

OECD Economics Department Working Papers No. 591

The Private Internal Rates of Return to Tertiary Education: New Estimates for 21 OECD Countries

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https://dx.doi.org/10.1787/031008650733

OECD

Unclassified **ECO/WKP(2007)51**

Organisation de Coopération et de Développement Economiques
Organisation for Economic Co-operation and Development **20-Dec-2007**

English - Or. English

ECONOMICS DEPARTMENT

ECO/WKP(2007)51
Unclassified

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By
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JT03238193

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English - Or. English

ABSTRACT/RESUMÉ

The private internal rates of return to tertiary education: new estimates for 21 OECD countries

This study provides estimates of the private Internal Rates of Return (IRR) 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 education cost. 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 gender. Overall, a slightly increasing trend is observed over time. The study 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
Key words: Investment in tertiary education, Returns to education, Labour market premia

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Les taux de rendement privés de l'éducation supérieure : nouvelles estimations pour 21 pays de l'OCDE

Cette étude fournit des estimations des taux de rendement privés de l'éducation supérieure, pour les hommes ainsi que pour les femmes, dans 21 pays de l'OCDE et pour les années comprises entre 1991 et 2005. Les rendements sont calculés en estimant les primes sur le marché du travail à partir de données individuelles comparables entre les pays. Ces primes sont ensuite corrigées par des facteurs fiscaux et par les coûts de l'éducation. Les rendements d'une année supplémentaire d'enseignement supérieur sont en moyenne supérieurs à 8%, et varient dans un intervalle de 4% à 15% entre pays et pour la période considérée. Les rendements sont à peu près les mêmes pour les hommes et pour les femmes. Dans l'ensemble, une légère tendance à la hausse apparaît dans la période d'observation. L'étude examine l'influence des différentes politiques sur les incitations individuelles à investir dans l'éducation supérieure et propose des estimations de l'impact des réformes sur ces incitations .

Classification JEL : I21, I22, I28, J24
Mots clefs : Rendements de l'éducation, Education supérieure, Primes du marché du travail.

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THE PRIVATE INTERNAL RATES OF RETURN TO TERTIARY EDUCATION: NEW ESTIMATES FOR 21 OECD COUNTRIES

by

Romina Boarini and Hubert Strauss[1]

Introduction

1. A longstanding view in Labour Economics is that the demand for education depends on the economic incentives associated to studying (Becker, 1967; Freeman, 1986). Internal Rates of Return (IRR) to education are a standard measure of the profitability of undertaking additional years of schooling, as is well documented in the empirical literature. IRR estimates have also 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 study builds on such recent developments (De la Fuente and Jimeno, 2005) and on new estimates of wage *premia* (Strauss and de la Maisonneuve, 2007) to provide IRR estimates for men and women in 21 OECD countries for the time period 1991 to 2005.

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

3. The cross-country average of the baseline IRR is above 8% in the period under scrutiny, and essentially varies from 4 to 15%. IRR are relatively homogenous across gender. Overall, a slightly increasing trend is observed over time. IRR increase more markedly in Ireland, Portugal and Canada and they decline in the United Kingdom in the early 2000s. Labour market *premia* turn out to be the main drivers of IRR, often irrespective of education cost configurations. Beyond labour markets, returns to schooling depend (positively) on average tax rates and the share of students' time worked; and (negatively) on marginal tax rates, study duration and tuition fees.

4. The study is structured 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 the IRR, namely labour market *premia*, fiscal and social benefit parameters and private

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costs. Section 3 shows estimates of IRR in the baseline scenario and in a number of alternative scenarios. It compares the IRR estimates with those from previous studies and discusses both their interpretation and limitations. The final section presents a sensitivity analysis assessing the relative importance of basic IRR components and concludes.

1. Methodological approaches to computing private returns to schooling (IRR)

Education as an investment

5. In human capital theory (Becker, 1967) schooling is seen as an optimising investment decision. 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 is supposed to 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.

6. Against this background it has often been objected 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,[2] their net total effect is bound to be an empirical question (Harmon *et al*. 2003). A related criticism is that individuals would not invest in education to increase their potential productivity, but rather send a signal on their ability (signalling effects).

7. Assessing the size of the endogeneity bias and explaining the true causality between wages and innate and/or acquired skills of workers is important on many accounts, not least to set the right targets for policies aimed at enhancing growth and productivity. It is, thus, of some comfort that many empirical studies find only a small ability bias (around 10% of earnings variance, see Harmon *et al*. 2003)[3]. As concerns signalling effects, empirical evidence is more mixed; signalling effects are, however, more innocuous in the context of computing private incentives to schooling since, for the individual, it may be rational to invest irrespective of whether higher salary is warranted by inherent ability or received education.[4]

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2. The relationship between incentives to invest and innate ability (when all other sources of individual heterogeneity are constant) is two-fold: 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 invest in education for the most able will be, according to these two effects, respectively higher and lower. 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 in order 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 that 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 are higher for the most able, as is the optimal level of schooling.

3. It remains controversial, however, whether the ability bias is rightly captured in these studies.

4. However, whether the signalling/sheepskin theory or the human capital theory is true makes a difference for drop-outs from tertiary education. They would have no wage increase under signalling but some increase in the human capital view. Although this study follows the latter view, due to data limitations tertiary-education drop-outs have to be treated like upper-secondary degree holders.

8. Finally, a common assumption when computing returns to education is that costs and benefits 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. In addition, the possible two-way causality between education and various non-economic outcomes creates uncertainty as to the right avenues for policy. For these reasons, this study only takes into account pecuniary benefits.

Standard techniques to compute returns to education

9. 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) has shown that these two approaches produce similar results under stringent assumptions. Recently, the literature has combined the two methods into a unified framework, where the IRR is computed as the discount rate equalising the benefits from education to its costs, with benefits estimated through Mincerian equations.

10. The discount method is an application of cost-benefit analysis to the schooling decision. The IRR summarises how profitable it is to undertake an additional year of schooling on the basis of the relevant stream of benefits and costs associated to it. Figure 1 provides an intuition for the concept of IRR. In the discount method the optimality of the investment is assessed at the margin and the resulting return is compared with that of competing financial investments. For instance, Blöndal *et al.* (2002) used the discount method to compute private and social rates of return for ten OECD countries in 1999-2000. 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. While the discount method has the advantage of summarising into one indicator the many different benefits and costs associated to education, it often relies on average earnings across educational groups, without further controls for other individual characteristics.

[Figure 1. Private IRR to tertiary education illustrated]

11. By contrast, the Mincerian approach relies on the econometric estimation of earning functions, based on individual-level data. The seminal work by Mincer (1974)[5] stimulated a great deal of empirical analysis, reviewed in Harmon *et al.* (2003). In the most commonly used specification of earnings equations, the log of gross hourly wage is regressed on educational attainment, linear and quadratic terms measuring labour market experience, tenure and a more or less large set of other individual characteristics. The coefficient estimate of educational attainment is interpreted as the percentage wage differential due to an additional year of schooling (when the educational attainment is measured by years of schooling). While this method has the merit of singling out the part of the earnings variance that is due to education, it

5. Heckman *et al.* 2005 stresses the differences between the original Mincer model (1958) and the later one (1974), which gave rise to the abundant econometric literature on semi-log earnings equations. In the original model individuals are deemed to be equally talented, and the higher salary paid to those studying longer is interpreted as a compensation for the opportunity costs (foregone earnings) incurred while studying. In Mincer (1974) agents are heterogeneous in ability and education is assumed to yield an *average* rate of return which is constant across all years of schooling. However, the dispersion in ability accounts for differences between the average *ex ante* return to schooling and the marginal *ex post* returns, reflecting innate individual characteristics.

clearly neglects the cost of education, as well as the taxes and social benefits that workers pay/receive over the life-cycle.[6]

The analytical framework used in this study

12. This study essentially follows the approach developed in De la Fuente and Jimeno (2005), combining the discount method and the estimation of Mincerian wage *premia* and other labour market *premia* from micro-level data. This mixed approach provides an extensive and accurate measure of the stream of benefits and costs of education.

13. In this approach agents are assumed to enter the labour market once they have completed their studies. If they find a job, they earn a wage, which is an increasing function of the number of completed years of schooling, and pay some taxes on it. It is assumed that the number of working hours does not depend on the years of schooling. In case of unemployment, agents receive out-of-work benefits, also being taxed at some rate. When individuals retire, they receive a replacement income, which represents a constant fraction of the last earnings received. It may also be taxed and grows over time at a constant rate.

14. In this setting, the *additional stream of labour market income* yielded by any further year of schooling has two components: *i*) the increase in the net hourly wage, for a given level of hours worked; *ii*) the increase in hours actually worked implied by a higher probability of finding a job, for a given level of hourly wage. While the additional earning yielded by schooling is constant throughout the life-cycle, real earnings grow at a constant rate, which depends on both technological progress and accumulation of experience.

15. 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 (see Box 1). Lifetime income includes the expected value of life-cycle after-tax labour income and after-tax out-of-work benefits as well as the after-tax retirement benefits received over the period of retirement. To assess returns from undertaking tertiary education, it is necessary to compare the marginal benefit of an additional year of post-secondary schooling with its marginal cost: the IRR is indeed the discount rate equating *the marginal benefit* to the *marginal cost.*

16. The marginal benefit from education can be decomposed into three components: the "*net wage* premium" (θ_{net} in equation 3, Box 1), defined as the increase of wage entailed by an additional year of schooling and holding constant the employment probability; the "*net employability* premium" (P'_{net} in equation 3, Box 1) given by the increase of the employment probability associated with an additional year of schooling, and holding constant the wage; and the "*pension* premium" (*PENS(R)* in equation 3, Box 1), *i.e.* the discounted value of higher retirement benefits due to higher working-lifetime wage and employment probability resulting from an additional year of schooling. The marginal cost of education is given by two components: the "*opportunity cost of schooling*" (*OPPC*in equation 3, Box 1), *i.e.* the

6. 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. The Mincerian approach is built on three assumptions: a) log-earnings experience profiles are parallel across schooling levels, *i.e.* there is no interaction between educational attainment and labour market experience; b) log-earnings age profile diverge with age across schooling levels; and c) the variance of earnings over the life-cycle has a U-shaped pattern. Heckman *et al.* (2005) shows that assumption a) is required for the wage premium estimated through Mincerian assumptions to be equal to an IRR; the authors also test this assumption using American CPS data for the 1940s to 1990s and provide evidence against it for the later waves.

foregone earnings and labour-market experience due to continued schooling,[7] and the "*direct cost*" of schooling born by the agent (*DIRC* in equation 3, Box 1), essentially given by tuition fees. All marginal benefits and costs featuring in equation 3, Box 1, are expressed as a fraction of the average earning of an upper-secondary degree holder at the mid-point of his career.

Box 1. The IRR: from the theoretical model to an almost-closed formula

Following De la Fuente and Jimeno (2005), the number of years of schooling *(X)* is chosen by maximising the lifetime expected net income function[1]:

$$V(X) = A_0 \int_X^U F(X)\, e^{-Rt} dt + A_0 e^{(g+\nu-\varpi)U} F_p(X) \int_U^Z e^{-(R+g+\nu-\varpi)t} dt - A_0 \mu_s e^{\nu H_0/2} f(S_0) \int_0^X e^{-(R+\nu)t} dt \quad \textbf{(1)}$$

$$S_0 \equiv S(X_0), R \equiv r - g - \nu$$

S_0 is the 'reference' schooling attainment after X_0 years of schooling (*i.e.* the point from which the profitability of continuing education is assessed): in this work the reference attainment is the upper-secondary degree; *R* combines *r* the private return to schooling (at which the future stream of income is discounted) with *g* and ν, measuring the growth rate of earnings due to technological progress and accumulation of experience respectively; U is the retirement age and Z life expectancy at birth.

The first two terms in the function refer to the benefits from schooling *F(X)* that are given by (i) the present value of expected net lifetime labour earnings and unemployment benefits (both are an increasing function of the number of years of schooling *X* and are received during the working life *(U-X)* of the individual), and (ii) pension benefits $F_p(X)$, which are indexed on gross wages and technological progress and are received during retirement *(Z-U)*. By assumption F(X) is time-invariant, while real earnings grow at a pace of $(g + \nu)$ and their initial level is a function of A_0, the efficiency index reflecting the state of technology at X. The last term in the function expresses the present value of direct costs of education (direct costs are set as a fraction μ_s of the earnings of the reference person, *i.e.*, the average upper-secondary degree holder). Costs are paid over the duration of studies *(X)*.

Maximising the objective function with respect to *X* yields the optimal number of years of schooling. The IRR to tertiary education is obtained by equating the marginal benefit of an additional year of schooling to its marginal cost, at the point where the individual completes an upper-secondary degree. This is obtained by taking the first derivative of the objective function above (*V'(X)*, the 'marginal product' of schooling) and solving for the value of *R* for which the first order condition *V'(X)=0* is satisfied at $X=X_0$. De la Fuente and Jimeno (2005) show that this leads to the following 'almost-closed' formula for *R*:

$$\frac{R}{1-e^{-RH_0}} = \frac{p(1-T')[\tilde{\theta}S'(X_0) - \nu] + \Delta p' S'(X_0) + \gamma(R)(1-T_p')\kappa[\tilde{\theta}S'(X_0) - \nu]}{p(1-\tau) + \mu_S e^{\nu H_0/2}} \quad \textbf{(2)}$$

The IRR formula can be rewritten as follows:

7. The foregone earning is given by the weighted sum of labour market wage and out-of-work benefits, with weights given respectively by the employment and the unemployment probabilities. The loss of experience shows up in the numerator of equation (2) of Box 1 and translates into both a reduced net wage premium and a lower pension premium.

$$\frac{R}{1-e^{-RH}} = \frac{\theta_{\text{net}} + P'_{net} + PENS(R)}{OPPC + DIRC} \qquad \textbf{(3)}$$

θ_{net} is the net wage premium (shown in Fig. 7) $\theta_{\text{net}} \equiv p(1-T')[\tilde{\theta}S'(X_0) - \nu]$

P'_{net} is the net employability premium (shown in Figure 8) $P'_{net} \equiv \Delta p' S'(X_0)$

PENS(R) is the pension premium $\text{PENS(R)} \equiv \gamma(R)(1-T_p')\kappa[\tilde{\theta}S'(X_0) - \nu]$

OPPC is the opportunity cost $OPPC = p(1-\tau)$

DIRC is the direct cost (shown in Figure 10) $DIRC = \mu_S e^{\nu H_0/2}$

with :

- p : employment probability for the reference group (here: persons with upper-secondary education);
- T' : marginal tax factor for a person of the reference group, defined as a 'weighted' average of the marginal tax rate on labour earnings and the marginal tax rate on unemployment benefits, with weights given by the employment and unemployment probabilities;
- $\tilde{\theta}$: wage premium per year of tertiary education, *i.e.*, θ corrected for the duration of education (d);
- $S'(X_0)$: survival rate, *i.e.* the probability to complete an additional year of tertiary education once enrolled;
- ν : labour market experience premium (rate of annual gross wage increase);
- τ : average tax factor for the reference group, defined as a weighted average of the average tax rate on labour earnings and the average tax rate on unemployment benefits, with weights given by the employment and unemployment probabilities;
- Δ : differential between the "take-home-pay" rate (1- τ) and the net benefit replacement rate;
- p' : employability premium, *i.e.* marginal increase in the employment probability from completing the next higher attainment level *per year* of tertiary education (adjustment for study duration like in the case of θ);
- $\gamma(R)$: discount factor on pension benefits, $\gamma(R) \equiv \frac{R}{R+g+\upsilon-\varpi}\frac{1-e^{-(R+g+\upsilon-\varpi)(Z-U)}}{e^{RH}-1}$;
- *g*: labour productivity growth;
- ϖ : real growth rate of pensions;
- T_p': marginal income tax rate for pensioners;
- κ : pension benefit replacement rate;

- μ_S : cost of tertiary education paid by private agents, expressed as a fraction of the wage of an upper-secondary degree holder at mid-career;
- H: length of the working life, *H=U-X; (H_0* retirement age of an upper-secondary degree holder);
- *U*: average retirement age;
- *Z*: life expectancy at birth;

1. De la Fuente and Jimeno's (2005) original framework assumes that students work part-time and thus earn some additional money during their studies. This translates into another term to be added to the objective function: $A_0 e^{\upsilon H_0/2} \int_0^X F_s(t) e^{-(R+\upsilon)t} dt$. For the simulation shown in Figure 14, the IRR were recalculated to incorporate this additional term.

17. In contrast with De la Fuente and Jimeno (2005), the baseline IRR constructed here does not include the possibility of students' part-time work, although alternative estimates of IRR under some arbitrary assumptions on duration and reward of students' work are provided below. This choice is mainly due to the lack of cross-country data on (the actual incidence of) students' work. Another difference with De la Fuente and Jimeno (2005) is that the *educational reference level* for computing IRR is completed upper-secondary education, rather than the average number of years of schooling in the population.

