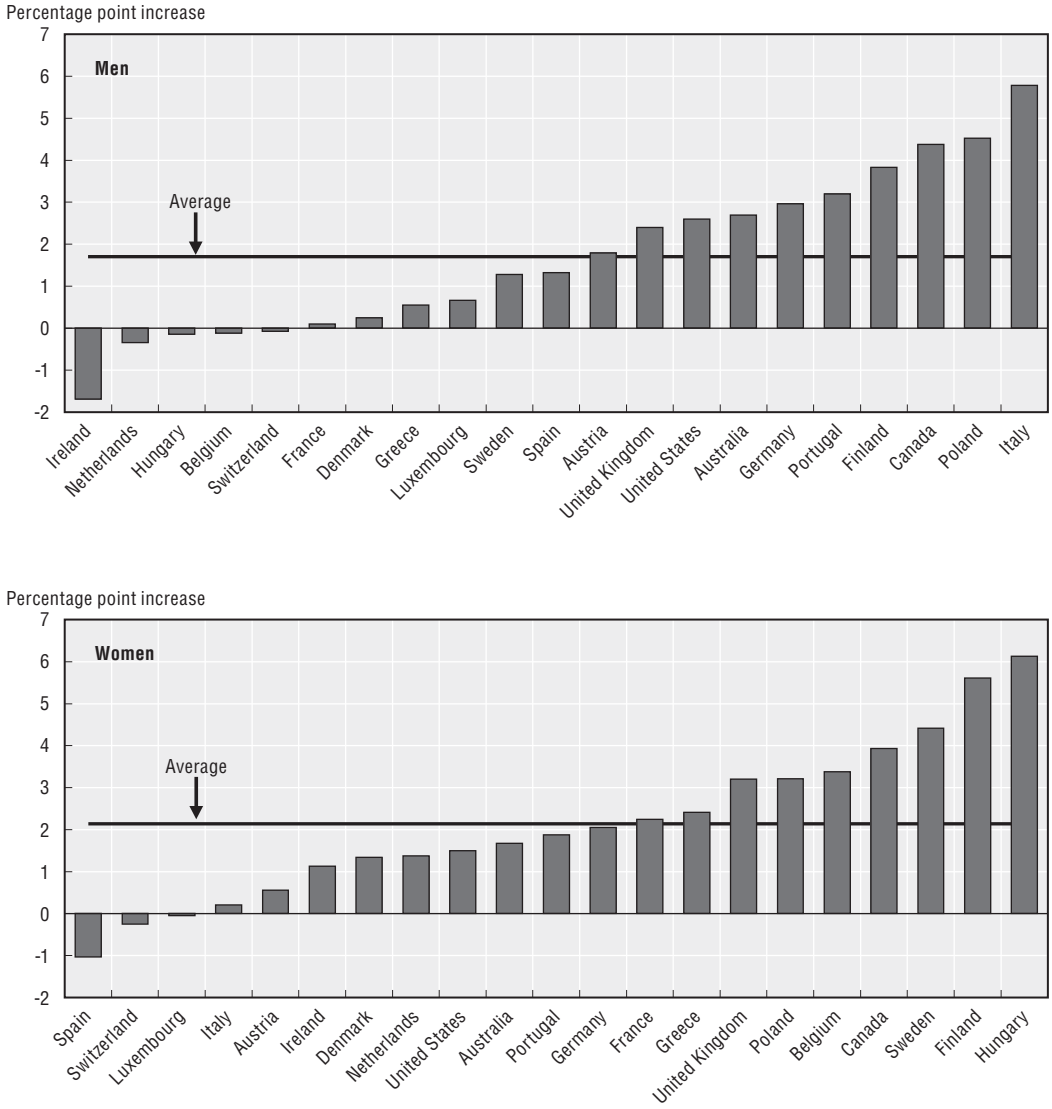
In 2001, the estimated conditional probability of employment for an upper-secondary degree holder was around 92% for women and 95% for men in most countries. With a tertiary education degree the employment probability increases on average by around 2 percentage points (Figure 4). The largest premia (*i.e.* the difference between the estimated employment probabilities for tertiary and upper-secondary graduates) are found for men in Italy, Poland and Canada, and for women in Hungary, Finland and Sweden. Small (or even negative) effects are found for men in Ireland, the Netherlands, Belgium, Switzerland and France, and for women in Spain, Switzerland, Luxembourg and Italy. Gender differences are particularly large in Italy and Belgium. Although the employability premia are estimated on micro-data and carefully isolate the education effect on employment from other characteristics, they are generally broadly in line with the gaps between aggregate unemployment rates of upper-secondary and tertiary degree holders.[14]

Perhaps not surprisingly, the employability premia display stronger cyclical sensitivity than wage premia.[15] They increase rapidly between 1995 and 1997, and fall monotonically afterward. The fluctuations are particularly marked for Spain and Italy, partly due to concomitant changes in labour market policies, often targeted at low-skilled workers. Moreover, the premium tends to decline in a majority of countries – reflecting that employment prospects improved more strongly for upper-secondary degree holders than for tertiary degree holders – and becomes more homogenous over time for men and women.

2.2. From the gross labour market premia to the net premium components of IRR

The estimated gross wage premia are adjusted for the effective duration of education, for the foregone experience premium as well as for average and marginal income tax rates. Finally, they are expressed as a percentage wage increase per year of tertiary education.[16]

Figure 4. **Marginal effect of tertiary education on the employment probability,[1] 2001[2]**



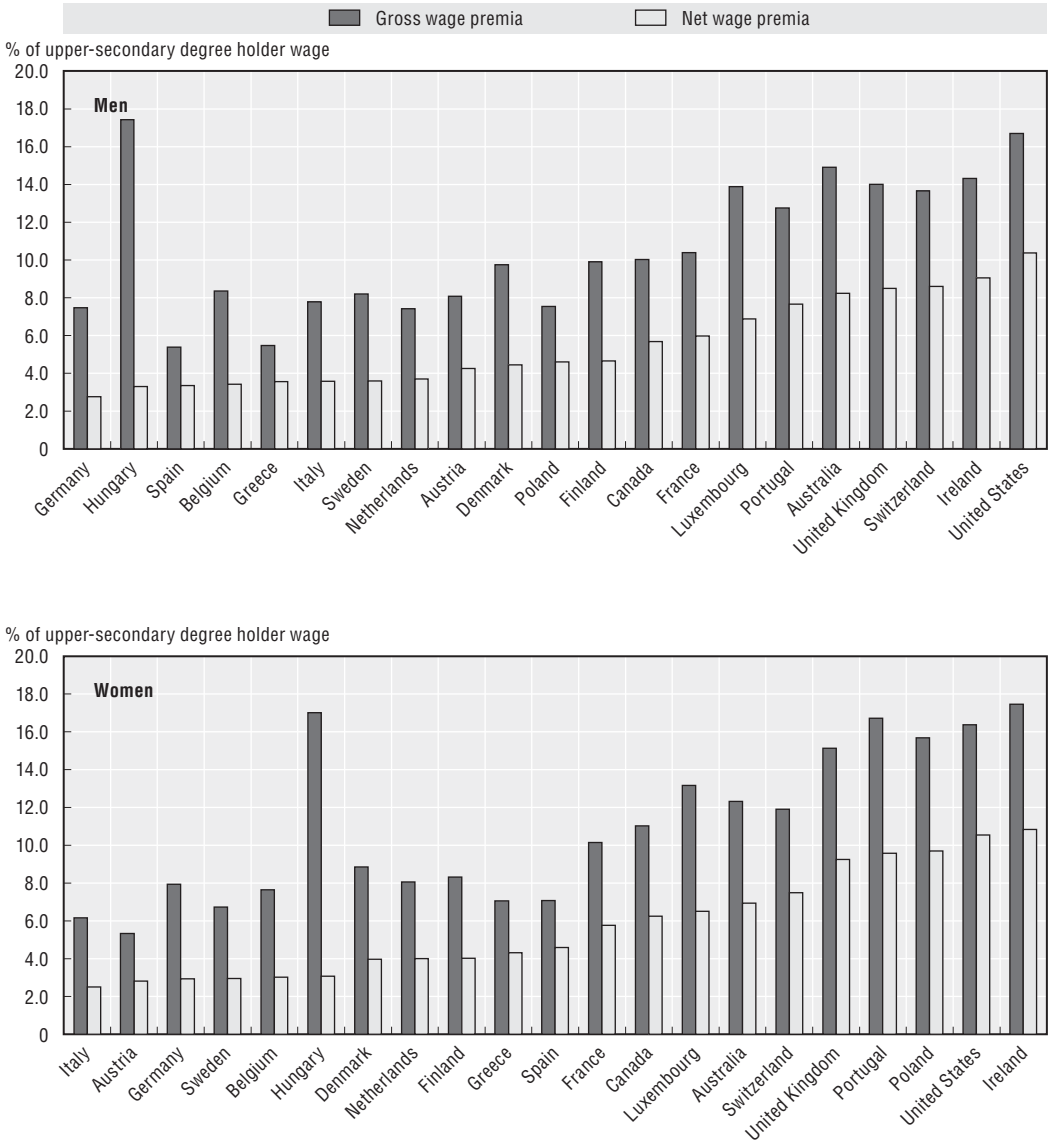
1. Increase in probability of employment: tertiary degree holders relative to holders of upper-secondary degrees.
2. Except for Hungary 1997 and Poland and Switzerland 2000.