18. 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 to grow at a constant rate over time;
- The employment probability is an increasing and time-invariant function of schooling;
- 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.

19. 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 the average earning (AE). While the next section discusses in detail all ingredients of the IRR, Box 2 provides a summary checklist of parameters and sources.

Box 2. Data Sources for the parameters entering the IRR

- θ (wage premium on completed tertiary education degree) and ν (experience premium): OECD Estimates from variouson Various Household Panel Surveys (*ECHP, BHPS, CPS, CHER, CNEF, HILDA*): Strauss and de la Maisonneuve (2007).
- p (employment probability) and p' (employability premium): OECD Estimates from variouson Various Household Panel Surveys (*ECHP, BHPS, CPS, CHER, SLID, HILDA*).
- *d (*duration of tertiary studies): *Education at a Glance (EAG) 2005*, Table B1.3b.
- $S'(X_0)$ (survival rate): *EAG 2005*, Table A3.2.
- T' (marginal tax factor) and τ (average tax factor) and out-of-work replacement rates: *OECD Taxing Wages Model*; *OECD Benefits and Wages Model*.
- *g* (labour productivity growth) = 1.75% by assumption (baseline IRR); *OECD Labour Productivity Data Set* (alternative scenario IRR with country-specific productivity growth).
- ϖ (real growth rate of pensions) = 0.5**g* by assumption.
- κ (pension benefit replacement rate) and T_p' (marginal income tax rate for pensioners): *OECD Pensions at a Glance 2005.*
- μ_S (cost of tertiary education paid by private agents) : *EAG 2005*, Indicators B1.1 and B3.2b.
- H (length of working life): Burniaux *et al.* (2003).
- *U* (average retirement age): Burniaux *et al.* (2003).
- *Z* (life expectancy at birth): *OECD Health Data Base 2005*.

2. Computation of the IRR components

Estimation of labour market premia: the use of individual-level data

20. As discussed above, schooling yields three kinds of labour market *premia*: the wage premium, the experience premium, and the employability premium. These *premia* are computed using individual-level data from cross-country comparable household survey datasets. 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, upper secondary degree, tertiary education).[8] In what follows, the focus is on *premia* from upper-secondary to tertiary degree level even

8. In principle, the data would allow following individuals over time and, hence, using panel econometric techniques to control for possibly omitted variables at an individual level. However, for several reasons only cross-sectional analysis is implemented in the study. First, the main explanatory variable (education) does not vary over time (or varies very little in the bulk of the relevant sample for estimation), so that standard fixed-effects models could not be used. Second, a panel approach would require the use of time-varying variables (*e.g.* the unemployment rates at a disaggregated level, *i.e.* gender-sector-occupation-attainment-specific) that are not readily available in the datasets exploited here. Third, the focus of this study is the return to education by country rather than changes in individual conditions over time. Fourth, pooling the data over time is not needed on efficiency grounds given the already large sample size of each country cross-section.

though the approach readily allows computing the premium on completing upper-secondary education as well. Labour market *premia* are also estimated separately for males and females.[9]

Wage and experience premia[10]

21. 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.[11] In the absence of relevant information on actual labour market experience, regressions made use of years of *potential* experience, proxied as the difference between current age and age at labour market entry.

22. 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 their over- or under-qualification for the job.

Empirical results for wage and experience premia

25. Regression results of the wage equation are in line with priors for most variables (results for 2001, the year with the widest country coverage, are shown in Table 1).[12,13] The Mincerian coefficient of tertiary education attainment, the gross wage premium, is found to be on average 55% and to vary widely across countries (between 27% and 92%; see Figure 2). The strong dispersion of wage *premia* across countries may reflect country-specific productivity differences between tertiary and upper-secondary degree holders but 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.

[Table 1. Results of the Mincerian wage regressions for 21 OECD countries, 2001]

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

9. Both 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 study show that *premia* differ across gender.

10. This sub-section draws on Strauss and de la Maisonneuve (2007) where the datasets, the choice and construction of variables and the econometric specification are discussed in detail.

11. Hourly wages reflect the impact of education on productivity, while monthly or annual wages also capture the effect of decisions on working hours. Although there is some evidence that working time is positively correlated with educational attainment, it is reasonable to assume that the choice of hours worked reflects individuals' tastes rather than educational levels. The number of years spent in the labour market is preferred over age because this allows better disentangling of education from experience effects.

12. Descriptive statistics of variables entering the regressions are shown in Strauss and de la Maisonneuve (2007).

13. In these regressions most coefficients are significant, virtually all of them at the 1% level. Moreover, the sign of all non-interacted coefficients is in line with expectations. The results of these regressions are discussed in more detail in Strauss and de la Maisonneuve (2007).

23. Women's tertiary wage *premia* are higher (positive interaction coefficient) 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 (Figure 3). 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 3. Male/female differences in tertiary wage *premia*]

24. The experience premium per year of accumulated labour market experience also shows large cross-country variation: 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.[14] Finally, with the exception of Portugal the experience premium is lower for women than for men.

[Figure 4. Experience *premia* for 21 OECD countries]

25. Tertiary education *premia* are found to be fairly stable over time[15], particularly so in the second part of the period studied, *i.e.* between 1997 and 2001. However, upward trends are observed over the period 1994-2001 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), in Portugal (men) and to a slightly lesser extent in the United Kingdom (women). The premium on labour market experience is also relatively stable over time for both gender. The average coefficient of variation for the 42 country-gender pairs of the cross-sectional estimates of experience *premia* is below 0.01.

Employability premia

26. Together with wage *premia*, the benefits of higher education may also include a lower unemployment probability. Estimates of this probability have traditionally relied on unemployment rates by educational levels (see for instance Blöndal *et al.* 2002). This method, however, relies on bivariate statistics and, hence, fails to control for other individual factors that could affect the chance of finding a job and are not directly related to education. The individual-level data used in this study allow for introducing such controls.

27. However, the impact of tertiary education on the probability of employment can only be estimated for individuals participating in the labour market. This is likely to bias the estimates, with the selection bias being the stronger the larger the difference in participation rates between the two groups of secondary-educated and tertiary-educated individuals. 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 upwards and the employability premium associated with tertiary education under-estimated.

14. The coefficient of job tenure ranges from 0.28% (Switzerland) to 3.13% (France) and tends to be high where the experience premium is low and *vice versa*.

15. The relative stability of tertiary education wage *premia* would indicate that degree holders are less exposed to business cycle shocks than less-educated persons.

28. The Heckman two-step method can be used to assess and correct for the selection bias when the decision to participate in the labour market is not independent of the education level (Heckman, 1979; Heckman *et al*. 2005). The participation and employment propensities are supposed to be a function of individual characteristics, such as educational attainment, gender, age (quadratic specification),[16] marital status and presence of children in the household (see De la Fuente and Jimeno, 2005 and Ciccone *et al*. 2004). The participation equation also includes controls for discouraged worker effects (experience of long-term unemployment), and regional dummies for some countries.[17]

29. More formally, with *P(a=1)* and P(e=1) denoting the propensities of being active and employed, respectively, the following two-stage Probit model is estimated:

$$P(a_i = 1 \mid X_i) = P(\gamma' X_i + \varepsilon_i \geq 0 \mid X_i)$$

$$P(e_i = 1 \mid Z_i) = P(\beta' Z_i + u_i \geq 0 \mid Z_i) \quad \text{where,}$$

$$\gamma' X : c_1 + \gamma_1 woman + \gamma_2 edu1 + \gamma_3 edu3 + \gamma_4 edu1 * woman + \gamma_5 edu3 * woman + \gamma_6 age + \gamma_7 age^2 + \gamma_8 children + \gamma_9 married + \gamma_{10} married * woman + \gamma_{11} persistent_unemployment$$

$$\beta' Z : c_2 + \beta_1 woman + \beta_2 edu1 + \beta_3 edu3 + \beta_4 edu1 \cdot woman + \beta_5 edu3 \cdot woman + \beta_6 age + \beta_7 age^2 + \beta_8 rich_region + \beta_9 poor_region + \beta_{10} \hat{\lambda}_a$$

and:

children = Dummy for non-adult children living in the household

persistent unemployment = Dummy for unemployment spell longer than one year at least once in the five years preceding the survey

rich_region (*poor region*) = Dummy for individual living in a region that has both higher (lower) GDP per capita and a lower (higher) unemployment rate than the national average

λ_a = estimated conditional mean of the error of the participation equation (so-called inverse Mills ratio)

16. 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.

17. Controlling for discouraged workers excludes from the sample the 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 in between the cases where either no adjustment is made for the selection bias or all working age individuals are viewed as potential participants in the labour market. The variables of long-term unemployment and regional dummies are only introduced 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.

30. Regression results for 2001 are shown in Table 2.[18] Participation and employment probabilities are correlated (*i.e.* there is indeed selection) only in some countries and in some years.[19] The estimates are in line with expectations for most variables. 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, where upgrading from secondary to tertiary education increases the employment probability by more than upgrading from primary to secondary education).

[Table 2. Results of the employment and participation regressions for 21 OECD countries, 2001]

31. The estimation of employment and participation equations delivers two parameters to be used in computing the IRR: the probability of employment (conditional on participation) across levels of schooling and the marginal effect of schooling on the employment probability (employability premium). The latter is computed as the difference between the estimated employment probabilities for tertiary and upper-secondary graduates, using the coefficients β_2 and β_4 estimated in the equations above. In this calculation, the other variables are fixed at a reference level (corresponding to a single prime-age individual without children).

32. 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 two percentage points (Figure 5). The largest *premia* (above 3-4 percentage points) are found for men in Italy, Poland and Canada, and for women in Hungary, Finland and Sweden.[20] Small (or even negative) effects are found for men in Ireland, the Netherlands, Belgium, Switzerland and France, and for women in Spain, Switzerland, Luxemburg, and Italy. Gender differences are particularly large in Italy and Belgium. Although these employability *premia* estimated on micro-data 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.[21]

[Figure 5. Marginal effect of tertiary education on the employment probability, 2001]

33. The employability *premia* display stronger cyclical sensitivity than wage *premia*. They increase rapidly between 1995 and 1997, and fall monotonically afterwards. The fluctuations are particularly

18. Descriptive statistics and definition of the variables used in the regressions are reported in Annex 1

19. Though selection is found only for a subset of countries/years, drawing consistently on two-step approach estimates even when the selectivity bias is rejected allows for a unified framework warranting comparability across countries and years.

20. Employment probabilities for all countries refer to the average man/woman. For Italy these probabilities are calculated for a woman/man coming from middle-income regions (mostly central regions). This additional restriction was made to isolate the impact of education on the employment probabilities from the impact of idiosyncratic labour market conditions. In fact, Italy is the country where the regional characteristics of the reference individual matter most for the marginal effect of schooling on employment probability. For the other countries, where the regional effects were significantly different from zero, the marginal effects were computed without specifying the region of residence; this comes down to considering average marginal effect across regions.

21. The microeconomic estimates are generally lower than aggregate figures (2.2 versus 3 percentage points for women and 1.9 versus 2.1 percentage points for men) and show lower cross-country dispersion (1.8 versus 2.8 percentage points for women and 1.7 versus 2.3 percentage points for men).

marked for Spain and Italy, partly due to concomitant changes in labour market policies.[22] Moreover, the marginal effect of schooling tends to decline in the majority of countries and becomes more homogenous over time for both men and women.[23]

Box 3. The impact of variables other than education on employment and participation probability

Gender effects vary across countries but women are generally less likely to participate and to be employed. The joint effect of education and gender on participation turns out to vary across countries too, being generally positive at tertiary attainment level and negative at primary education level (implying that tertiary-educated women tend to participate more often than tertiary-educated men and conversely that primary-educated women are active less often than primary-educated men). Concerning the link between gender, education and employment probability, regressions results for 2001 do not show any strong relationship.

Both the age profiles of employment and participation probabilities are inverted U-shaped, but the latter age-profile is more "concave". Being married increases the propensity to participate for men and decreases it for women, while having children has mixed effects depending on the country. Participation generally decreases after the experience of long-term unemployment, though this depends on the country under study. The probability of finding a job is higher in richer regions and lower in poorer regions. The regional disparities effects are considerable in Italy and moderate in Germany, Austria, Finland and Spain. The impact of the control variables is essentially the same in the years prior to 2001, though the size of coefficients may vary.

Tax and benefit parameters

34. Gross *premia* have to be transformed into net *premia* taking into account labour income taxation. In computing net labour market *premia* both *progressivity* and *the level* of taxes matter. The average tax rate is more important for net employability *premia* whereas the marginal tax rate dominates in determining net wage *premia* (see section below).[24] The relevant marginal and average tax rates for computing the IRR to one (additional) year of tertiary education are those applying to an upper-secondary degree holder, which is the reference individual in the calculation). Lacking information on tax schedules by level of education, marginal and average tax rates of upper-secondary degree holders are proxied by the rates paid by workers at 100% of average earnings, as defined in various OECD fiscal models (see Box 3).[25] These tax rates include personal income tax and employees' social security contributions.[26]

22. In the mid-1990s Spain, in particular, introduced a number of reforms targeted at increasing the labour market participation of low-skilled workers. These reforms could explain the declining importance of tertiary degree for employment after 1997.

23. While employment prospects of both upper-secondary and tertiary degree holders have increased between 1994 and 2001, the employability of upper-secondary degree holders has progressed at an even faster pace. This explains the trend decline of the employability *premia* of tertiary education. Female employability *premia* are declining faster because women with an upper-secondary education have benefited relatively more from the up-swing in labour markets during the 1990s.

24. As discussed above, the higher absolute amount of additional income earned by a tertiary degree holder can be decomposed into: *i*) an *increase in net wages* holding the employment probability constant; and *ii*) the monetary equivalent of an increase in the employment probability *holding net wages constant*. Analogously, marginal and average tax rates on unemployment benefits are respectively applied to marginal and average gross out-of-work replacement rates.

25. This assumption may possibly introduce some measurement error in countries with very high/low stock of human capital, *i.e.* where the educational attainment of the average worker is higher/lower than upper-secondary. This assumption was tested by comparing the average number of years of schooling as estimated in Education at a Glance, with the typical duration of study programmes at various levels. In most of the OECD countries under scrutiny the average number of years of schooling indeed corresponds to the number of years of schooling required to complete an upper-secondary degree. Detailed results of this test are available upon request.

35. On the benefit side, the model accounts for out-of-work transfers from unemployment insurance and retirement schemes. As for taxes, unemployment benefits matter both on average and at the margin. Data for average and marginal replacement rates drawn from the Benefits and Wages model (see Box 3). Gross pension replacement rates are based on the new OECD Pensions model (see OECD, 2005a). They reflect the pension entitlements for a worker entering the system in 2002 at the age of 20 and retiring after a full career.[27] The pension model includes all mandatory pension schemes for private-sector workers, as well as systems with near-universal coverage (at least 90% of employees). Mandatory individual accounts and resource-tested benefits are also included. Replacement rates are calculated separately for men and women whose gross pre-retirement earnings were 100% of average earnings. When unemployment and retirement benefits are taxed, this is taken into account in the calculations, with tax rates, referring to individuals at 100% of average earnings.

Box 4. Assumptions on tax and benefits parameters

All *tax rates* used in computing IRR are specific to the labour force status of individuals (employed, unemployed or retired) but not to gender, and are assumed to be constant over the life-cycle. The different sources for the tax parameters are as follows:

For *employed* individuals, marginal and average labour income tax rates are based on the OECD Taxing Wages Dataset. These tax rates include personal income taxes and employees' social security contributions. The representative benchmark for an upper-secondary degree holder is assumed to be a single individual without children earning 100% of Average Earnings (hereafter, AE). Average Earnings are defined according to the new definition of the Average Worker implemented in the 2004 OECD Taxing Wages Model (see OECD, 2004a). The previous definition of the average production worker referred to manual employees working full-time in the manufacturing sector, while the new one refers to manual- and non-manual employees working in a broader set of industries.

For the *unemployed*, tax rates are based on the 2001 OECD Benefits and Wages model and refer to a representative individual whose earnings before unemployment were 100% of AE. These tax rates assume short-term unemployment

For *pensioners*, marginal and average tax rates are derived from the OECD Pensions at a Glance model (OECD, 2005a). They are based on the same benchmark individual and include personal income taxes and social security contributions paid by pensioners.

The calculation of *out-of-work benefits* is based on the OECD Benefits and Wages Model. However, not all the required data, both across time and income levels, are available from this source (the data for the representative individual - *i.e.* a single person without children earning 100% of the AE - were not available before 2001). Gross unemployment benefit average replacement rates for each year in the sample are then approximated by the average of replacement rates corresponding to two earning levels, three family situations and three durations of unemployment. The marginal replacement rate can only be calculated for year 2001 and is assumed to remain constant over the sample period.