Source: The European Community Household Panel (ECHP), the Consortium of Household Panels for European Socio-Economic Research (CHER), the Survey of Labour and Income Dynamics (SLID), the Household, Income and Labour Dynamics in Australia Survey (HILDA) and OECD calculations.

The net wage premium per year of tertiary education is quite different from the unadjusted wage premium both in absolute terms and from a comparative perspective (Figure 5). The latter is because duration, survival probability and taxation vary widely across the OECD area. The position of some countries, notably Hungary, Germany and Belgium, worsens considerably after these adjustments.

Before entering the IRR formula, the employability premia require an adjustment similar to that made for net wage premia. They are first expressed per year of tertiary education. Then *net* employability premia are derived from gross premia. The difference between gross and net employability premia depends on the out-of-work replacement

Figure 5. **Comparison of gross and net wage premium per year of tertiary education,[1] 2001[2]**



1. Adjusted for survival rates, experience premia, marginal tax rate for employed and unemployed, marginal gross out-of-work replacement rates, probability of unemployment and duration of studies. See Box 1, equation 3 in Boarini and Strauss (2007).
2. Except for Hungary 1997 and Poland and Switzerland 2000.

Source: Gross wage premia and unemployment probability are based on the European Community Household Panel (ECHP), the Consortium of Household Panels for European Socio-Economic Research (CHER), the Cross-National Equivalent File (CNEF) and the Household, Income and Labour Dynamics in Australia Survey (HILDA). Survival rates and duration of studies are from *OECD Education at a Glance*. Marginal tax rates are from the OECD Taxing Wages model. Replacement rates are from the OECD Benefits and Wages model.

income and the income tax treatment of replacement income.[17] In all countries net employability premia are much smaller than gross premia in absolute terms, the reason being the generally small difference between the net take-home pay and out-of-work replacement income. As a result, the magnitude of the net employability premium is small compared with that of the other drivers of IRR. In gross terms, employability premia are on average around ½ per cent whereas, in net terms, they decrease to only 0.1%.

2.3. Pension benefits

In computing IRR, pension benefits[18] are first adjusted by a tax factor and then discounted according to a representative market interest ratewhich is a function of labour productivity growth, the degree of indexation of pension benefits on wages, the length of the working life and the length of the retirement period. Portugal and Luxembourg display the highest net pension benefits, as a result of high replacement rates on pension benefits. On the other side of the spectrum, Finland and Italy are among the countries with the lowest net pension benefits owing to high taxation of pension benefits. By assumption, net pension benefits are received from the end of the active life until the expected death of the person so that differences in life expectancy and retirement age could change the country ranking with respect to net pension benefits. However, discounting those benefits (due to late occurrence in life) levels the country differences in the net pension premium on education.

2.4. Direct and indirect costs of education

In most countries, individuals do not bear the whole cost of education because funding to defray tuition fees and living expenses is publicly provided. This public support takes the form of either grants or loans (see OECD, 2006). The baseline estimates of direct costs presented below take into account grants for tuition fees but not for living costs.[19] This may imply a downward bias in IRR for Nordic countries, which are most generous in paying grants and loans for living costs to students.

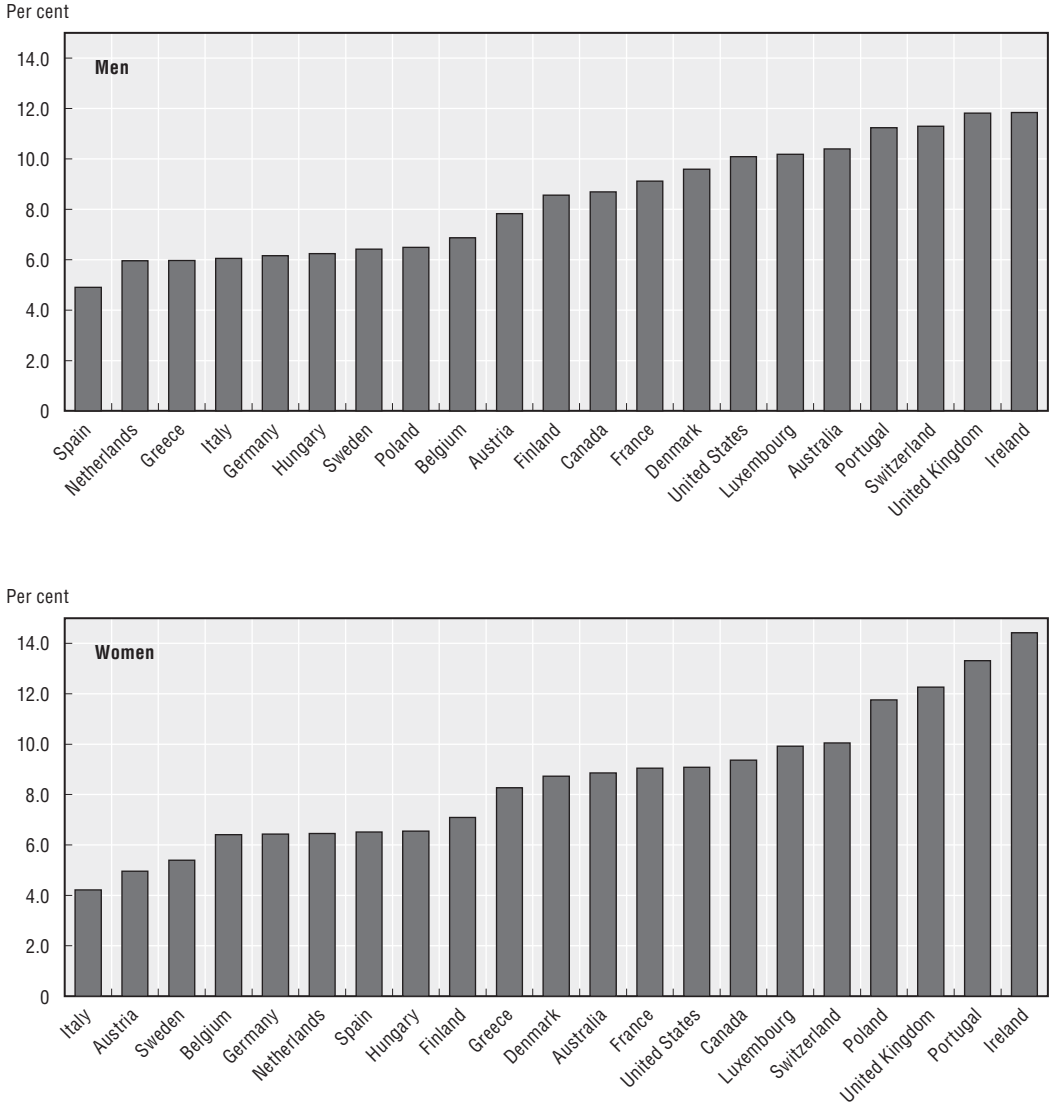
In practice, direct costs are obtained by combining three indicators: 1) annual total expenditure on tertiary education per student (including core educational services and R&D activities) (indicator B1.1 in OECD, 2005b); 2) the share of *final* expenditure borne by the private sector; and 3) the proportion of private final expenditure subsidised by the public sector, which covers only tuition fees (indicator B3.2b in OECD, 2005b). "Net" direct costs are thus given by the product of the annual total expenditure per student and the share of the *initial* expenditure borne by the private sector [given by 2) minus 3)].[20] In the baseline calculation, direct cost figures refer to 2002.