26. Arguably, differences in the way of splitting social security contributions between employees and employers may affect the cross-country comparability of the IRRs. Considering only employees' social security contributions could indeed over-estimate tax rates in countries where the bulk of contributions is paid by employees (*e.g.* Denmark) compared with countries where the burden is mostly on employers (*e.g.* Belgium, France, and Spain). However, this potential bias is likely to be compensated by lower gross wages in countries where the bulk of social security contributions is paid by employers.

27. These entitlements include changes in pension rules that have been legislated and are being implemented. It is assumed that they will remain unchanged over the life cycle of the representative individual.

From the Mincerian gross wage premium to the net wage premium component of the IRR

36. Mincerian regressions deliver wage *premia* per completed tertiary degree. In order to get the relevant net wage premium component for the IRR (θ_{net} in equation (3), Box 1) several adjustments are required. First, it is necessary to express wage *premia* at annual rates, *i.e*. *per year* of tertiary education. Second, the wage premium needs to be corrected to reflect that individuals may fail to complete their tertiary education.[28] Third, the wage premium has to be "netted out" of the foregone experience premium during tertiary studies. Finally, the net wage premium is obtained by multiplying the gross wage premium (as adjusted in the previous three steps) with the expected marginal tax factor. These corrections are addressed in turn.

37. To express the results as gross wage premium per year of tertiary education, the country-specific average duration of tertiary studies *d* is used to bring the estimates of the previous section to an annual basis. Assuming a constant percentage increase in the hourly wage for each year of tertiary education, the gross wage premium *per year* of tertiary education is obtained as $(1+\theta)^{(1/d)}-1$, where θ is the estimated premium. Figure 6 summarises the results. The country average of the gross hourly wage premium is around 11% for both men and women. Wage *premia* are comprised between above 5% (men in Greece and Spain, women in Austria and Italy) and over 14% in Luxembourg, Hungary, United Kingdom, the United States, and Ireland. When controlling for the duration of tertiary studies, the country ranking changes significantly in some cases. Australia and Ireland where studies are shorter than the OECD average considerably increase their position. So do Switzerland and the United Kingdom, although to a smaller extent. At the same time, countries characterised by long study duration such as Austria, Germany, Greece and Italy, fall further back.

[Figure 6. Gross wage *premium* per year of tertiary education]

38. The second adjustment on the wage premium is required on the grounds that students may drop out of tertiary education and that the estimated Mincerian wage *premia* refer to people who, instead, have completed it and obtained a degree. The correction simply consists of discounting the wage premium per year of tertiary education by the so-called survival rates, which measure the probability of finishing tertiary education once enrolled.[29] Survival rates vary in a small interval across OECD countries, and tend to be generally higher in countries with more segmented study tracks.

39. The third adjustment is made to add back the experience loss due to continued schooling from the wage premium. However, since the experience *premia* vary between 0% and 1.7% (German women and Swiss men respectively), this adjustment to wage *premia* is relatively small.

40. Finally, the net wage premium is calculated by multiplying the gross wage premium per additional year of tertiary education with the expected marginal tax factor. The latter is expressed as the average of the marginal tax rate for workers, weighted by the employment probability P_e, and the marginal tax rate of unemployed times the marginal replacement rate, weighted by $(1-P_e)$. These probabilities are fixed at the level of an upper-secondary degree holder. In many countries the changes from gross to net

28. This adjustment is necessary because we use *ex post* wage *premia*, *i.e. premia* obtained by people who have completed a tertiary degree, to predict *ex ante* wage *premia*, *i.e.* forecasts of labour market prospects for individuals just starting tertiary education.

29. The available survival rates (from OECD Education at a Glance) refer to the overall duration of studies; they are then converted to an annual basis using the actual duration of studies. This may imply an upward bias to the extent that the probability of dropping out is higher in the first year of tertiary education than in successive years.

wage *premia* are sizeable, implying reductions in the premium by 2.5 to over 10 percentage points (Figure 7).

[Figure 7. Comparison of gross and net wage *premium* per year of tertiary education]

From the employability premium to the net employability premium component of the IRR

41. As for the adjustment from gross to net wage *premia*, the employability premium (P'_{net} in equation (3), Box 1) also requires some transformation before entering the IRR formula. The bulk of the net employability premium is given by the "monetary equivalent" of the increase in the probability of employment reflecting additional schooling: *i.e.* the additional amount of after-tax wage earned. In this calculation, wages are fixed at the level of an upper-secondary degree holder and taxed at the corresponding average tax rate. However, the net employability premium also takes into account the loss in out-of-work net benefits due to the lower incidence of unemployment associated with higher schooling. The net employability premium thus depends on the marginal effect of schooling on employment as estimated through the employment equations and expressed per year of tertiary education (*i.e.* adjusted for the study duration), but also on the size of out-of-work replacement income and taxation.

42. Figure 8 shows the net employability premium per year of tertiary education. In all countries net employability *premia* are much smaller than gross *premia* in absolute terms,[30] the reason being the generally small difference between the net take-home pay and out-of-work replacement income.[31] As a result the magnitude of the net employability premium is small compared with that of the other drivers of the IRR. In gross terms, employability *premia* are, on average, around ½%, whereas in net terms they decrease to a negligible 0.1%. Negative *premia* are mostly due to cyclical effects in 2001 and tend not to occur in other years.

[Figure 8. Comparison of gross and net employability *premium* per year of tertiary education]

Pension benefits

43. In computing IRR, pension benefits are first adjusted by a tax factor and then discounted according to a representative market interest rate which is a function of labour productivity growth, the degree of indexation of pension benefits on wages, the length of the working life and the retirement period. Discounted net pension benefits (normalised to the average earning of someone with an upper-secondary degree) are shown in Figure 9. Portugal and Luxembourg display the highest net pension benefits, as a result of both 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 potentially change the

30. The gross *premia* shown in Figure 5 are smaller than those discussed above because they are expressed *per year* of tertiary education, favouring countries with short study duration over long-duration countries like for wage *premia*.

31. This difference ranges from 50% of gross earnings of an upper-secondary degree holder in Ireland (male-female average) to almost nothing in Portugal.

country ranking with respect to net pension benefits. However, discounting those benefits (due to late occurrence in life) levels country differences in benefits.[32]

[Figure 9. Undiscounted net pension benefits]

Direct and indirect costs of education

Direct costs

44. In most countries, individuals do not bear the whole cost of education because funding to defray tuition fees and living expenses is publically-funded. 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. However, 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 were only netted out of grants earmarked to tuition fees. 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.

45. In practice direct costs are obtained by combining three indicators: *i)* annual total expenditure on tertiary education per student (including core educational services and R&D activities) (indicator B1.1, EAG 2005); *ii)* the share of *final* expenditure borne by the private sector and *iii)* the proportion of private final expenditure subsidised by the public sector, which only covers tuition fees (indicators B3.2b, EAG 2005). "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)].[33] In the baseline calculation direct cost figures refer to 2002.

46. Figure 10 shows the baseline measure of net private costs (panel A) and two alternative (and conceptually superior) measures of costs, which are, however, only available for a few OECD countries. One is direct cost net of grants for living costs, as discussed above. The other is based on the latter and additionally subtracts interest subsidies on student loans and the part of the principal that is never repaid. Education costs vary widely across OECD countries, ranging from around 0 to 64% of the wage of an upper-secondary degree holder. European countries display the lowest costs, due to zero or low tuition fees and/or grants for education costs. Panel B shows that in countries where a substantial share of funding of tertiary education takes the forms of grants and loans for living costs, the actual cost of studying is even negative, meaning that students are in fact subsidised.

[Figure 10. Net direct costs of tertiary education, 2002]

32 In reality the discount rate on pensions is endogenous, being itself a (decreasing) function of IRR. As a consequence, the contribution of pension benefits to IRR will be further reduced for countries that have small returns to schooling.

33. "Final" expenditure refers to the disbursement, while "initial" expenditure to the cost truly sustained by individuals, *i.e.* adjusted for public subsidies. Missing values for EAG indicators B1.1 and B3.2b have been replaced by the sample mean.

Opportunity cost

47. 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.

Productivity growth

48. Since the duration of working life is assumed to be the same for all educational levels, tertiary-degree holders enter and quit the labour market later than upper-secondary degree holders. With aggregate productivity growing over time, tertiary-degree holders, therefore, enjoy a higher labour productivity level throughout their career. In the baseline, labour productivity growth is uniform across countries and set equal to 1.75% per year (the long-term economic growth rate usually retained in OECD projections).[34] As an alternative, an internal rate of return was also calculated extrapolating country-specific average labour productivity growth over the past decade.

Country and period coverage of the IRR calculation

49. IRR are computed for males and females in 21 OECD countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Poland, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States. Estimates cover the period 1991-2005. Country coverage is highly unbalanced, ranging from two years for Switzerland (1999-2000) to fifteen years for the United Kingdom.

50. Among the components of the IRR the following are time-variant: wage-premium, employment probabilities, employability premium, experience premium, average and marginal taxes on labour earnings; by contrast, due to data limitations the following are time-invariant: average and marginal taxes for the unemployed, replacement rates for out-of-work and pension benefits, taxes on pension benefits, direct costs, duration of studies, and survival rates in tertiary education. The time-invariant parameters are set at their 2001 or 2002 values, depending on availability. The following components of IRR are gender-specific: wage premium, experience premium, employment probabilities, employability premium, pension replacement rates, length of working life, and life expectancy at birth.

3. Results for the private IRR

Baseline IRR estimates for 2001

51. Incorporating all the elements described above allows computing the baseline internal rates of return. Results for 2001 are shown in Figure 11. 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% *vs.* 5 to 12%).

34. This was considered a sensible forecast of the rate of growth in real wages over the life-cycle across OECD countries, under the assumption of convergence to the best performer.

[Figure 11. Estimates of the IRR to tertiary education]

52. 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 Ireland.

Alternative IRR estimates for 2001

53. Figure 12 shows IRR under an alternative scenario for 2001, with labour productivity growth equal to the country-specific average over the period 1995-2004. This alternative assumption does not affect the country ranking with respect to IRR but changes their levels. On average country-specific growth IRR are 0.3% points higher than baseline IRR. For some countries the change is substantial; for instance, IRR increase by 2.8% points in Ireland, by 1.8% points in Hungary and by 1.5% points in Greece. By contrast, the IRR fall in the Netherlands, Italy and Spain (respectively by 1.3% points, 1% points and 0.7% points) relative to the baseline estimates.

[Figure 12 Estimates of the IRR to tertiary education, alternative calculations with country-specific productivity growth]

54. An additional alternative scenario is produced with IRR containing time-invariant employability *premia* and employment probabilities. A motivation for this variant is that the employment parameters vary with cycle much more than wage and experience *premia*, and that investment decisions may be taken on the basis of average values rather than on year-specific information. Figure 13 shows that the IRR resulting from this alternative computation are broadly consistent with the baseline estimates. The largest differences between the baseline and the alternative scenarios are observed for Ireland (men only, 70 basis points up), Greece (50 basis points up for women and 30 for men), Italy and Spain (women only, around 30 basis points up).

[Figure 13 Estimates of the IRR to tertiary education, alternative calculations with time-invariant employment *premia* and employment probabilities]

55. IRR estimates presented in Figure 14 include revenues from students' part-time work. Lacking complete cross-country information on both the extent of students' participation to the labour market and their earnings, it was necessary to make some arbitrary assumptions. First, it was assumed that students spend 10% of their time working in paid employment at the gross wage rate of upper-secondary degree holders; second, their earnings are taxed at 10% on average; finally, their employment probability (conditional on participation) is that of upper-secondary degree holders. Under those assumptions, concomitant work income reduces the opportunity cost of studying and, hence, increases the IRR in all countries compared with the baseline.[35] The effect amounts to almost 1 percentage point on average, ranging from 0.6 percentage points in Spain to over 1.5 percentage points in Denmark.

[Figure 14. Estimates of the IRR to tertiary education, alternative calculations with students' part-time work]

35. To the extent that study duration is negatively correlated with the extent of students' participation to the labour market the impact of students' work on IRR may be overestimated.

IRR over the period 1991-2005

56. Baseline IRR is computed for the years 1991-2005 (Table 4). 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. The IRR vary more across countries than over time. Returns are relatively stable, with the OECD average only slightly increasing between 1994 and 2001 (see Figure 15). 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 3. Estimates of IRRs, various years]

[Figure 15. Evolution of OECD average IRR between 1994 and 2001]

57. Table 5 summarises the variance of IRR components across countries and over time. Concerning the cross-country dimension, annual employability *premia* vary the most. With the exception of employment probabilities, all the other components reported in the table (annual wage *premia*, marginal tax rates, gross out-of-work benefits and net replacement rates) display essentially the same variance. From a time variance perspective, the majority of IRR ingredients do not vary substantially, with the only exception of employability *premia* and (to a much lower extent) of wage *premia*.

[Table 4. Variation across countries and over time of the main IRR components]

Results of earlier IRR estimations

58. 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 the IRR estimates presented here with those from previous studies. Harmon *et al.* (2003) for instance provide an extensive and detailed review of findings on returns to education, but only regarding wage *premia*. Even the latter are hardly comparable to our estimates of wage *premia* in this study, since they do not refer to tertiary education but to all education attainment levels.

59. Psacharopoulos and Patrinos (2004) report IRR computed through the discount method (but relying on aggregate labour market *premia*) for a huge sample of countries (including many non-OECD countries). They find average IRR to higher education of 11.6% for the 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% (the United Kingdom), with an average value of 11.6%. The data sources and the methodology underlying these estimates are, however, quite different from those retained in this study.[36]

60. De la Fuente and Jimeno (2005), which this study closely follows, compute returns for some European countries which range between 4.28% (Sweden) and above 12% (United Kingdom), with a 15-EU countries 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*.

36. Notably labour market *premia* are not estimated through multivariate regression but are calculated as gender-age-specific ratios of the average *annual* earnings of tertiary degree holders relative to those of upper-secondary degree holders.

Interpretation of the IRR and caveats

61. Despite efforts to compute IRR as accurately as possible, some limits of this method need to be pointed out. First of all, the 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.[37]

62. 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 which may preserve rents on skilled-labour.[38] For this reason, IRR (or wage *premia*) provide only an imperfect proxy of labour productivity of tertiary-educated workers and should be better read as a measure of how high the incentives are to undertake tertiary education. The related question for policy-makers 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

63. 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 (see Oliveira Martins *et al.* 2007) or indirectly, by increasing or decreasing private incentives to invest in tertiary education. This section addresses the impact of policies on private incentives by analysing how IRR respond to changes in labour market characteristics and education, social, and fiscal policies.

64. The analysis is carried out in two steps. First, ingredients of IRR are changed one-by-one by the same small (absolute) amount in all countries. This exercise highlights to what extent cross-country differences in the IRR depend on those in these components. A second round of simulations consist of setting wage and employability *premia*, as well as private costs, to the upper end of their respective cross-country distributions (conversely, tax rates are set at the lower end of their cross-country distribution). These simulations illustrate country-specific effects of policy changes. All sensitivity exercises are carried out for 2001[39] and are partial-equilibrium in nature, ignoring both the direct effect of policies on human capital investment and feedback effects from changed investment volumes on the IRR *via* the wage premium.

37. 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 datasets under use.

38. Boarini *et al.* (forthcoming) assess the relative importance of labour market forces and institutions on wage *premia*.

39. The missing 2001 values of labour market *premia* are replaced with their latest available counterparts (Poland and Switzerland: 2000; Hungary: 1997).

Main influences on the IRR: policies and labour market outcomes

65. This part of the sensitivity analysis looks at the elasticity of IRR with respect to their main drivers. 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% point increase, with the exception of study duration which is varied by 1%. 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.

66. The main results concerning the IRR elasticities, which are summarised in Figure 16, show that both OECD average figures and the range of dispersion across countries. These results can be summarised as follows:

- *Fiscal policy:* A higher marginal tax rate reduces the net wage premium (elasticity slightly over 0.12). By contrast, a higher *average* income tax rate tends to increase the IRR, mainly *via* a reduction in opportunity costs, which represent the bulk of total private costs.[40] The net effect of a joint increase in average and marginal tax rates depresses the IRR in all countries.

- *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. The net effect on the IRR is very small.[41,42]

- *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 the 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.[43]

- *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, with the effect ranging from 4 to 20 basis points. At 7.2 basis-points, the average increase resulting from higher employability premium is much smaller because any increase in net lifetime earnings due to the higher conditional employment probability of tertiary degree holders is partly undone by the loss of unemployment benefits and by those being usually taxed at much lower rates than labour earnings. A not negligible IRR effect of changes to the gross employability premium is only observed for countries (such as Australia, Austria, Denmark, Greece, and Ireland) where the difference between the take-home pay rate and the net

40. Tax changes in Figure 16 and thereafter are jointly applied to labour and replacement incomes.

41. The effect is small because the conditional probability of unemployment and, hence, the resulting reduction in life-time earnings are fairly small for upper-secondary degree holders in most countries, limiting employment-related increases in lifetime earnings for tertiary degree holders.