The opportunity cost associated with tertiary education consists of foregone labour earnings during tertiary studies, including both the wage of an upper-secondary degree holder and the premium on work experience accumulated while working (rather than studying). Opportunity costs are calculated as the average of net wages and unemployment benefits for an individual with upper-secondary attainment participating in the labour market, weighted by the probabilities of being respectively employed and unemployed.

3. Results for private IRR

Incorporating all the elements described above allows computing the baseline internal rates of return. Results for 2001 are shown in Figure 6. Internal rates of return vary across countries from 4 to above 14%. The average return (across countries and gender) is 8.5%, which is lower than previous OECD estimates but substantially higher than current market real interest rates. The range of returns for women is somewhat wider than for men (from 4 to 14.4% *versus* 5 to 12%). Low average returns are found (by ascending order) for Italy, Spain, Sweden, the Netherlands, Germany, Austria, Hungary, Belgium, Greece and Finland. IRR are moderate in Canada, France, Poland and Denmark. The highest returns are recorded in the United States, Australia, Luxembourg, Switzerland, the United Kingdom, Portugal and

Figure 6. **Estimates of the internal rates of return to tertiary education, 2001**[1]



1. Except for Hungary 1997 and Poland and Switzerland 2000.
Source: OECD calculations.

Ireland. In addition to the baseline, several alternative scenarios were estimated. They are discussed in detail in Boarini and Strauss (2007). Overall IRR estimates remain close to the baseline results, though in some cases country ranking varies considerably.

The baseline IRR is computed for the years 1991-2005 (Table 1). The cross-country cross-period average IRR is found to be slightly above 8% for both men and women, slightly less than the 8.5% observed in 2001. IRR vary more across countries than over time. Returns are relatively stable (see Boarini and Strauss, 2007, and Table 2 for a decomposition of the variance), with the OECD average increasing only slightly between 1994 and 2001 (Figure 7). The strongest upward trends are observed for Ireland, Portugal and Canada. Conversely, the United Kingdom displays a downward trend, especially at the end of the observed period.

Table 1. **Estimates of IRRs, various years**

In per cent

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Men															
Australia											10.4	10.2	10.1		
Austria					8.4	8.3	7.4	7.7	8.3	8.5	7.8				
Belgium				5.9	5.9	6.0	6.2	7.3	6.3	6.2	6.9				
Canada						7.3	5.9	7.1	7.0	8.7	8.7	8.4			
Denmark				5.4	7.0	6.5	6.7	8.1	8.5	8.4	9.6				
Finland						8.5	8.7	7.6	8.6	8.8	8.6				
France				9.5	9.3	9.4	9.8	10.2	9.3	10.1	9.1				
Germany				5.5	5.7	5.5	5.8	6.4	7.3	6.7	6.2				
Greece				5.4	5.2	5.6	5.7	4.9	5.8	6.0	6.0				
Hungary		7.3	6.4	6.4	5.0	6.8	6.2								
Ireland				7.2	8.1	8.5	9.8	9.0	8.8	8.6	11.8				
Italy				4.8	4.6	5.3	5.5	6.1	6.0	5.7	6.1				
Luxembourg					11.5	10.8	10.0	11.8	11.4	12.2	10.2				
Netherlands				6.9	6.9	6.7	5.6	6.3	4.4	5.0	6.0				
Poland							7.5	8.7	8.9	6.5					
Portugal				11.4	13.8	15.7	13.0	13.7	12.3	13.6	11.2				
Spain				5.0	5.4	5.5	4.4	3.9	3.1	2.2	4.9				
Sweden							6.4	7.3	7.2	7.0	6.4				
Switzerland									12.1	11.3					
United Kingdom	12.4	12.2	12.5	12.2	11.6	12.2	11.9	12.1	12.2	11.7	11.8	11.5	10.9	9.9	
United States				9.1	9.1	9.4	9.2	9.0	9.9	9.9	10.1	10.7	10.1	10.4	10.4
Women															
Australia											8.9	10.0	9.9		
Austria					9.3	9.5	7.5	6.9	7.1	5.7	5.0				
Belgium				4.4	5.1	4.4	5.4	5.5	7.4	6.0	6.4				
Canada						7.3	6.6	7.5	7.4	9.5	9.4	9.3			
Denmark				5.8	6.4	6.8	5.7	7.9	7.5	7.8	8.7				
Finland						6.5	6.1	5.8	6.7	6.4	7.1				
France				8.3	8.3	8.4	9.1	9.2	8.6	8.7	9.0				
Germany				5.2	6.0	5.3	5.9	5.9	6.5	5.7	6.4				
Greece				4.7	4.3	5.2	6.4	7.9	7.2	7.5	8.3				
Hungary		5.7	6.3	6.9	6.8	6.7	6.5								
Ireland				7.5	8.7	9.4	11.6	9.5	11.0	9.8	14.4				
Italy				4.3	4.4	4.2	4.3	4.4	4.5	4.8	4.2				
Luxembourg					12.2	10.4	10.1	11.2	10.5	10.9	9.9				
Netherlands				5.5	5.9	5.9	4.2	4.9	4.1	4.1	6.5				
Poland							9.2	10.3	11.3	11.8					
Portugal				10.6	11.3	12.6	11.5	13.3	12.2	15.6	13.3				
Spain				6.5	7.0	6.9	6.1	5.0	4.8	4.6	6.5				
Sweden							6.2	5.8	4.4	5.2	5.4				
Switzerland									10.4	10.1					
United Kingdom	12.6	13.9	13.3	12.7	12.7	12.3	12.6	12.8	12.2	11.5	12.3	12.1	10.9	9.9	
United States				8.6	8.6	8.9	8.7	8.5	9.0	8.9	9.1	9.4	8.7	9.2	9.1

3.1. Discussion of results

An abundant empirical literature exists on IRR. However, methodological differences in the computation of IRR, as well as relative paucity of cross-country comparative studies, make it problematic to compare IRR estimates presented here with those from previous studies. Psacharopoulos and Patrinos (2004) report IRR computed through the discount method (but not relying on microeconomic estimates of labour market premia) for a huge