42. No side-effects of higher UB on employment of secondary degree holders are taken into account.

43 . Albeit occurring through the same channel (change in opportunity costs), the average IRR-elasticity with respect to student work at 0.10 is somewhat higher than that with respect to the average income tax rate (0.07) because a tax hike also lowers the net benefit from higher employability. No such offsetting force is at play with student work.

unemployment benefit replacement rate is above average. In some countries this difference is very small (*e.g.* in Portugal).

[Figure 16. Reaction of IRR to changes in their main components, 2001]

76. 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. As to changes in the growth rate of average labour productivity (assumed to equal 1.75% in all countries in the baseline), they raise the IRR almost one to one and are therefore important for policymakers concerned with tertiary education incentives.[44]

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

Wage premium

67. 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.[45] To illustrate this possible gain, the gross wage premium is set to two standard deviations above the country mean, at 68%, *i.e.* the simple mean of the value for men (66%) and that for women (70%).[46] With all other parameters remaining unchanged, the IRR would increase by between slightly less than 1 percentage point in Portugal and almost 8 percentage points in Australia (Figure 17).

[Figure 17. Changes in IRR induced by higher gross wage *premia*, 2001]

68. Overall, the lowest is the initial *gross* wage premium, the highest the increase in the 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

44. On the empirical connection between policies and labour productivity growth, see OECD (2003), *The Sources of Economic Growth in OECD Countries*.

45. Policies and institutions contribute to compressing the distribution of gross wages. At the low end of the distribution, binding minimum wages and strong EPL may provide workers with a higher gross wage than would be warranted by their marginal productivity would suggest. 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. Boarini *et al*. (forthcoming) provide an empirical test of the impact of labour market institution on wage *premia*.

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

reflects short average study duration.[47] Finally, any increase in the labour market benefit (numerator of the IRR calculation) is amplified if total private costs (denominator) are low.[48]

Employability premium

69. If the employability premium were to be two standard deviations above the cross-country mean everywhere, *i.e.* equal to 4.7 percentage points (gender average),[49] 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 different impact in mind, the resulting average IRR effect (less than 0.2 percentage points) is extremely small (see Figure 18). Changes in IRR would be the highest in Ireland and the lowest in Poland and Portugal.[50]

[Figure 18. Changes in IRR induced by higher employability *premia*, 2001]

Private direct cost

70. Higher net private costs would reduce the IRR if other policy settings do not change at the same time. [51] 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, *i.e.* 22.7%, which happens to be equal to the Australian level. 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 the IRR lies between 0.7 percentage points in Poland and slightly more than 3 percentage points in Denmark (Figure 19).[52]

[Figure 19 Changes in IRR induced by higher direct costs, 2001]

71. The effect on the IRR of a *given* increase in the cost-to-income ratio is the 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,

47. Due to the high incidence of short tertiary studies in Australia, the tertiary gross wage premium is much lower than in the United States and Hungary, and it would seem unrealistic to move it up to the US level without simultaneously increasing the average number of years in tertiary education.

48. A second-order effect, occurring through the negative observed correlation between private costs and wage *premia*, makes for a bigger increase in IRR in low wage *premia* countries, where education costs are also the lowest.

49. 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 only simulated for countries where they would not move the employment probability for tertiary degree holders (the sum of the employment probability for upper-secondary degree holders and the employability premium) exceed 1. In countries (*e.g.* Luxembourg, Netherlands, and Switzerland) where the employment probability for upper-secondary degree holders is above 0.953, the simulated marginal effect is not 4.7 percentage points but just the margin missing to 1 (*i.e.* to full employment of tertiary degree holders).

50. In Portugal the IRR decrease due to high out-of-work net replacement rates.

51. Private costs in the baseline IRR are net of grants for tuition fees but not net of other grants and loans due to data limitations.

52. Due to missing data, results are not shown for Canada, Luxembourg and Switzerland. The United States is the only country where the IRR would increase, the actual private cost being higher than the simulated one.

leading to a strongly (weakly) negative effect on the 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, as argued above.

Marginal and average income tax rates

72. As discussed above, the joint effect on the 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 20). In the second step, average tax rates are also set to the lower end of the distribution, *i.e.* 13.3% of average labour earnings.[53] The total IRR effect is positive and ranges from 1/8 percentage point or less in Greece, Denmark and Poland to almost 7.6 percentage points in Hungary but there are only four more countries where the effect exceeds 1 percentage point (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.

[Figure 20. Changes in IRR induced by lower income tax rates, 2001]

Summary and conclusions

73. This study has provided estimates of private 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 study. Labour market returns have been obtained by cross-sectional regressions based on individual data from international panel data sources, which allowed 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, the duration of and survival probability in tertiary education and also to calculate the average private cost of tertiary education.

74. We have shown that returns are, on average, above 8%, thus substantially higher than returns from 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 the IRR depends positively on the wage premium, the employability premium, the share of their time students devote to paid work and the average income tax rate and 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 the 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.

75. However, if the policy targets the volume of investment in tertiary human capital rather than the IRR *per se*, Oliveira Martins *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

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

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 to 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 relevant signal as to how big these returns are, the investment in education may not materialise.

76. The financial set-up of tertiary education is also of large importance: greater reliance on private resources may help conveying relevant information on costs and benefits associated to education, thus making possible informed investment decisions in education. Oliveira Martins *et al.* (2007) show, however, that introducing or significantly increasing tuition fees would weigh on tertiary human capital investment, not only through a lower average rate of return but even more so through more severe financing constraints for individual students. As a consequence, if governments want to raise overall expenditure on tertiary education *via* more significant contributions from students without having a detrimental effect on graduation ratios, the increase in tuition fees requires the introduction or extension of individual student financing systems, *e.g.* in the form of appropriately designed student loan systems.

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Table 1 Results of the *Mincerian* wage regressions for 21 OECD countries, 2001 [1]

	Australia	Austria	Belgium	Canada	Denmark	Finland	France	Germany	Greece	Hungary
primary educ.	-0.1814	-0.5169	-0.2289	-0.2994	-0.2579	-0.2419	-0.1277	-0.2324	-0.2363	-0.2595
	[0.0197]***	[0.09792]***	[0.02682]***	[0.01885]***	[0.03009]***	[0.03911]***	[0.02091]**	[0.02955]***	[0.02351]***	[0.06052]***
prim. educ*woman	-0.0324	0.0058	-0.0185	-0.0833	-0.0377	-0.0089	-0.0664	0.0449	0.0314	-0.0581
	[0.0280]	[0.03998]	[0.04682]	[0.02831]***	[0.04328]	[0.04136]	[0.03429]*	[0.03928]	[0.03485]	[0.07147]
tertiary education	**0.3515**	**0.4332**	**0.3344**	**0.4024**	**0.3870**	**0.4237**	**0.4625**	**0.3830**	**0.3031**	**0.4772**
	[0.0188]***	[0.04422]***	[0.02365]***	[0.01454]***	[0.02123]***	[0.02477]***	[0.02369]***	[0.02214]***	[0.02523]***	[0.07443]***
ter. educ*woman	**-0.0574**	**-0.1435**	**-0.0240**	**0.0383**	**-0.0327**	**-0.0655**	**-0.0102**	**0.0231**	**0.0832**	**-0.0112**
	[0.0233]**	[0.05386]***	[0.03197]	[0.01819]**	[0.02811]	[0.03096]**	[0.03616]	[0.03038]	[0.03540]**	[0.09110]
experience	0.0067	0.0068	0.0097	0.0075	0.0041	0.0061	0.0075	0.0023	0.0083	0.0058
	[0.0007]***	[0.00102]***	[0.00114]***	[0.00056]***	[0.00097]***	[0.00100]***	[0.00084]***	[0.00087]***	[0.00100]***	[0.00227]**
exp.*woman	-0.0020	0.0003	-0.0027	-0.0013	-0.0007	-0.0030	-0.0051	-0.0017	-0.0020	-0.0034
	[0.0010]*	[0.00144]	[0.00161]*	[0.00074]*	[0.00126]	[0.00131]**	[0.00117]***	[0.00130]	[0.00144]	[0.00288]
woman	-0.0535	-0.1597	-0.0557	-0.2473	-0.0804	-0.1211	-0.0733	-0.1373	-0.1674	-0.1007
	[0.0229]**	[0.03400]***	[0.04008]	[0.01990]***	[0.03543]**	[0.03669]***	[0.03545]**	[0.03405]***	[0.02908]***	[0.07126]
married	0.1026	0.0365	0.0078	0.1570	0.0310	0.0158	0.0515	0.0586	0.1060	0.0235
	[0.0115]***	[0.01688]**	[0.01605]	[0.00933]***	[0.01365]**	[0.01491]	[0.01454]***	[0.01439]***	[0.01649]***	[0.03100]
public sector	-0.0118	-0.0024	-0.0234	0.2041	-0.0939	-0.0379	0.0582	0.0126	0.1094	-0.0519
	[0.0129]	[0.01706]	[0.01549]	[0.01003]***	[0.01475]***	[0.01493]**	[0.01551]***	[0.01459]	[0.01773]***	[0.03164]
part-time worker	-0.0108	0.0604	0.0714	-0.0680	-0.0050	0.0998	0.1322	0.1264	0.2928	0.1832
	[0.0155]	[0.03034]**	[0.02572]***	[0.01182]***	[0.03283]	[0.04663]**	[0.03139]***	[0.02522]***	[0.03596]***	[0.08046]**
tenure	0.0101	0.0152	0.0177	..	0.0099	0.0096	0.0313	0.0188	0.0218	0.0202
	[0.0016]***	[0.00297]***	[0.00265]***	..	[0.00202]***	[0.00275]***	[0.00271]***	[0.00222]***	[0.00258]***	[0.00522]***
indef. contract	0.0455	0.3160	0.1119	..	0.1844	0.0573	0.2517	0.2956	0.1312	..
	[0.0133]***	[0.03647]***	[0.03002]***	..	[0.03018]***	[0.02693]**	[0.02810]***	[0.02443]***	[0.01954]***	..
firm size (log)	0.0416	0.0436	0.0487	..	0.0271	0.0450	..	0.0618	0.0414	..
	[0.0029]***	[0.00418]***	[0.00391]***	..	[0.00356]***	[0.00425]***	..	[0.00321]***	[0.00398]***	..
overqualified	-0.2328	-0.0031	-0.1598	-0.3773	-0.2069	-0.3047	-0.2253	-0.2812	-0.1626	-0.0206
	[0.0199]***	[0.04953]	[0.04283]***	[0.02326]***	[0.02729]***	[0.03575]***	[0.02039]***	[0.02536]***	[0.02071]***	[0.05252]
underqualified	0.1439	0.2201	0.1310	0.2403	0.1842	0.2362	0.1969	0.1269	0.0864	0.2184
	[0.0169]***	[0.09363]**	[0.02258]***	[0.01307]***	[0.01941]***	[0.03174]***	[0.01769]***	[0.02512]***	[0.02341]***	[0.06253]***
Constant	2.1110	1.7130	1.9127	2.1046	2.3202	2.0229	1.7188	1.6696	1.4130	0.5746
	[0.0219]***	[0.04115]***	[0.04334]***	[0.01536]***	[0.04364]***	[0.03527]***	[0.03559]***	[0.03661]***	[0.02845]***	[0.06270]***
Observations	5211	1965	1615	25555	1585	1866	2891	3688	2079	879
Adjusted R-squared	0.31	0.46	0.46	0.17	0.44	0.40	0.42	0.36	0.59	0.33

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

1. Except Hungary (1997); Poland and Switzerland (2000).

2. Source: Strauss and de la Maisonneuve (2007); European Community Household Panel (ECHP), the Consortium of Household Panels(CHER), the Cross-National Equivalent File (CNEF), and the Household, Income and Labour Dynamics in Australia Survey (HILDA).

Table 1 (cont'.) Results of the *Mincerian* wage regressions for 21 OECD countries, 2001

	Ireland	Italy	Luxembourg	Netherlands	Poland	Portugal	Spain	Sweden	Switzerland	United Kingdom	United States
primary educ.	-0.2718	-0.2650	-0.4217	-0.2621	-0.2932	-0.4438	-0.2769	-0.1776	-0.6163	-0.3507	-0.6496
	[0.03497]**	[0.01745]**	[0.02182]**	[0.05075]**	[0.03285]**	[0.03131]**	[0.02553]**	[0.02797]**	[0.04462]**	[0.0253]***	[0.0140]***
prim. educ*woman	-0.0027	0.0033	0.0148	0.1029	-0.0092	-0.0101	0.0236	0.0543	0.2357	0.0195	-0.0045
	[0.04522]	[0.02391]	[0.04150]	[0.04477]**	[0.03980]	[0.03410]	[0.03229]	[0.03894]	[0.06171]**	[0.0310]	[0.0179]
tertiary education	**0.4336**	**0.4111**	**0.4244**	**0.3478**	**0.3061**	**0.5046**	**0.2336**	**0.2597**	**0.3785**	**0.5020**	**0.6500**
	[0.03848]**	[0.02739]**	[0.02451]**	[0.02904]**	[0.07147]**	[0.04331]**	[0.02427]**	[0.02337]**	[0.03255]**	[0.0156]***	[0.0098]***
ter. educ*woman	**0.0855**	**-0.0827**	**-0.0230**	**0.0302**	**0.3072**	**0.1476**	**0.0789**	**-0.0458**	**-0.0477**	**0.0376**	**-0.0113**
	[0.04985]*	[0.03666]**	[0.04130]	[0.04090]	[0.08534]**	[0.04943]**	[0.03327]**	[0.02994]	[0.04340]	[0.0193]*	[0.0123]
experience	0.0060	0.0068	0.0138	0.0060	0.0048	0.0029	0.0060	0.0101	0.0169	0.0069	0.0154
	[0.00133]**	[0.00076]**	[0.00110]**	[0.00102]**	[0.00130]**	[0.00071]**	[0.00073]**	[0.00098]**	[0.00125]**	[0.0007]***	[0.0004]***
exp.*woman	-0.0034	-0.0011	-0.0056	-0.0029	0.0015	0.0027	0.0007	-0.0025	-0.0031	-0.0042	-0.0055
	[0.00157]**	[0.00107]	[0.00192]**	[0.00155]*	[0.00176]	[0.00094]**	[0.00110]	[0.00130]*	[0.00172]*	[0.0009]***	[0.0005]***
woman	-0.1363	-0.1137	-0.0828	-0.1310	-0.3088	-0.2785	-0.2791	-0.0502	-0.1432	-0.1223	-0.1862
	[0.03676]**	[0.02408]**	[0.03769]**	[0.04611]**	[0.04656]**	[0.03088]**	[0.03066]**	[0.03563]	[0.04175]**	[0.0219]***	[0.0132]***
married	0.1196	0.0540	0.0886	0.0554	0.2056	0.0662	0.0430	0.0305	0.0249	0.0927	0.1657
	[0.02609]**	[0.01248]**	[0.01611]**	[0.01898]**	[0.02309]**	[0.01265]**	[0.01356]**	[0.01377]**	[0.01875]	[0.0103]***	[0.0060]***
public sector	0.1737	0.0665	0.2523	-0.0082	0.1449	0.2037	0.0770	-0.1298	0.0487	0.0635	-0.0828
	[0.02266]**	[0.01241]**	[0.01671]**	[0.01859]	[0.01969]**	[0.01505]**	[0.01687]**	[0.01514]**	[0.01935]**	[0.0109]***	[0.0075]***
part-time worker	0.0540	0.2801	0.1123	0.0886	0.1829	0.2138	0.0865	0.1047	0.0396	-0.0823	-0.2125
	[0.02725]**	[0.01969]**	[0.03569]**	[0.02736]**	[0.04258]**	[0.04258]**	[0.02826]**	[0.02840]**	[0.03226]	[0.0138]***	[0.0125]***
tenure	0.0177	0.0115	..	0.0187	..	0.0182	0.0282	..	0.0028	0.0071	..
	[0.00366]**	[0.00199]**	..	[0.00289]**	..	[0.00198]**	[0.00235]**	..	[0.00129]**	[0.0015]***	..
indef. contract	0.1790	0.1332	0.2762	0.1737	..	0.0661	0.0624	0.2801	0.6109	0.1698	..
	[0.03289]**	[0.02183]**	[0.03378]**	[0.04736]**	..	[0.01576]**	[0.01612]**	[0.03975]**	[0.05374]**	[0.0255]***	..
firm size (log)	0.0408	0.0306	0.0410	0.0216	..	0.0445	0.0535	0.0248	0.0340	0.0413	0.0370
	[0.00610]**	[0.00291]**	[0.00448]**	[0.00448]**	..	[0.00351]**	[0.00350]**	[0.00316]**	[0.00434]**	[0.0024]***	[0.0013]***
overqualified	-0.2663	-0.1852	-0.2318	-0.0412	-0.2340	-0.3000	-0.2336	..	-0.1319	-0.4041	-0.4546
	[0.03352]**	[0.01711]**	[0.02296]**	[0.03274]	[0.03128]**	[0.02484]**	[0.01925]**	..	[0.03817]**	[0.0136]***	[0.0105]***
underqualified	0.1689	0.1231	0.2640	0.1282	0.1552	0.3566	0.1219	..	..	0.2150	0.3061
	[0.02790]**	[0.02183]**	[0.02494]**	[0.04555]**	[0.04022]**	[0.03647]**	[0.02279]**	..	..	[0.0170]***	[0.0101]***
Constant	1.8686	1.9271	1.8108	2.1870	0.9551	1.5714	1.7916	1.4703	1.7208	1.9261	1.8883
	[0.04319]**	[0.02818]**	[0.04345]**	[0.05537]**	[0.03834]**	[0.03299]**	[0.02856]**	[0.04500]**	[0.05896]**	[0.0303]***	[0.0117]***
Observations	1457	3254	2213	2031	2285	3859	3615	2330	2260	7960	49571
Adjusted R-squared	0.51	0.49	0.58	0.31	0.32	0.61	0.50	0.26	0.53	0.38	0.32

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

1. Except Hungary (1997); Poland and Switzerland (2000).

2. Source: Strauss and de la Maisonneuve (2007); European Community Household Panel (ECHP), the Consortium of Household Panels(CHER), the Cross-National Equivalent File (CNEF), and the Household, Income and Labour Dynamics in Australia Survey (HILDA).

Table 2 Results of the *employment and participation* regressions for 21 OECD countries, 2001[1]

	Australia		Austria		Belgium		Canada		Denmark		Finland		France	
	Employment	Participation	Employment	Participation	Employment	Participation	Employment	Participation	Employment	Participation	Employment	Participation	Employment	Participation
woman	0.179***	-0.305***	-0.027	-0.303***	-0.563***	-0.065	0.018	-0.263***	-0.182	-0.219**	-0.156*	-0.143*	-0.279**	-0.409***
	[0.067]	[0.056]	[0.135]	[0.082]	[0.201]	[0.113]	[0.028]	[0.031]	[0.129]	[0.109]	[0.088]	[0.076]	[0.136]	[0.115]
primary educ.	-0.254***	-0.484***	-0.272*	-0.126	-0.476**	-0.025	-0.302***	-0.626***	-0.042	-0.202	-0.024	-0.216***	-0.1	-0.248**
	[0.07]	[0.05]	[0.161]	[0.098]	[0.217]	[0.116]	[0.037]	[0.033]	[0.196]	[0.127]	[0.117]	[0.082]	[0.120]	[0.097]
prim. educ*woman	0.058	0.086	0.185	-0.117	0.467	-0.386***	0.064	-0.118***	-0.313	-0.133	-0.035	0.143	-0.044	0.142
	[0.094]	[0.064]	[0.223]	[0.118]	[0.288]	[0.146]	[0.055]	[0.042]	[0.252]	[0.163]	[0.159]	[0.113]	[0.164]	[0.119]
tertiary education	0.238***	0.143***	0.365	0.352*	0.026	0.576***	0.276***	0.186***	0.009	0.418***	0.375***	0.364***	0.037	-0.01
	[0.077]	[0.062]	[0.291]	[0.185]	[0.235]	[0.135]	[0.041]	[0.055]	[0.161]	[0.147]	[0.141]	[0.118]	[0.140]	[0.113]
ter. educ*woman	-0.077	0.199***	-0.242	0.479*	0.571*	0.036	-0.03	0.133**	0.106	0.179	0.158	-0.088	0.178	0.256*
	[0.113]	[0.077]	[0.375]	[0.248]	[0.298]	[0.165]	[0.057]	[0.066]	[0.216]	[0.191]	[0.186]	[0.144]	[0.194]	[0.140]
age	0.046***	0.08***	0.01	0.247***	0.067	0.344***	0.027***	0.15***	0.001	0.203***	0.017	0.359***	0.04	0.266***
	[0.013]	[0.007]	[0.041]	[0.013]	[0.050]	[0.017]	[0.008]	[0.005]	[0.032]	[0.020]	[0.023]	[0.014]	[0.034]	[0.018]
age2	-0.00***	-0.001***	0	-0.003***	-0.001	-0.004***	0	-0.002***	0	-0.003***	0	-0.004***	0	-0.003***
	[0]	[0]	[0.001]	[0.000]	[0.001]	[0.000]	[0]	[0]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
strong_region			0.394***		0.417**						0.321***		0.058	
			[0.113]		[0.184]						[0.084]		[0.087]	
weak_region			0.121		0.058								-0.1	
			[0.109]		[0.172]								[0.094]	
married		0.507***		0.510***		0.692***		0.599***		0.662***		0.329***		0.329***
		[0.049]		[0.096]		[0.114]		[0.037]		[0.125]		[0.089]		[0.092]
marriedw		-0.651***		-0.764***		-0.906***		-0.776***		-0.376***		-0.361***		-0.864***
		[0.058]		[0.107]		[0.130]		[0.04]		[0.144]		[0.101]		[0.110]
child				-0.142**		-0.062		-0.108***		-0.059		-0.222***		-0.278***
				[0.060]		[0.073]		[0.0223]		[0.090]		[0.067]		[0.062]
pers_unem				-0.589***		-0.802***				-0.463***		-0.562***		-0.285***
				[0.124]		[0.086]				[0.105]		[0.081]		[0.094]
Constant	0.516**	-0.235*	1.445*	-2.928***	0.281	-5.391***	0.392		1.766***	-2.394***	1.145***	-5.414***	0.67	-3.300***
	[0.229]	[0.118]	[0.769]	[0.229]	[0.973]	[0.313]	[0.146]		[0.617]	[0.366]	[0.433]	[0.245]	[0.670]	[0.363]
Observations	11561	11561	3916	3916	2938	2938	35246	35246	2883	2883	4493	4493	4039	4039
Selection	yes		no		no		no		no		yes		no	

* significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors in brackets.

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), and the Household, Income and Labour Dynamics in Australia Survey (HILDA) and OECD calculations.

Table 2 (cont'.) Results of the employment and participation regressions for 21 OECD countries, 2001 [1]

	Germany		Greece		Hungary		Ireland		Italy		Luxembourg	
	Employment	Participation	Employment	Participation	Employment	Participation	Employment	Participation	Employment	Participation	Employment	Participation
woman	0.018	-0.039	-0.665***	-0.288***	-0.366*	-0.313*	-0.219	-0.285***	-0.349***	-0.170***	-0.209	-0.514***
	[0.075]	[0.077]	[0.111]	[0.073]	[0.203]	[0.181]	[0.167]	[0.095]	[0.090]	[0.063]	[0.232]	[0.137]
primary educ.	-0.15	-0.103	-0.126	-0.118*	-0.666***	-0.174	-0.387**	-0.381***	-0.028	0	-0.439**	-0.416***
	[0.109]	[0.083]	[0.105]	[0.071]	[0.184]	[0.167]	[0.154]	[0.094]	[0.074]	[0.058]	[0.178]	[0.112]
prim. educ*woman	0.222	-0.313***	0.116	-0.169*	0.576**	-0.175	0.389*	-0.175	-0.435***	-0.620***	0.228	0.284**
	[0.148]	[0.101]	[0.154]	[0.087]	[0.233]	[0.203]	[0.233]	[0.117]	[0.137]	[0.073]	[0.263]	[0.136]
tertiary education	0.306***	0.495***	0.007	0.252**	-0.057	0.631	-0.183	0.608***	0.093	0.418***	0.443	0.831***
	[0.112]	[0.110]	[0.142]	[0.111]	[0.263]	[0.480]	[0.188]	[0.174]	[0.145]	[0.131]	[0.308]	[0.205]
ter. educ*woman	-0.042	-0.031	0.207	0.493***	0.660*	-0.263	0.355	-0.136	-0.292	0.07	-0.401	-0.306
	[0.157]	[0.141]	[0.183]	[0.138]	[0.366]	[0.531]	[0.260]	[0.200]	[0.180]	[0.158]	[0.393]	[0.232]
age	-0.002	0.200***	0.173***	0.261***	-0.092**	0.229***	0.039	0.187***	0.191***	0.275***	0.237***	0.099***
	[0.018]	[0.013]	[0.026]	[0.011]	[0.038]	[0.021]	[0.034]	[0.014]	[0.028]	[0.010]	[0.034]	[0.020]
age2	0	-0.003***	-0.002***	-0.003***	0.001***	-0.002***	0	-0.002***	-0.002***	-0.003***	-0.003***	-0.002***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
strong_region	0.453***		0.392***						0.787***			
	[0.062]		[0.114]						[0.081]			
weak_region									-0.225***			
									[0.071]			
married		0.269***		0.824***		0.690***		0.637***		0.485***		
		[0.084]		[0.085]		[0.192]		[0.107]		[0.070]		
marriedw		-0.599***		-1.414***		-0.524**		-1.196***		-1.019***		0.531***
		[0.094]		[0.089]		[0.206]		[0.114]		[0.075]		[0.117]
child		-0.400***		-0.096*		-0.055		-0.062		-0.076*		-1.448***
		[0.055]		[0.050]		[0.098]		[0.061]		[0.044]		[0.136]
pers_unem		-0.594***		-0.005				-0.307***		-0.014		-0.505***
		[0.080]		[0.061]				[0.101]		[0.049]		[0.070]
Constant	1.413***	-2.197***	-2.104***	-4.049***	3.467***	-3.141***	0.878	-2.221***	-2.989***	-4.143***	-2.092***	0.940**
	[0.332]	[0.241]	[0.526]	[0.192]	[0.781]		[0.638]	[0.236]	[0.571]	[0.178]	[0.614]	[0.403]
Observations	5476	5476	6387	6387	1962	1962	3143	3143	8238	8238	3733	3733
Selection	yes		yes		no		no		no		no	

* significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors in brackets.

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), and the Household, Income and Labour Dynamics in Australia Survey (HILDA) and OECD calculations.

Table 2 (cont'.) Results of the employment and participation regressions for 21 OECD countries, 2001 [1]

	Netherlands		Poland		Portugal		Spain		Sweden		Switzerland		United Kingdom		United States	
	Employment	Participation	Employment	Participation	Employment	Participation	Employment	Participation	Employment	Participation	Employment	Participation	Employment	Participation	Employment	Participation
woman	-0.997***	-0.669***	0.170	-0.173*	-0.141		-0.360***	-0.207***	-0.036	-0.255**	-0.262**	-0.081	-0.143	-1.165***	0.147***	-0.017
	[0.321]	[0.186]	[0.142]	[0.096]	[0.154]		[0.113]	[0.071]	[0.093]	[0.105]	[0.130]	[0.100]	[0.112]	[0.085]	[0.026]	[0.019]
primary educ.	-1.132***	-0.205	-0.108	-0.250***	0.176		-0.109	0.038	-0.141	-0.621***	0.369	-0.314***	-0.692***	-0.406*	-0.208***	-0.504***
	[0.341]	[0.139]	[0.114]	[0.074]	[0.130]		[0.086]	[0.061]	[0.138]	[0.110]	[0.284]	[0.117]	[0.066]	[0.107]	[0.034]	[0.02]
prim. educ*woman	0.801**	-0.1	-0.136	-0.128	-0.137		-0.291**	-0.239***	0.035	0.181	-0.485	-0.007	-0.034	-0.192*	-0.121***	-0.13***
	[0.401]	[0.170]	[0.162]	[0.093]	[0.175]		[0.125]	[0.080]	[0.180]	[0.145]	[0.304]	[0.130]	[0.105]	[0.117]	[0.045]	[0.026]
tertiary education	-0.395	0.521***	0.820***	0.214	0.768**		0.12	0.368***	0.144	0.123	-0.019	-0.553***	0.236***	0.209**	0.326***	0.329***
	[0.404]	[0.161]	[0.281]	[0.168]	[0.365]		[0.104]	[0.078]	[0.112]	[0.130]	[0.173]	[0.109]	[0.061]	[0.108]	[0.032]	[0.024]
ter. educ*woman	0.987*	-0.251	0	0.600***	-0.556		-0.122	0.305***	0.374**	0.216	0.003	0.485***	0.218**	0.197*	-0.09**	-0.091***
	[0.528]	[0.200]	[0]	[0.222]	[0.401]		[0.140]	[0.099]	[0.173]	[0.171]	[0.219]	[0.127]	[0.092]	[0.116]	[0.046]	[0.029]
age	0.019	0.341***	0.051	0.247***	0.040**		0.121***	0.253***	0.046*	0.227***	0.021	0.212***	0.08***	0.045***	0.018***	0.118***
	[0.099]	[0.030]	[0.047]	[0.011]	[0.019]		[0.023]	[0.009]	[0.028]	[0.017]	[0.026]	[0.013]	[0.01]	[0.01]	[0.006]	[0.003]
age2	0	-0.004***	-0.001	-0.003***	0		-0.001***	-0.003***	0	-0.003***	0.000	-0.003***	-0.001***	-0.001***	0*	-0.001***
	[0.001]	[0.000]	[0.001]	[0.000]	[0.000]		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0]	[0]	[0]	[0]
strong_region							0.314***									
							[0.056]									
weak_region							-0.108*									
							[0.057]									
married				0.466***				0.704***				0.871***		0.357***		0.661***
				[0.077]				[0.062]				[0.118]		[0.107]		[0.02]
marriedw		-0.137		-0.414***				-1.237***		0.371***		-1.841***		-0.399***		-0.909***
		[0.163]		[0.086]				[0.068]		[0.115]		[0.123]		[0.1]		[0.023]
child		-0.096		-0.005				-0.147***		-0.287**		-0.500***		-0.623***		-0.224***
		[0.189]		[0.055]				[0.042]		[0.136]		[0.060]		[0.047]		[0.012]
pers_unem		-0.628***						0.085*		-0.277***						
		[0.095]						[0.045]		[0.092]						
Constant	2.865	-3.832***	0.714	-4.055***	0.853**		-1.156***	-3.684***	0.536	-2.340***	1.583***	2.288***	-0.3*	1.562***	1.197***	-1.136***
	[2.111]	[0.657]	[1.019]	[0.188]	[0.364]		[0.445]	[0.155]	[0.544]	[0.303]	[0.485]	[0.241]	[0.172]	[0.188]	[0.117]	[0.047]
Observations	3074	3074	5108	5108	5817		8930	8930	3879	3879	5723	5723	12550	12550	80748	80748
Selection	no		no				no		no		no		yes		yes	

* significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors in brackets.

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), and the Household, Income and Labour Dynamics in Australia Survey (HILDA) and OECD calculations.