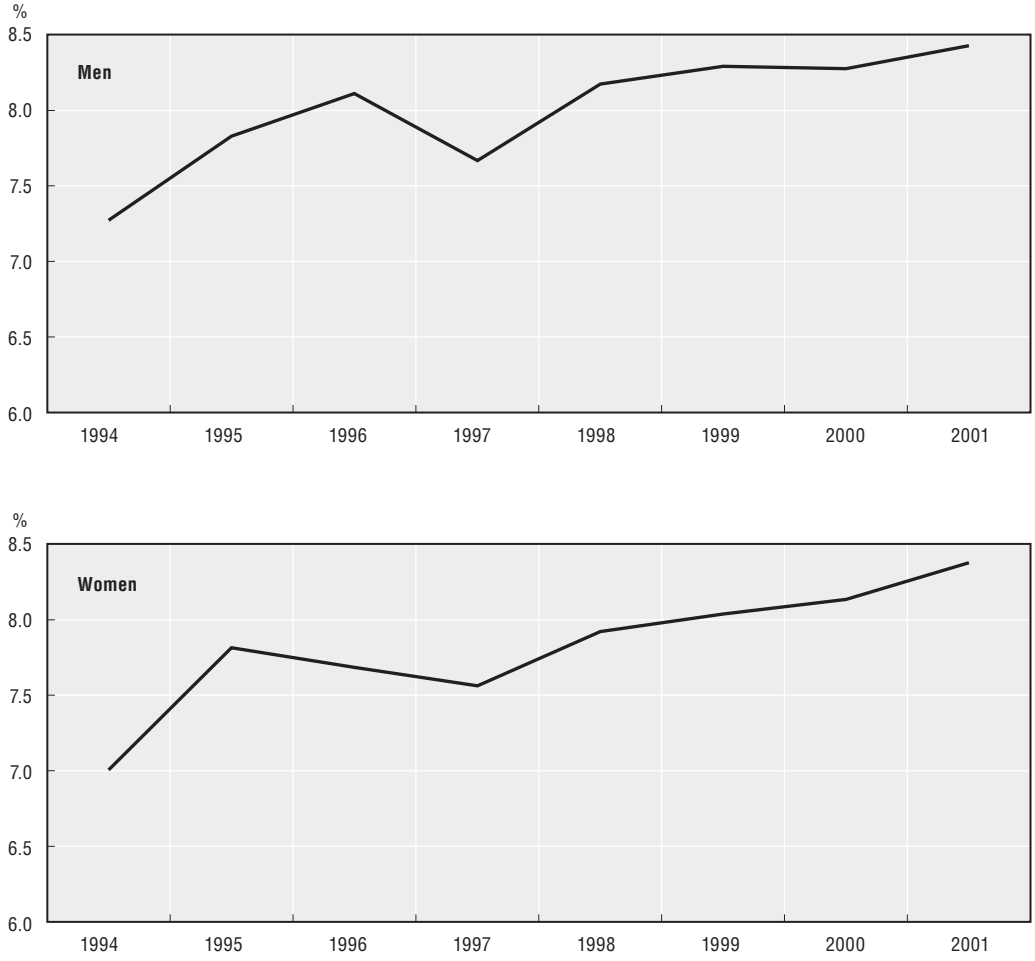
Table 2. **Variation across countries and over time of the main IRR components**

	IRR	Annual wage premia	Annual employability premia	Employment probability	Marginal tax rate	Average tax rate	Gross out-of-work benefits replacement rate	Net pension replacement rate
Cross-country coefficient of variation								
1994	0.31	0.44	0.74	0.07	0.32	0.26	0.34	0.41
1995	0.32	0.41	1.10	0.07	0.29	0.25	0.32	0.40
1996	0.30	0.40	0.91	0.07	0.28	0.24	0.30	0.42
1997	0.29	0.43	0.80	0.07	0.33	0.26	0.30	0.40
1998	0.29	0.39	0.94	0.06	0.26	0.27	0.30	0.42
1999	0.30	0.38	0.70	0.05	0.23	0.25	0.30	0.40
2000	0.33	0.40	1.05	0.05	0.24	0.26	0.30	0.40
2001	0.28	0.35	0.95	0.05	0.25	0.28	0.41	0.46
2002	0.11	0.20	0.32	0.03	0.09	0.03	0.44	0.60
2003	0.10	0.10	0.25	0.01	0.06	0.06	0.45	0.74
Over-time coefficient of variation								
Australia	0.04	0.07	0.26	0.01	0.00	0.02	0.19	0.85
Austria	0.15	0.18	2.27	0.01	0.00	0.02	0.17	0.15
Belgium	0.13	0.15	0.83	0.03	0.00	0.02	0.05	0.04
Canada	0.13	0.20	0.24	0.02	0.06	0.03	0.00	0.13
Denmark	0.15	0.18	1.27	0.02	0.01	0.02	0.07	0.09
Finland	0.15	0.14	0.46	0.03	0.03	0.05	0.05	0.35
France	0.05	0.08	0.96	0.05	0.04	0.01	0.01	0.53
Germany	0.08	0.10	0.51	0.02	0.02	0.03	0.01	0.01
Greece	0.18	0.20	0.75	0.08	0.11	0.02	0.28	0.08
Hungary	0.09	0.11	0.69	0.03	0.02	0.09	0.00	0.00
Ireland	0.17	0.20	1.12	0.03	0.19	0.18	0.15	0.01
Italy	0.13	0.11	0.67	0.06	0.01	0.03	0.06	0.16
Luxembourg	0.06	0.09	3.64	0.01	0.03	0.03	0.06	0.19
Netherlands	0.17	0.15	1.86	0.02	0.09	0.08	0.00	0.02
Poland	0.16	0.26	0.39	0.01	0.29	0.34	0.06	0.14
Portugal	0.09	0.12	0.58	0.02	0.01	0.03	0.16	0.16
Spain	0.26	0.21	1.16	0.12	0.03	0.04	0.05	0.03
Sweden	0.15	0.16	0.46	0.03	0.02	0.04	0.00	0.00
Switzerland	0.07	0.10	8.65	0.01	0.02	0.01	0.00	0.06
United Kingdom	0.06	0.09	0.58	0.02	0.01	0.04	0.13	0.06
United States	0.07	0.05	0.21	0.01	0.01	0.01	0.16	0.12

Note: The coefficient of variation across countries is only shown for years where it was possible to compute IRR for at least three countries.

sample of countries (including many non-OECD countries). They find average IRR to higher education of 11.6% for OECD countries. Blöndal *et al.* (2002) compute private internal rates of return to tertiary education at the end of the 1990s for ten countries and estimate higher returns than this study, varying in the range of 7.5% (Italy) to 18.5% (United Kingdom), with an average value of 11.6%. De la Fuente and Jimeno (2005), which this paper closely follows, compute returns for some European countries which range between 4.28% (Sweden) to above 12% (United Kingdom), with a 15-EU-country average of 8.8% (slightly above our estimates). Differences relative to results in this study are especially large for Italy, Greece, Spain and Germany, possibly reflecting different data sources for the estimation of labour market premia.

Figure 7. **Evolution of OECD average IRR between 1994 and 2001**



1. Country average is computed on a time unbalanced panel with a minimum of 13 observations.

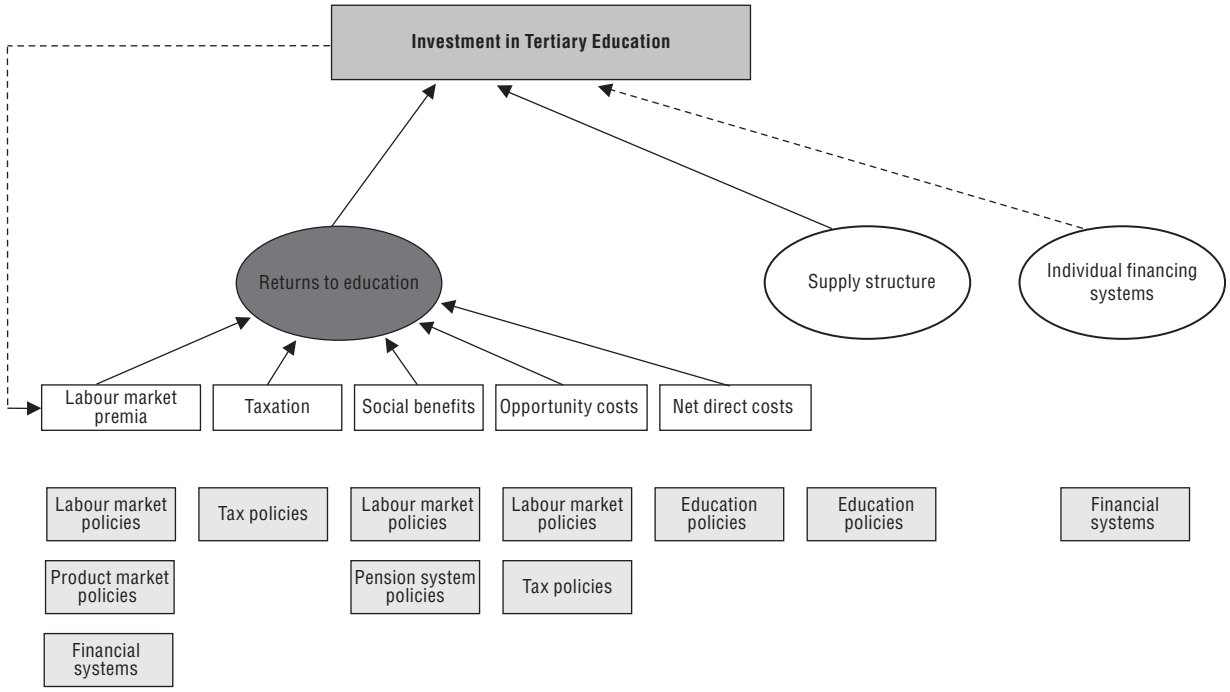
Despite efforts to compute IRR as accurately as possible, some limits of this method need to be pointed out. First of all, IRR shown above refer to an average individual, so that they do not reflect heterogeneity in a number of possible dimensions, notably ability, quality of education received, field of studies and possible liquidity constraints affecting students. Lacking a distribution of IRR for each of these dimensions, estimates should just be read as country-average returns for a representative individual.[21]

A second remark pertains to the general interpretation of IRR and to the possible explanation of cross-country differences in their levels. IRR depend on many factors and yet their main component is the wage premium. High wage premia may result from market forces, possibly reflecting scarcity rents, but also from specific labour market institutions, for example, country-specific aspects of the collective-bargaining system or of employment protection legislation. For this reason, IRR (or wage premia) provide only a very rough proxy of labour productivity of tertiary-educated workers and should rather be read as a proxy for the average individual's incentives to undertake tertiary education. The related question for policymakers is then how to act on these incentives, if the final goal is to increase tertiary human capital.

4. The impact of policies on IRR

Tertiary education and broader economic policies may affect the quantity of human capital accumulation either directly, for instance, by acting on the characteristics of tertiary education supply, or indirectly, by increasing or decreasing private incentives to invest in tertiary education (Figure 8). Many policy levers exist for increasing incentives to study. Labour markets are crucial to shape returns from education investment, as policies regulating wages and employment protection have a direct bearing on wage and employment premia. But other framework policies also matter for returns to education, for instance, product market regulation which has an impact on labour productivity and thus on IRR (see Oliveira *et al.*, 2007). Tax policies and welfare policies (unemployment and pension benefits) also matter for incentives to invest in education. Finally, education policies, in particular those governing financial support to universities and students, determine the costs sustained by students and thus the incentive to study. This section addresses the impact of some of these policies on private incentives by analysing how IRR respond to changes in labour market characteristics and education, social and fiscal policies.

Figure 8. **Policies affecting investment in tertiary education and IRR**



4.1. *Main influences on IRR: Policies and labour market outcomes*

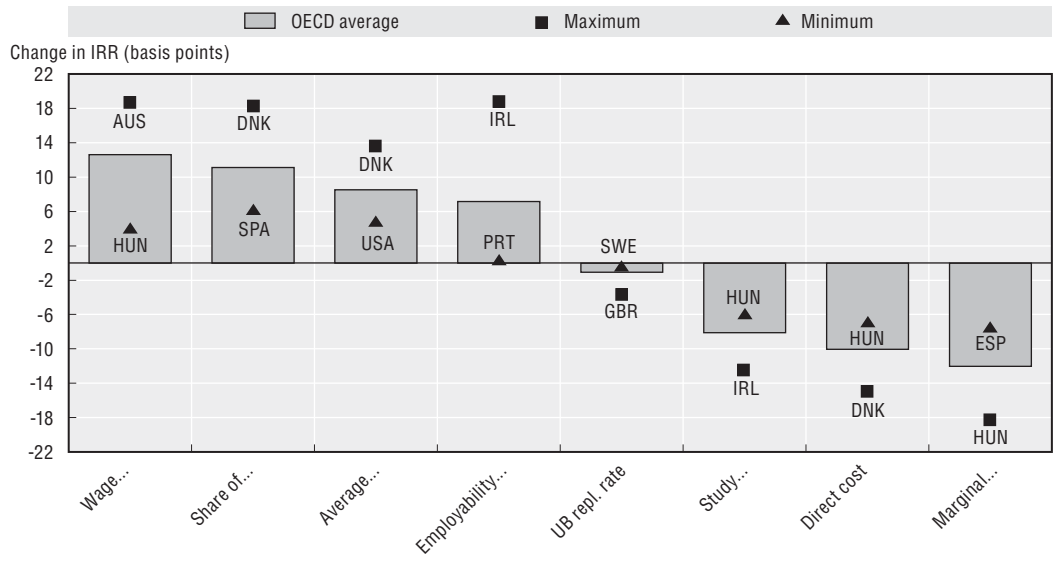
This part of the sensitivity analysis looks at the elasticity of IRR with respect to their main drivers, with the objective of assessing to what extent cross-country differences in IRR depend on cross-country differences in underlying components. Only one component is changed at a time, holding all the others constant except for obvious cases such as an increase in study duration, which is assumed to shorten the working life accordingly. All changes amount to 1 percentage point increases (except for study duration, which is changed by 1%) and refer to the 2001 baseline results.[22]

Figure 9 summarises the main results on IRR elasticities. It shows both OECD average elasticities and the range of elasticities across countries. These results can be summarised as follows:

- *Fiscal policy:* A strong progressivity of taxation may be detrimental to incentives to invest in human capital, as net labour market premia to higher education obviously become less attractive. Indeed a higher marginal tax rate reduces the net wage premium (elasticity slightly above 0.12). But the average tax rate matters, too: a higher *average* income tax rate tends to increase IRR, mainly via a reduction in opportunity costs, which represent the bulk of total private costs. Overall, the net effect of a joint increase in average and marginal tax rates depresses IRR in all countries, suggesting that progressivity of taxation matters more than the average tax rate for the incentive to study.
- *Social policy:* An increase in the *average unemployment benefit (UB) replacement rate* dampens labour market returns to education (as long as tertiary degree holders have higher employment probability than upper-secondary degree holders) and slightly increases the expected opportunity cost of studying. We find the net effect on IRR to be very small, reflecting the small net employability premia on tertiary education reported above.
- *Education policy: Higher tuition costs* (as a fraction of gross annual earnings of the average upper-secondary degree holder) have a direct negative effect on IRR (elasticity around 0.1). A marginal increase in the *study duration* also reduces the return per year of tertiary education. However, if students devote a higher share of their time to paid work (share assumed to be zero in the baseline), this significantly reduces opportunity costs.
- *Labour market characteristics:* An increase in the gross wage premium on tertiary education by 1 percentage point increases the private IRR by 0.13 percentage points on average. At 0.07 percentage points, the average increase resulting from a higher employability premium is smaller, as any increase in net lifetime earnings due to the higher conditional

Figure 9. **Sensitivity analysis on the internal rates of return,**[1] **2001**[2]

Male-female average



1. All drivers of IRR are changed by 1 percentage point except for study duration that is changed by 1%.
2. Except for Hungary 1997 and Poland and Switzerland 2000.