Table 3 Estimates of IRR, various years

Men															
Country	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
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															
Country	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
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%

Table 4 Variation across countries and over time of the main IRR components

Cross-country coefficient of variation

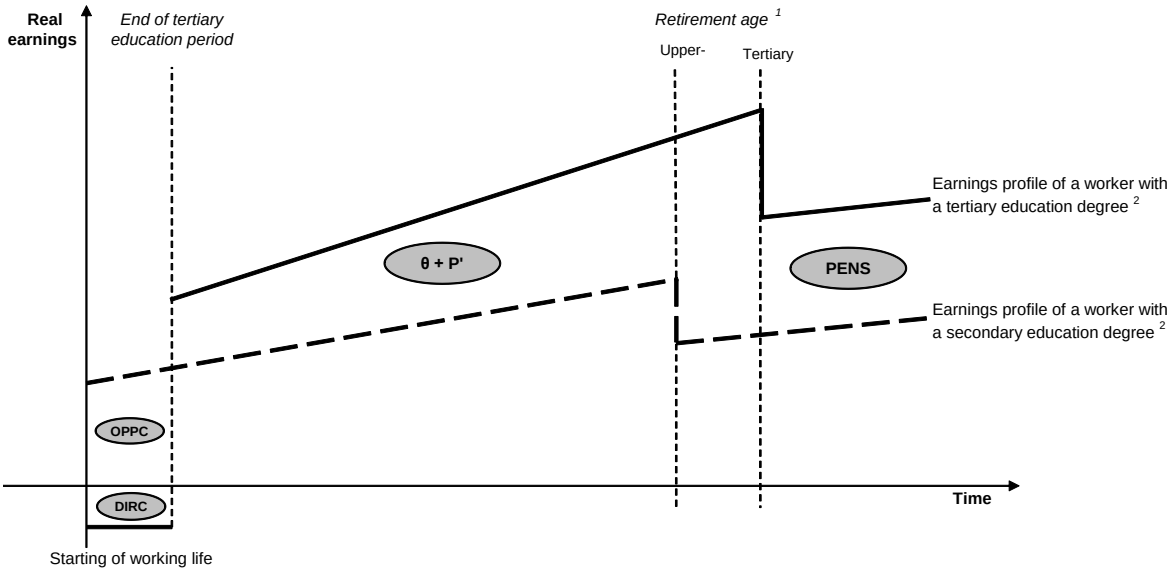
year	irr	Annual Wage Premia	Annual Employability Premia	Employment Probability	Marg. Tax Rate	Aver. Tax Rate	Gross out-of-work benefits replacement rate	Net Pension Replacement Rate
1994	0.31	0.44	0.74	0.07	0.32	0.26	0.34	0.41
1995	0.32	0.41	1.10	0.07	0.29	0.25	0.32	0.40
1996	0.30	0.40	0.91	0.07	0.28	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

country	irr	Annual Wage Premia	Annual Employability Premia	Employment Probability	Marg. Tax Rate	Aver. Tax Rate	Gross out-of-work benefits replacement rate	Net Pension Replacement Rate
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

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

Figure 1 Individual returns to tertiary education illustrated

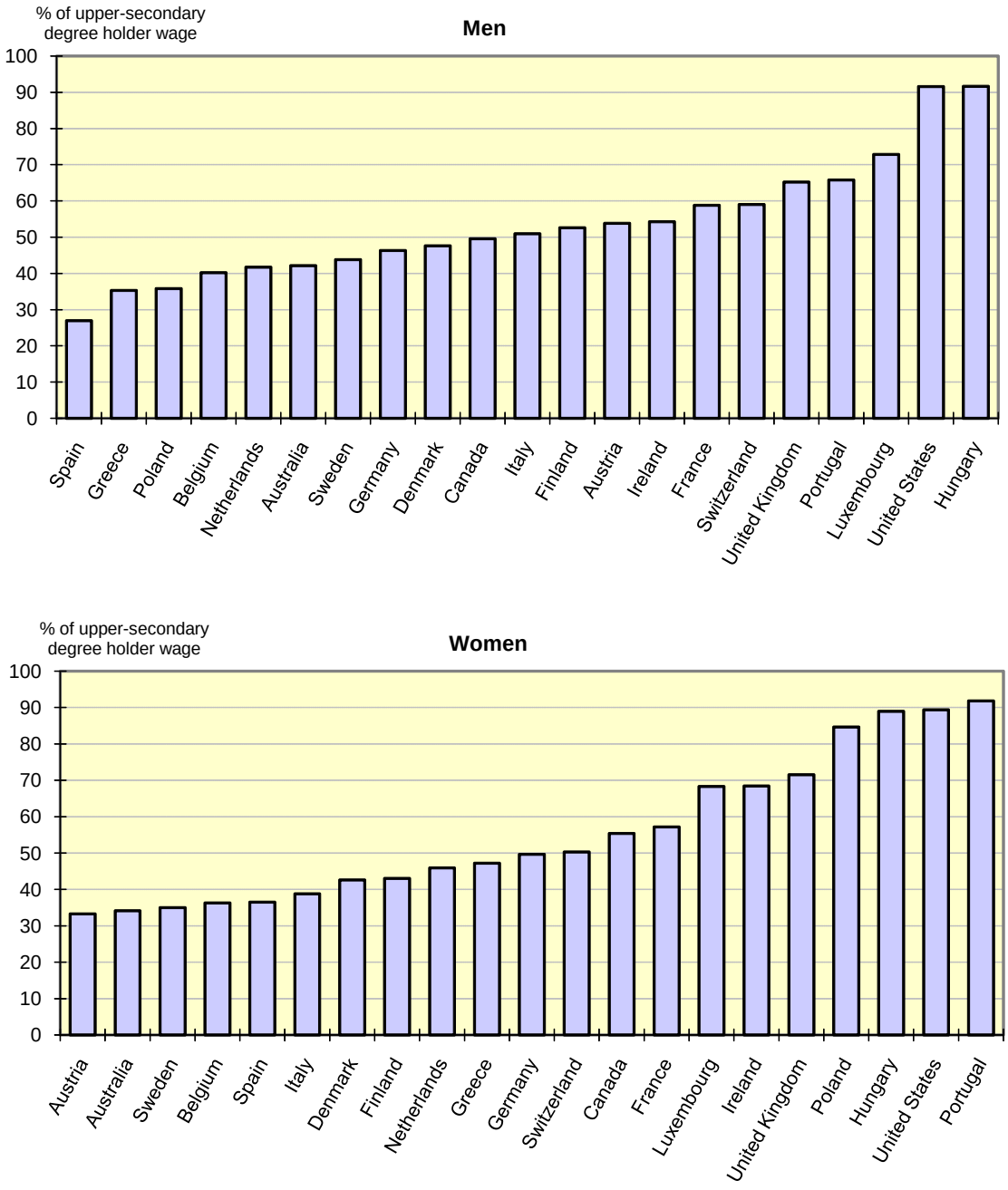


DIRC : Direct costs of tertiary education
OPPC : Opportunity costs of not starting to work after secondary education
θ + P' : Wage & employability premia associated with tertiary education (net of taxes and benefits)
PENS : Retirement premia for tertiary education workers (net of taxes)

1. Assuming the same length of working life.
2. Assuming partial indexation of pension benefits.

Figure 2 Gross wage premia from tertiary education [1]

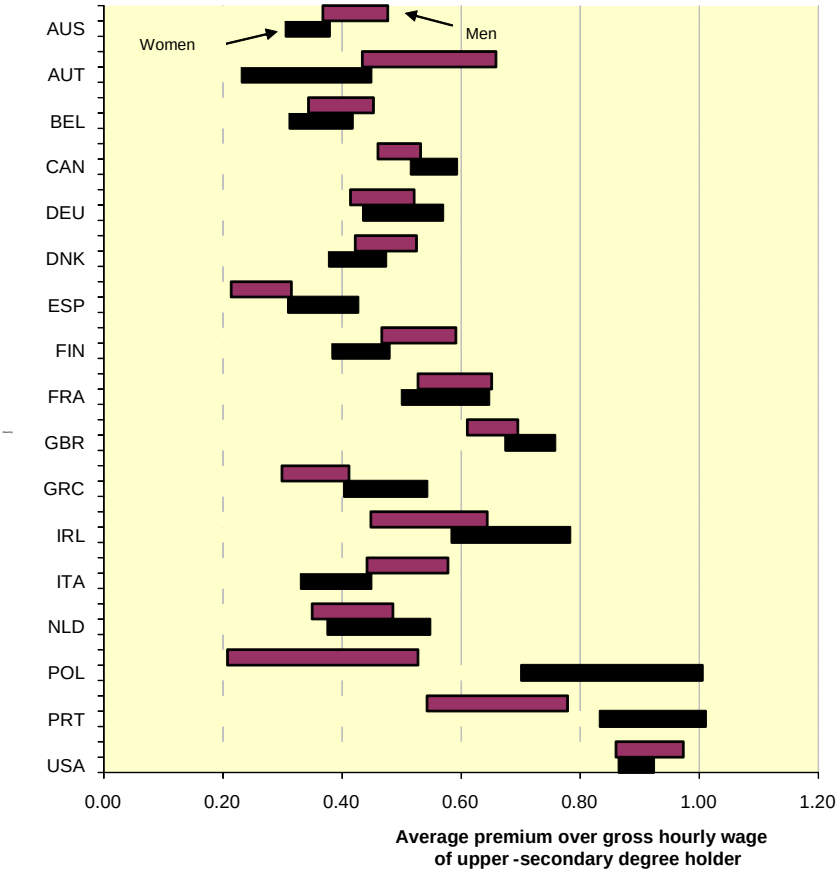
2001 [2]



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 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), and the Household, Income and Labour Dynamics in Australia Survey (HILDA) and OECD calculations.

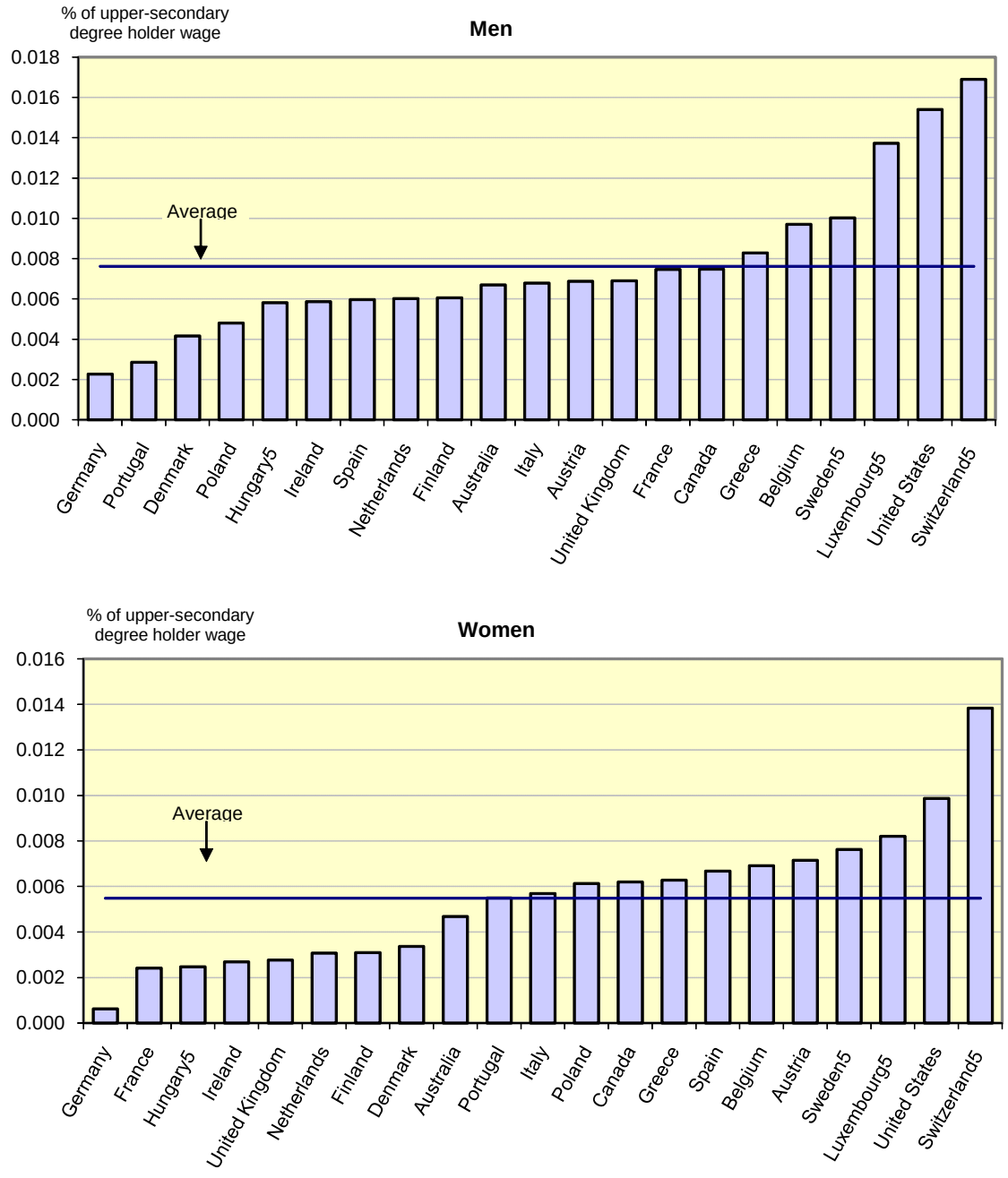
Figure 3 Male-female differences in tertiary wage premia

90% confidence intervals of point estimators, 2001 estimates [1]



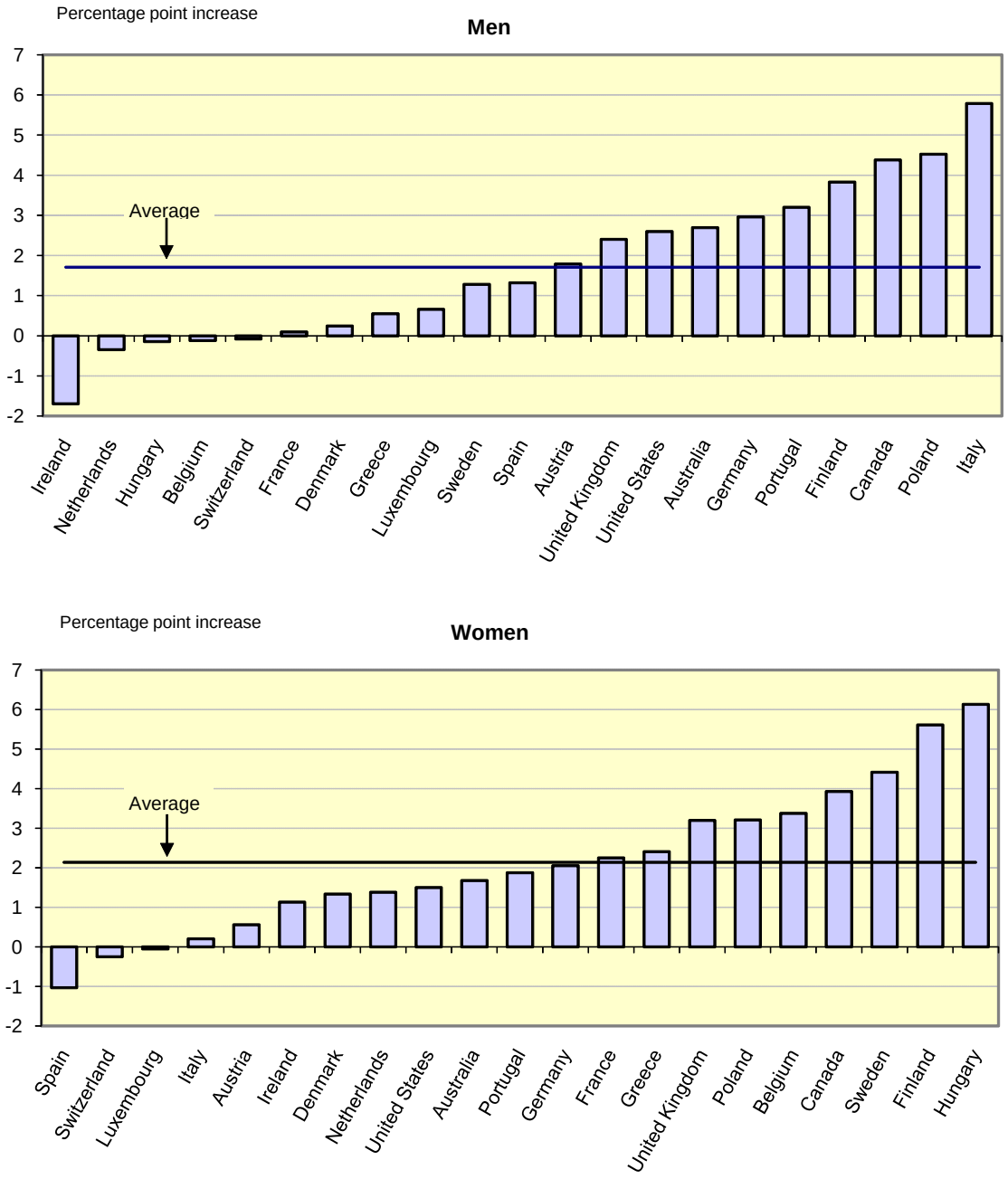
1 Except for Poland and Switzerland (2000).
Upper bar: men; lower bar: women.
Hungary, Luxembourg, Sweden and Switzerland are not shown in this chart since Mincerian regressions were ran on net rather than gross wages

Figure 4 Experience Premia for 21 OECD countries [1]
2001



1. Except 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), and the Household, Income and Labour Dynamics in Australia Survey (HILDA) and OECD calculations.