Source: OECD calculations.

employment probability of tertiary degree holders is partly undone by the concomitant loss of unemployment benefits, which are usually taxed at much lower rates than labour earnings. A non-negligible IRR effect of changes to the gross employability premium is observed only for countries where the difference between the take-home pay and the net unemployment benefit is large (*e.g.* Australia, Austria and Ireland).

Over and above those reported, a number of other parameter changes have been analysed. In most cases, their IRR effect is very small, such as for the pension benefit replacement rate, the degree of pension indexation, the length of the working life and the average experience premium. However, increases in the growth rate of average labour productivity raise IRR almost one to one and are therefore important for policy makers concerned with tertiary education incentives.

4.2. The differential impact of labour market characteristics and policies in individual countries

A second round of simulations consists of setting wage and employability premia, as well as private costs, to the upper end of their respective cross-country distributions so as to illustrate country-specific effects of policy changes. Conversely, tax rates are set at the lower end of their cross-country distribution.

4.2.1. Wage premium

Since IRR are most sensitive to gross wage premia, countries with moderate wage differentiation may gain in terms of tertiary education incentives from allowing for stronger differentiation. Policies and institutions contribute to compressing the distribution of gross wages (Katz and Autor, 1999). At the low end of the distribution, binding minimum wages and strong employment protection legislation (EPL) may grant workers a higher gross wage than would be warranted by their marginal productivity. At the high end, corporatist wage bargaining institutions (as measured by union density and the coverage of employment contracts by collective agreements) usually lead to some income sharing between high- and low-productivity workers. To illustrate possible gains from a higher wage premium, the latter is set to two standard deviations above the country mean.[23] With all other parameters remaining unchanged, IRR would increase by between slightly less than 1 percentage point in Portugal and almost 8 percentage points in Australia (Figure 10).

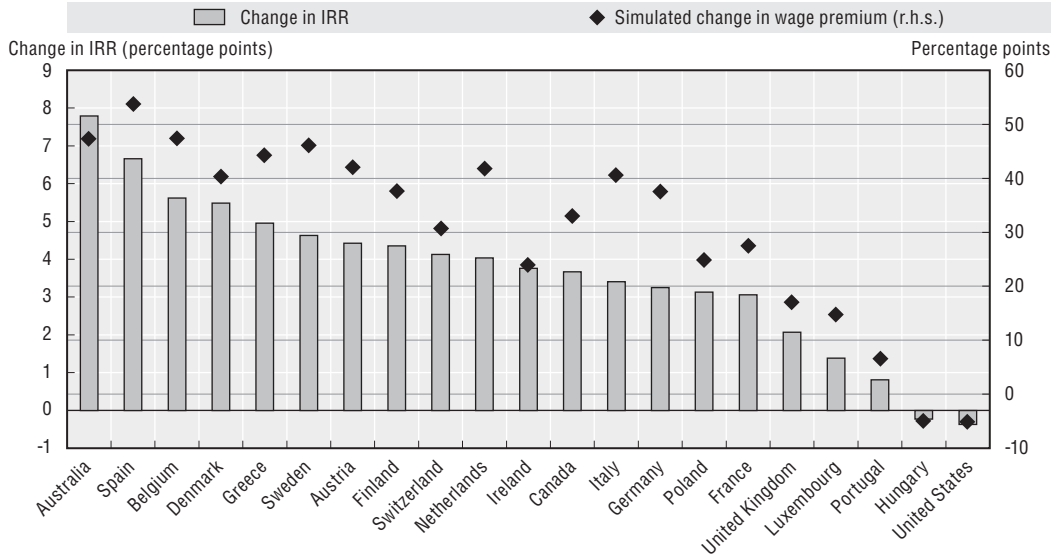
Overall, the lower is the initial *gross* wage premium, the higher the increase in IRR resulting from the simulation. Aside from this intuitive relationship, the increase in IRR also depends on the other parameters affecting the *net* wage premium, notably taxation and duration of studies, and on private costs. For example, in Ireland, where the marginal income tax is moderate and study duration is relatively short, the IRR increase would be stronger than in Germany and Italy, even though the simulated change in the gross wage premium is smaller. Likewise, the strong IRR increase in Australia mainly reflects short average study duration. Finally, as a rule, any increase in labour market benefits (numerator of the IRR calculation) is amplified if total private costs (denominator) are low.

4.2.2. Employability premium

If the employability premium were to be two standard deviations above the cross-country mean everywhere,[24] it would have to rise by 2 percentage points on average. This is modest compared with the wage-premium changes simulated above. Even with this

Figure 10. **Changes in IRR induced by higher gross wage premia,[1] 2001[2]**

Male-female average

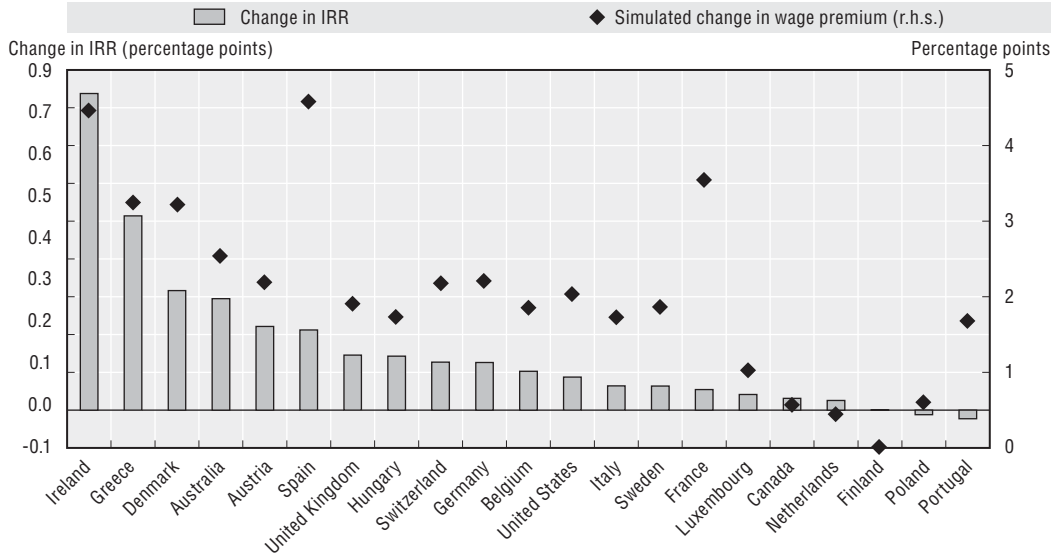


1. In this simulation the gross wage premium is set to two standard deviations above the country mean. In Hungary and the United States, where the wage premium is already higher than the simulated value, IRR would fall.
2. Except for Hungary 1997 and Poland and Switzerland 2000.

Source: OECD calculations.

Figure 11. **Changes in IRR induced by higher gross employability premia,[1] 2001[2]**

Male-female average



1. In this simulation the gross wage premium is set to two standard deviations above the country mean. In Poland and in Portugal, where the employability premium is already higher than the simulated value, IRR would fall.
2. Except for Hungary 1997 and Poland and Switzerland 2000.

Source: OECD calculations.

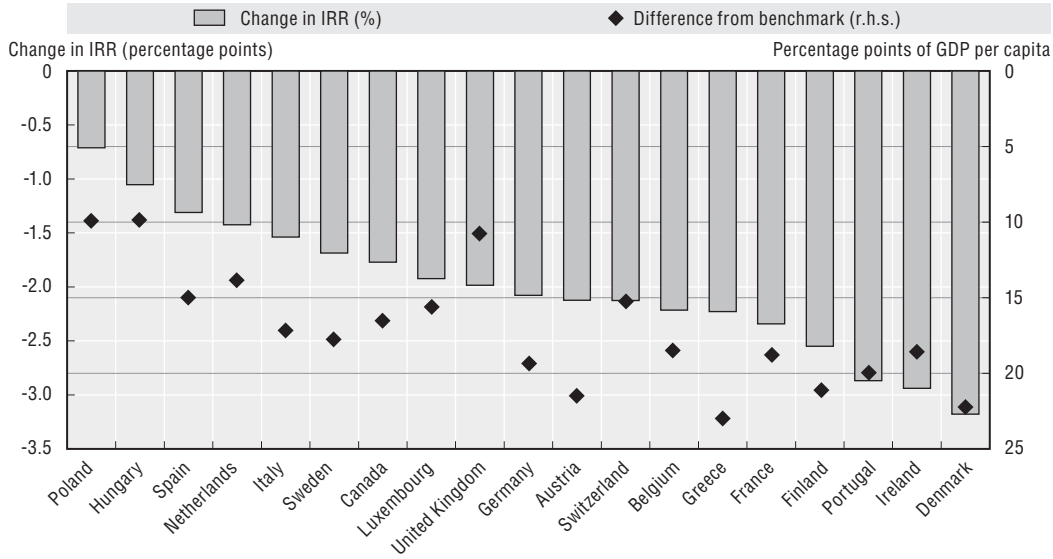
different impact in mind, the resulting average IRR effect (less than 0.2 percentage points) is extremely small (Figure 11). Changes in IRR would be the highest in Ireland and the lowest in Poland and Portugal.

4.2.3. *Private direct cost*

Higher net private costs would reduce IRR if other policy settings did not change at the same time. Again, the illustrative exercise consists of setting net private costs (as a fraction of GDP per capita) equal to the mean plus two standard deviations, which happens to be almost exactly equal to the Australian level but still well below the cost levels applied in the United States. The simulated increase in private costs is substantial in all countries, ranging from 10% of GDP per capita in Hungary and Poland to 22.9% in Greece. The fall in IRR lies between 0.7 percentage points in Poland and slightly more than 3 percentage points in Denmark (Figure 12).

Figure 12. **Changes in IRR induced by higher direct costs,[1] 2001[2]**

Male-female average



1. Net private costs are set to the country mean plus two standard deviations.
2. Except for Hungary 1997 and Poland and Switzerland 2000.

Source: OECD calculations.

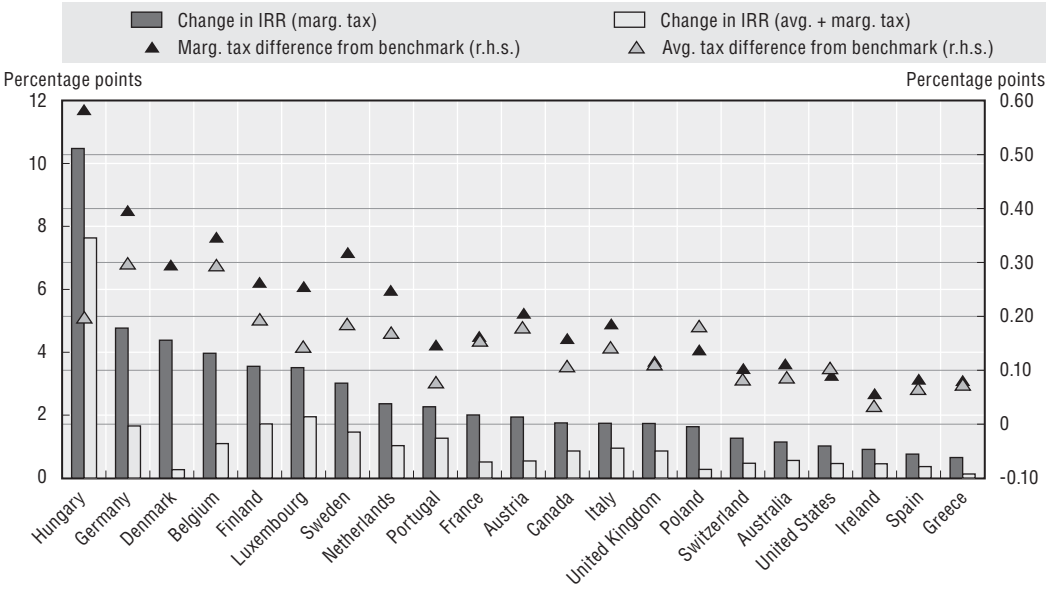
The effect on IRR of a *given* increase in the cost-to-income ratio is stronger the lower the initial level of costs (*e.g.* Austria, Belgium, Germany and Greece have levels much below the country mean) and the higher the labour market benefits to education (*e.g.* above-average levels for Ireland and the United Kingdom). A low (high) initial level of costs implies a large (small) simulated change in costs, leading to a strongly (weakly) negative effect on IRR. Yet the impact on IRR is cushioned somewhat by the fact that countries with low private costs also tend to have below-average labour market benefits.

4.2.4. *Marginal and average income tax rates*

As discussed above, the joint effect on IRR of setting marginal and average tax rates on labour earnings at the lower ends of their respective cross-country distributions is positive. Here the effects of tax reforms are assessed in two steps. In the first step the marginal tax rate is set at 20%, while the average tax rate is left unchanged. This leads to substantial IRR increases (Figure 13). In the second step, average tax rates are also set to the lower end of the distribution.[25] The total IRR effect is positive and ranges from 0.1 percentage point in

Figure 13. **Changes in IRR induced by lower income tax rates,[1] 2001[2]**

Male-female average



1. Marginal and average tax rates are, respectively, set at 20% and 13.3% (the lowest values in the sample).
2. Except for Hungary 1997 and Poland and Switzerland 2000.

Source: OECD calculations.

Greece, Denmark and Poland to 7½ percentage points in Hungary, with the effect exceeding 1 percentage point in four more countries (Finland, Germany, Luxembourg and Sweden). Indeed, IRR increases induced by sharp reductions in the marginal tax rate are undone by cuts in the average tax rate that increase opportunity costs.

5. Summary and conclusions

This paper provides estimates of private internal rates of return (IRR) to tertiary education for 21 OECD countries in the period 1991-2005. The high degree of cross-country comparability of the basic components entering these estimates – net wage premium, net-income equivalent of higher probability of being employed, net pension premium, direct costs and opportunity cost of studying – represents a major strength of the article. Labour market returns have been obtained by cross-sectional regressions based on individual data from international panel data sources, which allow controlling for a number of individual characteristics when estimating the effect of education on gross wages and on the conditional probability of being employed. Various OECD databases are used to adjust the estimated gross labour market premia for tax and benefit parameters and the duration of, and survival probability in, tertiary education. They also calculate the average private cost of tertiary education.

We have shown that returns are on average above 8%, thus substantially higher than returns to comparable financial investments. We have also illustrated the variety of policy levers that shape individual incentives to invest in tertiary education. Sensitivity analysis has shown that IRR depends positively on the wage premium, the employability premium, the share of time students devote to paid work and the average income tax rate, while it depends negatively on direct costs, study duration, the marginal tax rate and, to a lesser extent, the unemployment benefit replacement rate. Another set of simulations has shown

that moving the various IRR components to the boundary values of their respective cross-country distribution would lead to substantial changes in IRR. Policy makers may build on some of these results to design policies with the objective of stimulating incentives to invest in tertiary human capital.