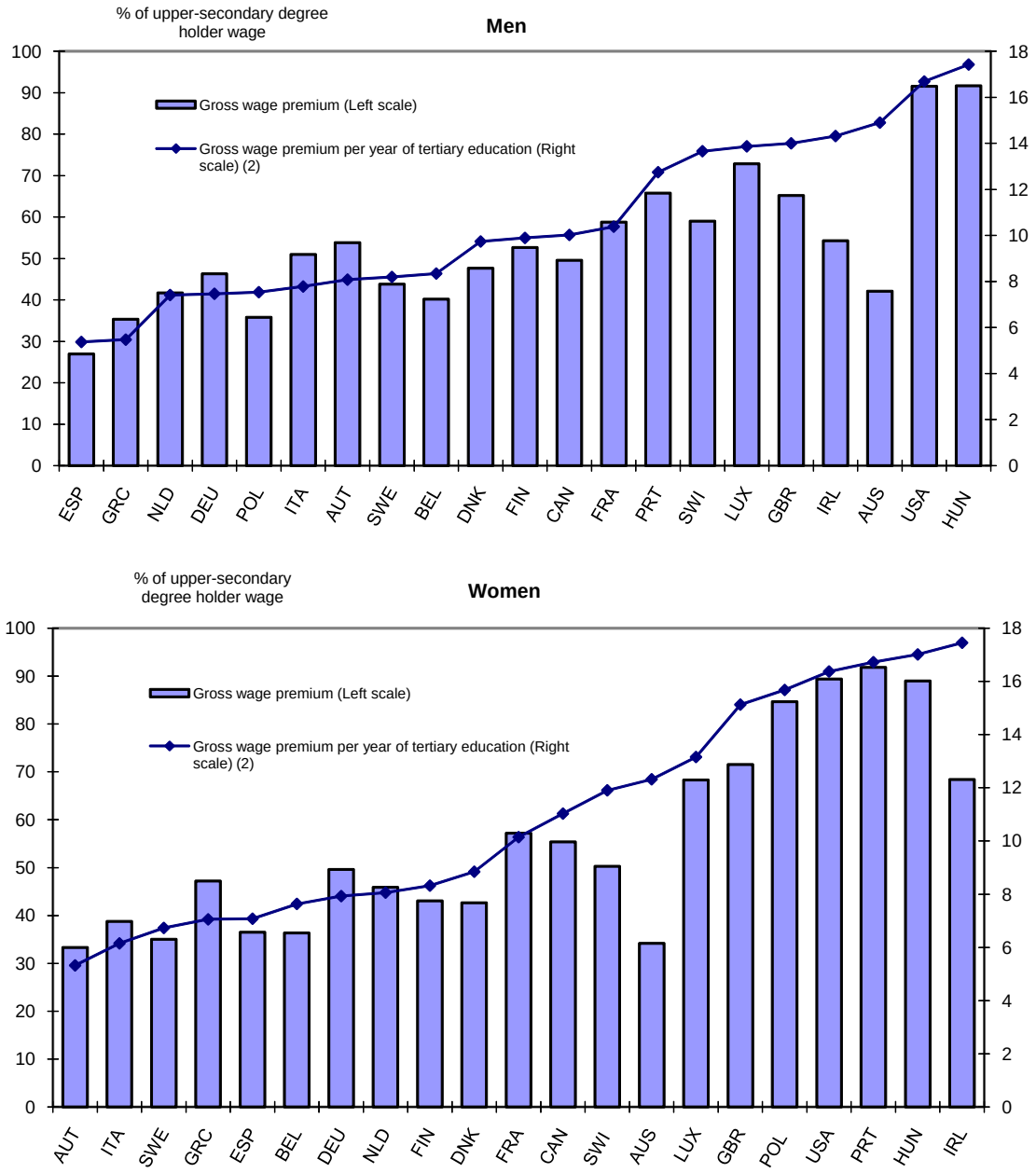
Figure 5 Marginal effect of tertiary education on the employment probability [1], 2001[2]



1. Increase in probability of employment: Tertiary degree holders relative to holders of upper secondary degree.
2. Except 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), and the Household, Income and Labour Dynamics in Australia Survey (HILDA) and OECD calculations.

Figure 6. Gross wage *premia per year of tertiary education*

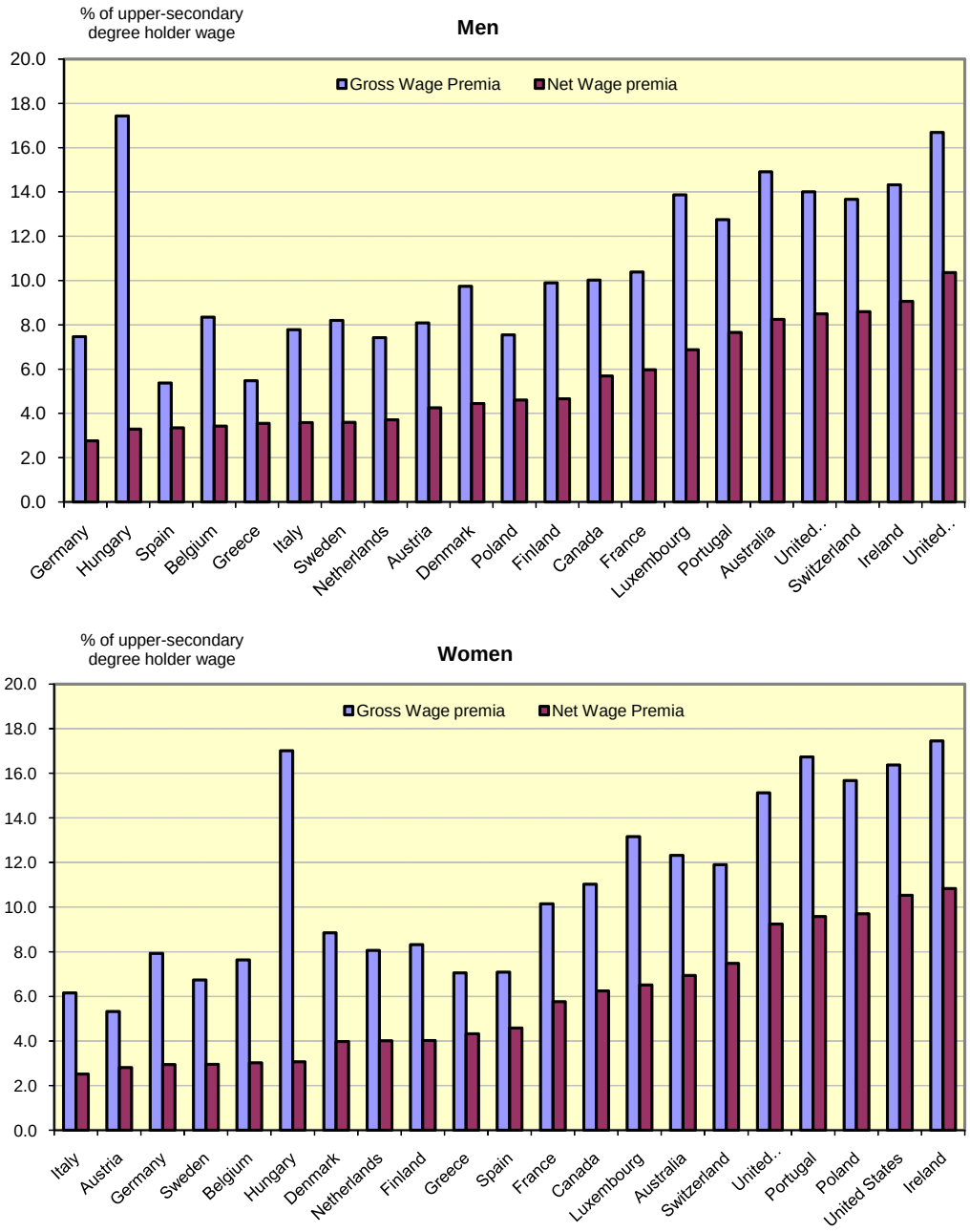
2001 [1]



1. Except Hungary (1997); and Poland and Swizerland (2000).
2. The total wage premium associated with a tertiary education level is converted to an annual basis by taking into account the duration of tertiary studies.

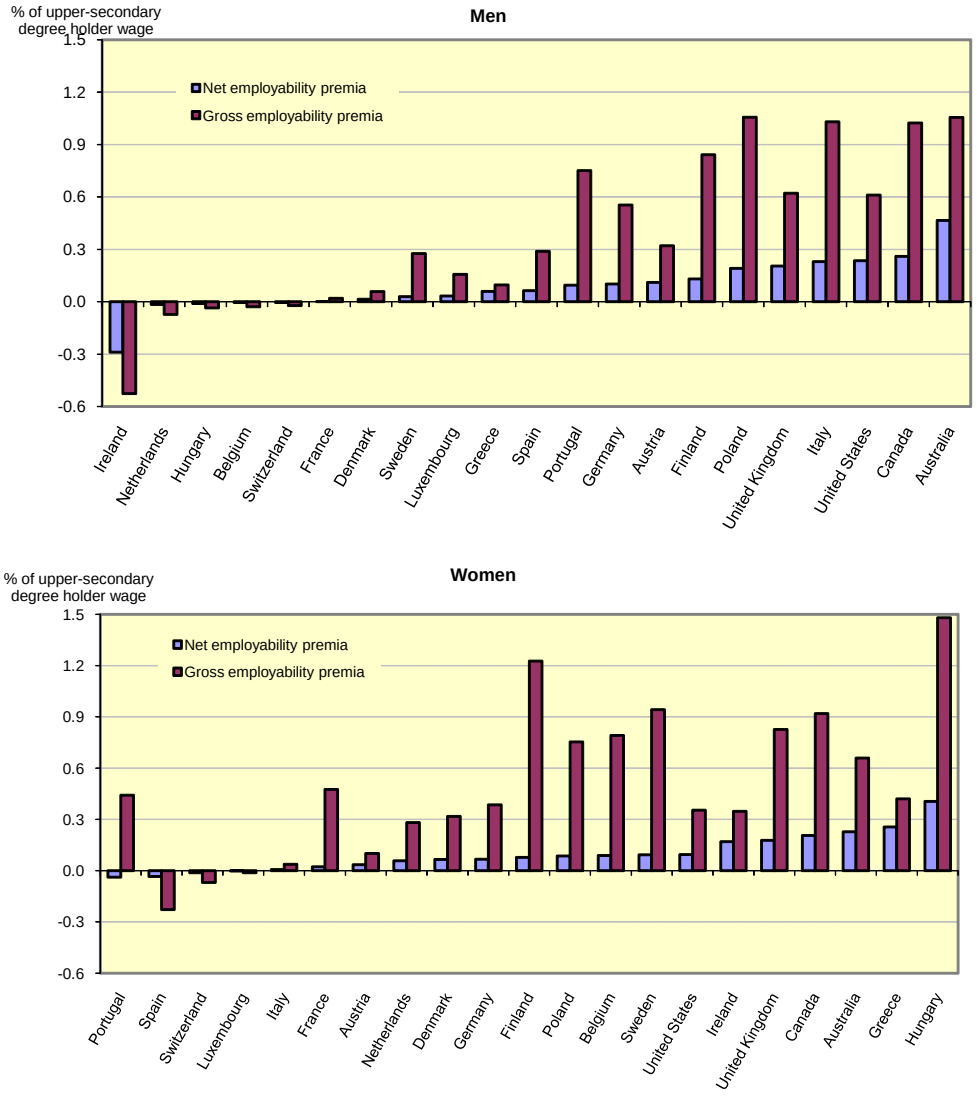
Source : the European Community Household Panel (ECHP), the Consortium of Household Panels for European Socio-Economic Research (CHER), the Cross-National Equivalent File (CNEF), and the Household, Income and Labour Dynamics in Australia Survey (HILDA) and OECD calculations.

Figure 7 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.
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 OECD Taxing Wages model. Replacement rates are from OECD Benefits and Wages model.
2. Except Hungary (1997); and Poland and Swizerland (2000).

Figure 8 Comparison of gross and net employability premium per year of tertiary education[1]
2001 [2]

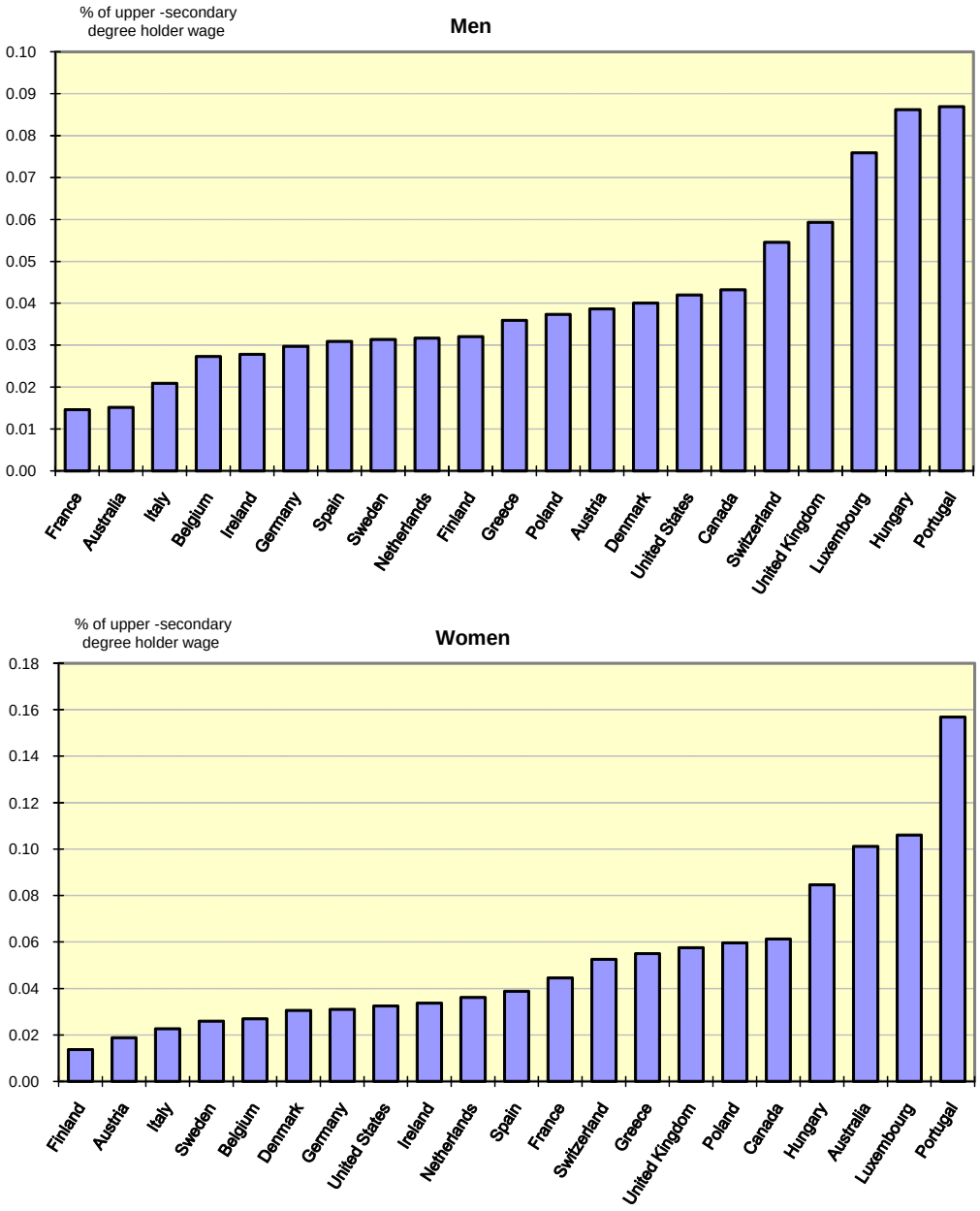


1. Monetary equivalent of increase in employment probability, adjusted for the difference between net labour market earnings and net out-of-work benefits, survival rates and duration of studies. See Box 1, equation 3.

Source :Employment probability are based on 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), and the Household, Income and Labour Dynamics in Australia Survey (HILDA). Survival rates and duration of studies are from OECD Education at a Glance. Fiscal parameters are from OECD Taxing Wages model and from OECD Benefits and Wages model.