However, if the policy targets the volume of investment in tertiary human capital rather than IRR *per se*, Oliveira *et al.* (2007) show that putting in place policies that increase returns to education is not the only way to go. They find that supply-side factors as well as financing constraints facing individual students also have an important role in determining the country-wide level of tertiary human capital investment. Their simulation results suggest that aligning the input and output flexibility as well as the accountability of tertiary education institutions on supply conditions observed in the best-performing countries in the OECD would lead to substantial increases in tertiary graduation rates. Some of the supply-side policies may also be seen as a necessary condition for the effectiveness of policies aimed at raising IRR: returns to education may well be substantial in a given country, but if the education system fails to send a clear signal as to how big these returns are, the investment in education may not materialise.

Notes

1. The relationship between incentives to invest and innate ability (when all other sources of individual heterogeneity are constant) is twofold: on the one hand, innate ability and received education are seen as complements in producing human capital; on the other hand, innate ability is deemed to be positively correlated with the opportunity cost of studying. Returns to investment in education for the more able will be, according to these two effects, respectively higher and lower than for the average individual. Higher discount rates due to impatience (distaste for schooling) or higher liquidity constraints will make the option of studying less attractive, for a given rate of return to education. In other words, returns should be higher to attract impatient students or financially constrained individuals. When ability and discount rates vary together, the endogeneity bias will be determined by the variance in ability relative to the variance in discount rates, as well as by the covariance of the two. For instance, when ability and discount rates are negatively correlated (typically through family background), marginal returns to education for the more able and, hence, their optimal level of schooling, are higher than for average individuals.
2. It remains controversial, however, whether the ability bias is rightly captured in these studies.
3. For instance, Blöndal *et al.* (2002) used the discount method to compute private and social rates of return for ten OECD countries in the 1999-2000 period. Psacharopoulos and Patrinos (1994) collect estimations from different studies based on the discount method encompassing more than 80 countries for periods ranging from the mid-1970s to the early 1990s.
4. The discount method and the Mincerian earnings equation differ not only in the extent to which they take into account costs of education, taxes and social benefits, but also because of different underlying assumptions on the life-cycle earnings profile (see Boarini and Strauss, 2007).
5. This choice is mainly due to the lack of reliable cross-country data on (the actual incidence of) students' work.
6. Previous empirical studies (Asplund and Pereira, 1999; Blöndal *et al.*, 2002; Harmon *et al.*, 2003; and Psacharopoulos and Patrinos, 2004) and the analysis in this paper show that premia differ across genders.
7. This sub-section draws on Strauss and de la Maisonneuve (2007), where the data sets, the choice and construction of variables and the econometric specification are discussed in detail. See also Strauss and de la Maisonneuve (2009).
8. It can be argued that an increased opportunity to work in a large plant could be an additional benefit of undertaking higher education, and thus this variable should not be controlled for. However, Strauss and de la Maisonneuve (2007) show that the correlation coefficient between educational attainment and the plant size is relatively small, suggesting that the possible associated endogeneity bias is also small.

9. It has to be borne in mind that the strong dispersion of wage premia across countries may reflect country-specific productivity differences between tertiary and upper-secondary degree holders, and also other factors, such as different scarcity rents on skilled labour and the degree of labour market regulation. In Portugal and Hungary high wage premia are more likely to reflect scarcity rents, whereas low degrees of labour market regulation seem to drive premia in the United Kingdom and the United States.

10. For instance, if only upper-secondary degree holders with good chances of finding a job participate in the labour market, the estimated employment probability of secondary-educated individuals will be biased upward and the employability premium associated with tertiary education will be underestimated.

11. As for the wage premia, the rationale to control for experience is strong when estimating the employment probabilities. However, approximating actual experience with potential experience would be more problematic in this context because the surveys provide no information on previous participation spells of currently inactive individuals. For this reason the variable age was retained instead.

12. Discouraged-worker effects are controlled for by excluding from the sample those individuals who, in any event, would have a very low probability of participating in the labour market. With this additional control, the estimates presented here are somewhere between the case where no adjustment is made for the selection bias and the one where all working age individuals are viewed as potential participants in the labour market. The variables of long-term unemployment and regional dummies are introduced only in estimations for European countries. The case for these variables has been tested through appropriate likelihood ratio tests. Countries where the regional dummies have a significant impact on the employment probabilities are Germany, Italy, Belgium, Spain, Greece and Austria. The underlying assumption is that workers do not migrate to regions where the probability of finding a job is higher, *i.e.* the region of residence is exogenous.

13. In countries where the selection bias is found to be non-existent, conditional employment probabilities are not significantly different from unconditional probabilities. Though the selection bias is found only for a subset of countries/years, drawing consistently on two-step estimates even when the selectivity bias is rejected allows for a unified framework warranting comparability across countries and years.

14. Some exceptions include Poland and women in Spain and Greece, where aggregate employability gaps are higher than estimates based on microeconomic data.

15. Limited time coverage of some countries (notably Switzerland, Hungary and Poland) might be a problem in this respect since, overall, the employability premium is found to fluctuate substantially over the cycle (see Boarini and Strauss, 2007). However, even large fluctuations in the employability premium have only a small impact on IRR (see the simulations around the employment premium in Boarini and Strauss, 2007).

16. See Boarini and Strauss, 2007, for the specific assumptions under these adjustments.

17. Data on average and marginal replacement rates are drawn from the OECD Benefits and Wages model.

18. Gross pension replacement rates are based on the new OECD Pensions model (OECD, 2005a); see Boarini and Strauss 2007 for details.

19. Due to data limitations, grants for living expenses cannot be computed for all countries and are therefore not accounted for in the baseline estimates of direct costs. In principle, grants for living expenses should be subtracted from private costs of education since upper-secondary degree holders who go to the labour market also bear living costs without receiving any transfer from the government. However, lacking relevant information for all countries under scrutiny, costs are only net of grants earmarked for tuition fees.

20. "Final" expenditure refers to the disbursement, while "initial" expenditure refers to the cost truly sustained by individuals, *i.e.* adjusted for public subsidies.

21. In principle it would have been possible, at least for labour market premia estimated on micro-data, to get a range of IRR by income decile (notably through quantile regressions). However, fiscal parameters and costs being solely available at aggregate level, the route of quantile regressions has not been pursued. Had this been done, it would not have been possible in any event to identify the causes of heterogeneity (*i.e.* individual ability *versus* higher quality of education, or high-rewarding field of studies) that remain unobservable in the data sets under use.

22. While these changes are numerically the same, they are quite different economically: a 1 percentage point increase in the employability premium from, say, 4 to 5 percentage points is more substantial than an increase in the wage premium from 40 to 41% or a 1% increase in the duration of studies.

23. These levels roughly correspond to the US wage premium for men and to the Hungarian wage premium for women. Hence, IRR in these two countries barely change in the simulation.

24. Both for men (3.8 percentage points) and for women (5.6 percentage points) the simulated employability premium is close to the 2001 levels observed in Finland. Note, however, that these values are not simulated for countries where this would move the employment probability for tertiary degree holders to values greater than one. For countries where the employment probability for upper-secondary degree holders is already above 0.962 for men and 0.944 for women (*e.g.* Luxembourg, the Netherlands and Switzerland), the simulated marginal effect is not 3.8 percentage points and 5.6 percentage points, respectively, but just the margin missing to one (*i.e.* to full employment of tertiary degree holders).

25. Average and marginal tax rates on replacement income are zero in this simulation to avoid negative values.

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