2. Except Hungary (1997); and Poland and Swizerland (2000).

Figure 9. Undiscounted net pension benefits[1], 2001[2]

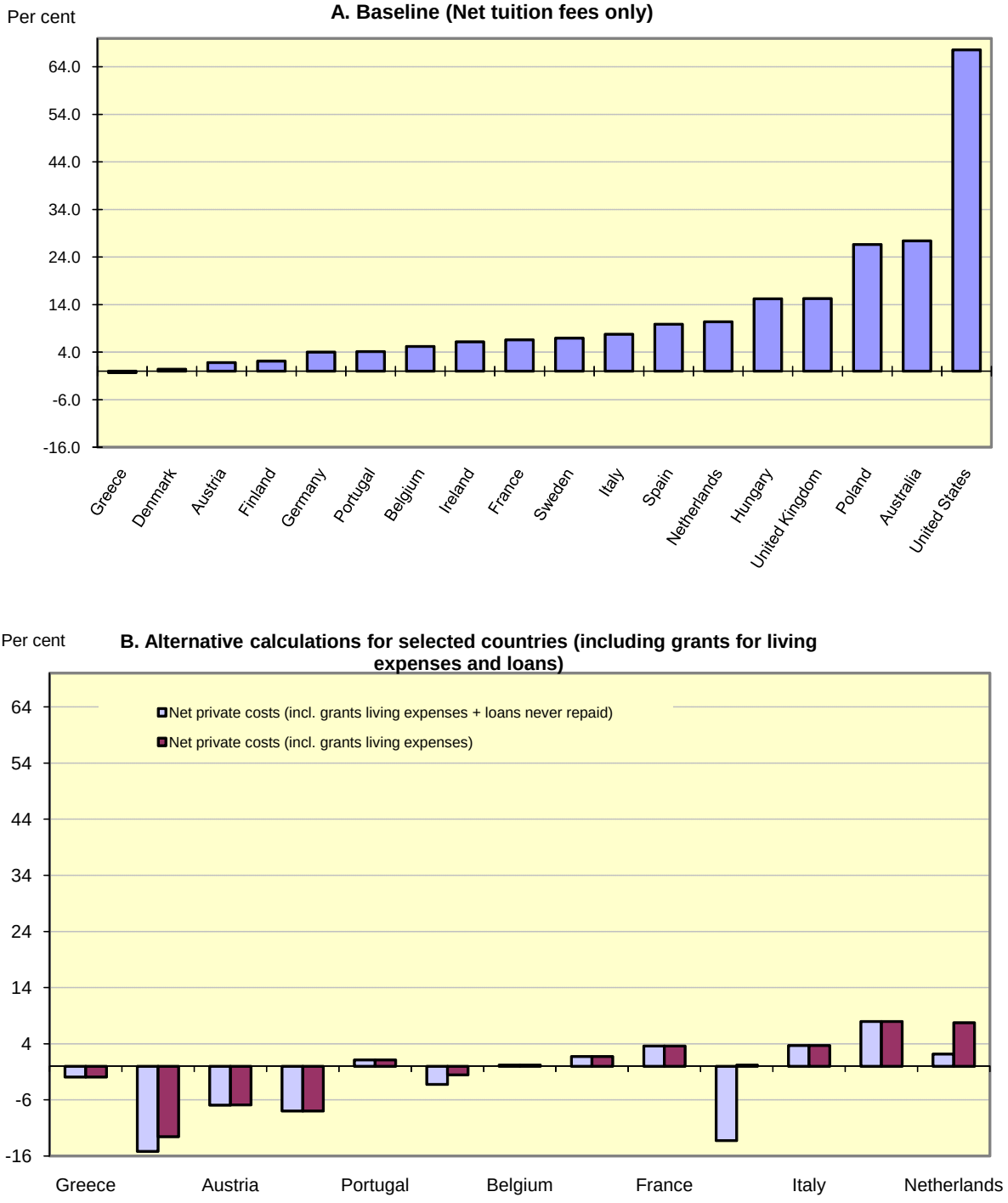


1. Net replacement income adjusted for survival rates and experience premia. See Box 1, equation 3.

Source : Wage and experience premia 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 are from OECD Education at a Glance. Fiscal parameters are from OECD Taxing Wages model. Replacement rate is from OECD Pension at a glance model.

2. Except Hungary (1997); and Poland and Swizerland (2000).

Figure 10 Net direct costs of tertiary education [1], 2002

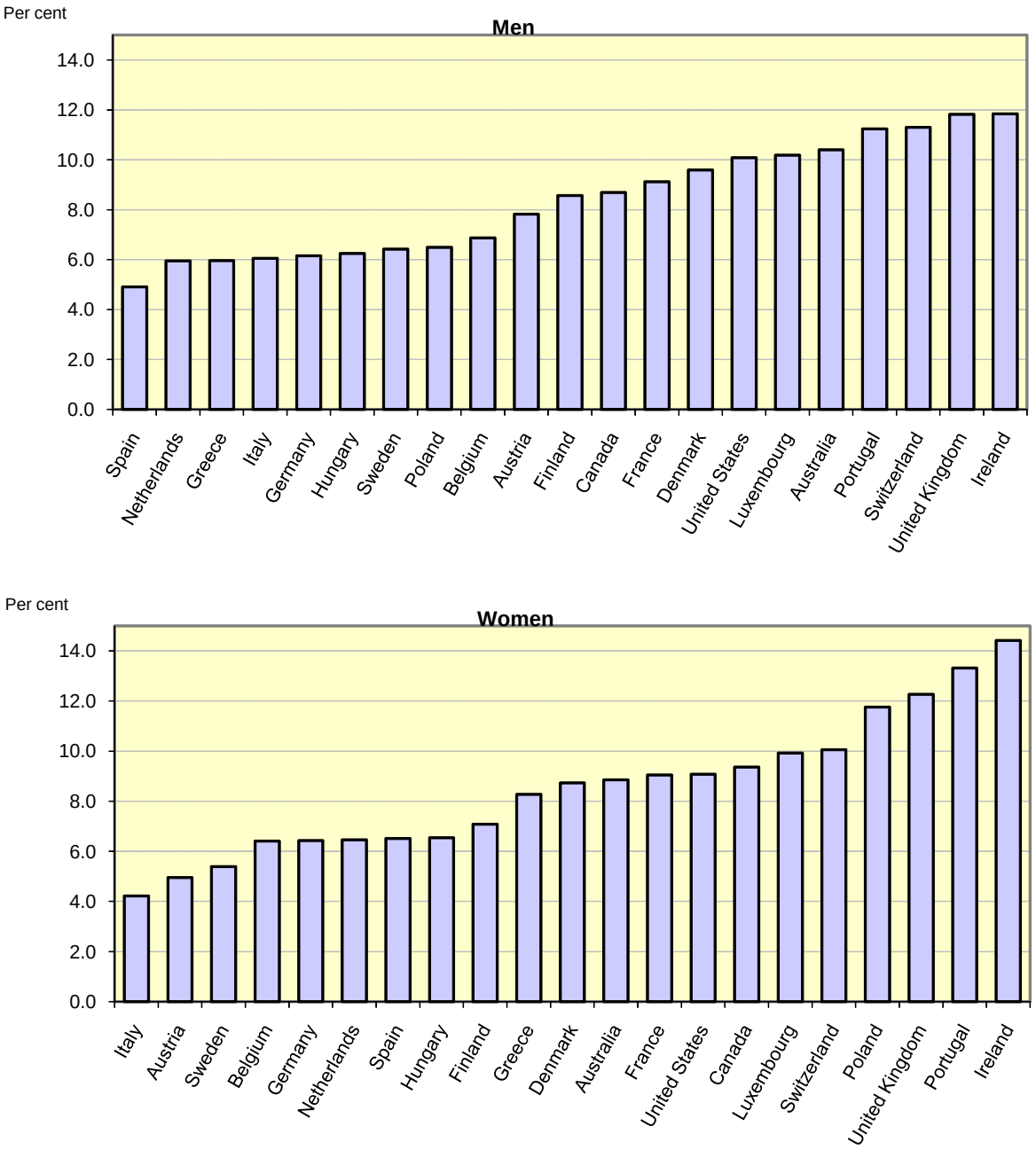


1. In % of gross annual wages of an upper-secondary degree holder.

Source : OECD calculations based on EAG (2005), indicators B1.1 and B3.2b.

Figure 11 Estimates of the Internal Rates of Return to Tertiary Education

2001 [1]

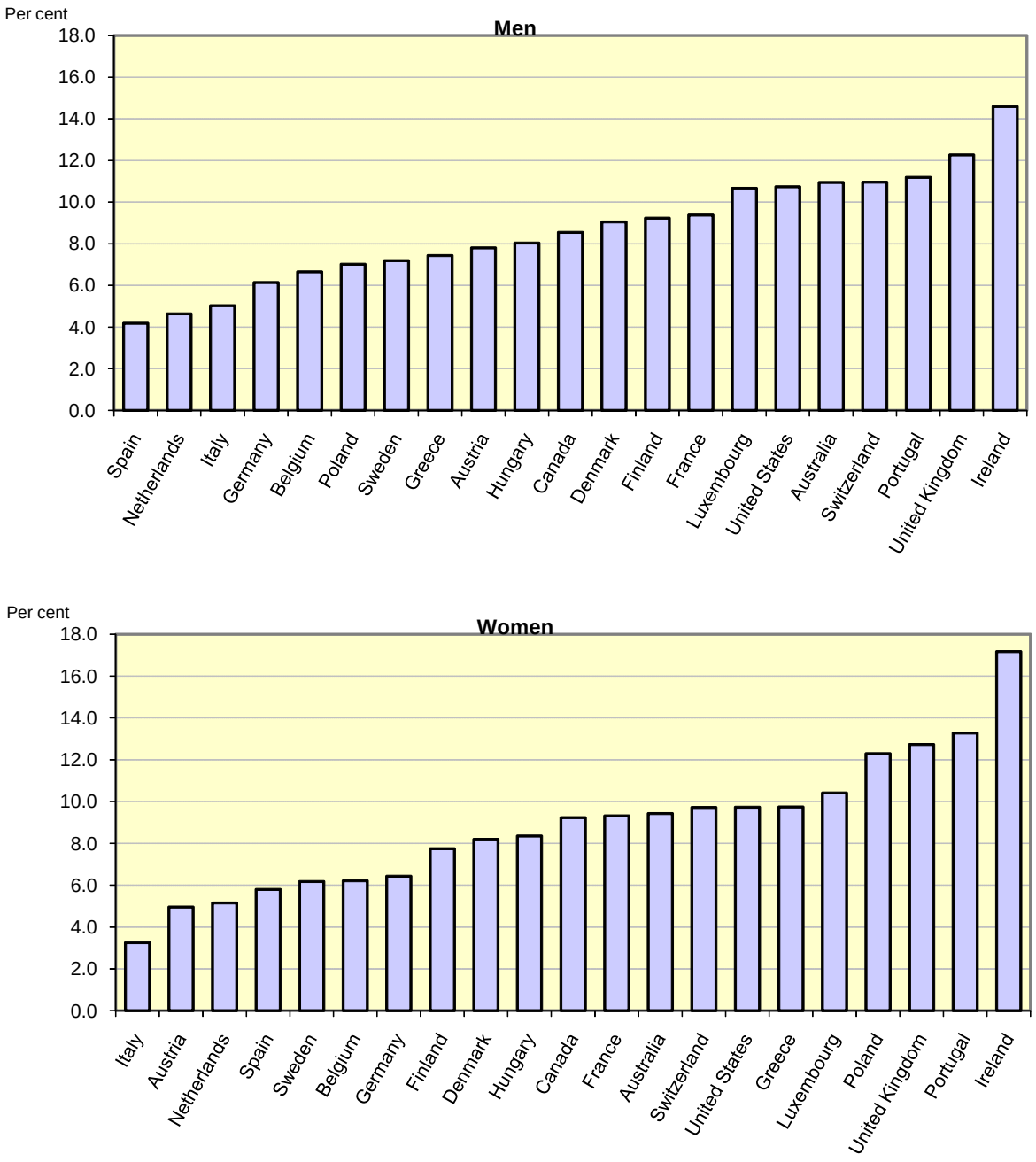


1. Except Hungary (1997); and Poland and Swizerland (2000).

Source : OECD calculations.

Figure 12 Estimates of the Internal Rates of Return to Tertiary Education, alternative calculations with country-specific productivity growth[1]

2001 [2]



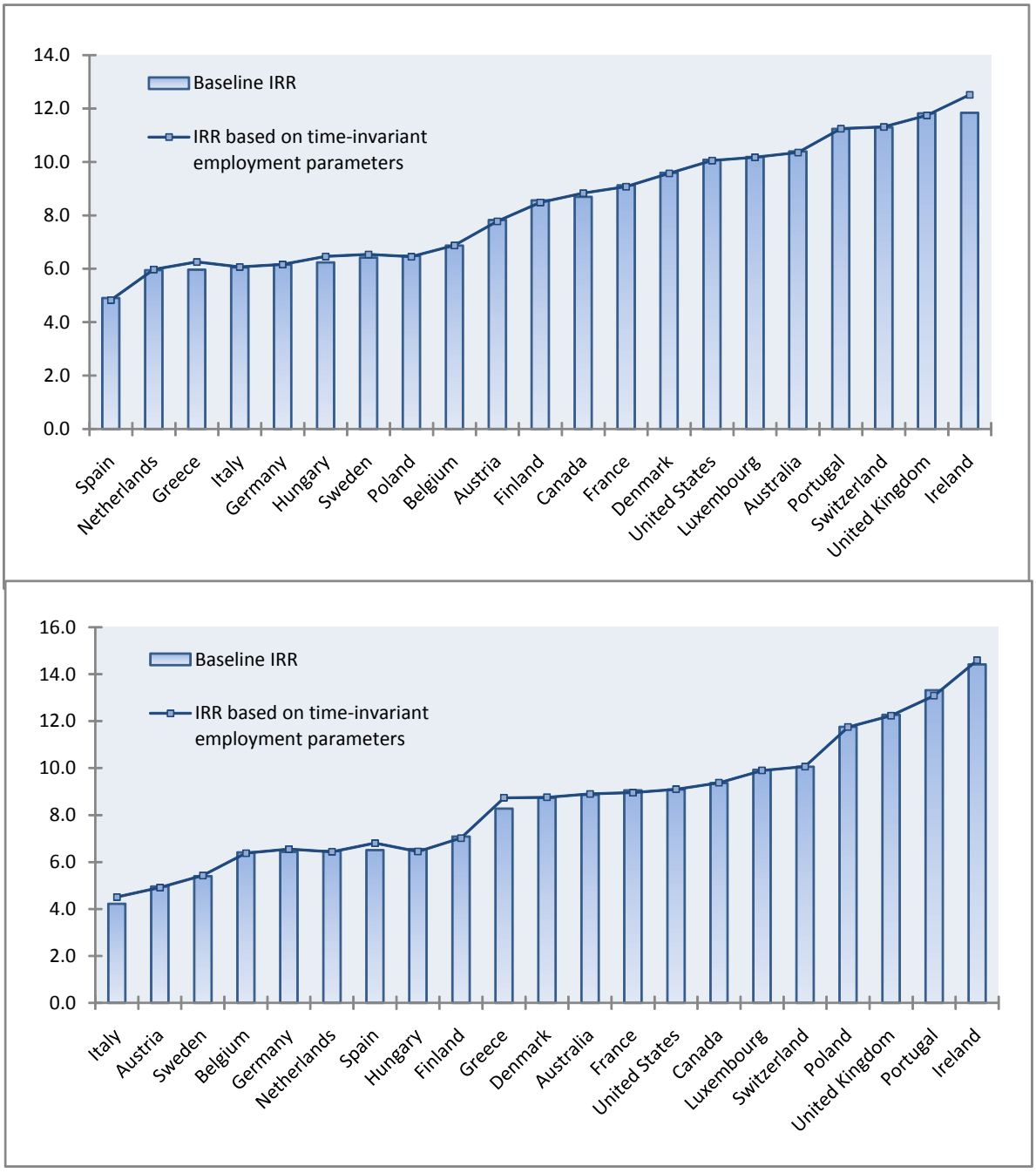
1. Labour productivity growth is the country average over the 1995-2004 period.

2. Except Poland and Switzerland: 2000 and Hungary: 1997.

Source : OECD calculations.

Figure 13 Estimates of IRR, alternative calculations with time-invariant employment premia and employment probabilities

2001 [1]

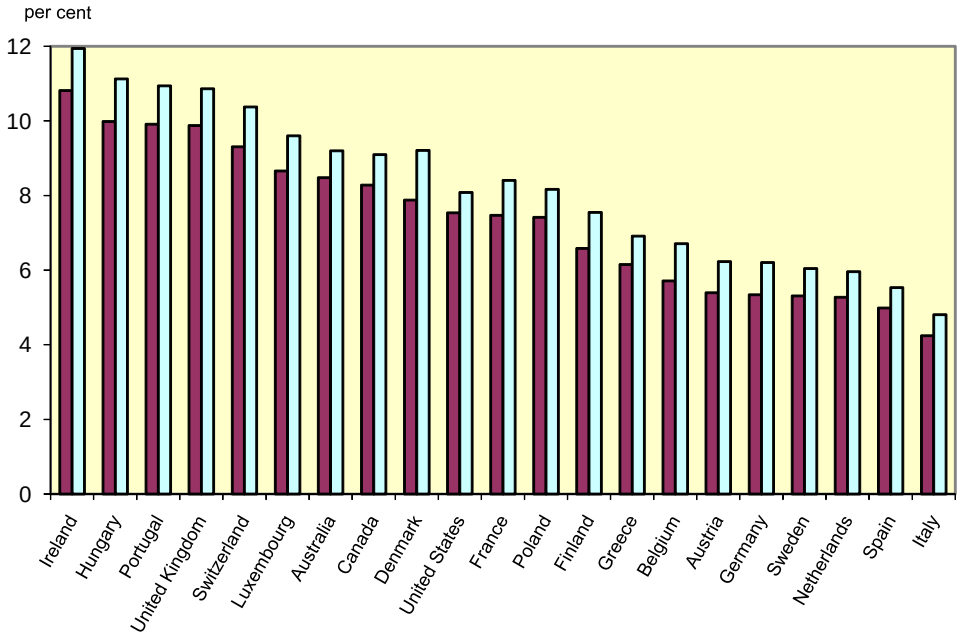


1. Employment premia and probabilities set at the time-average for the period 1994-2001.
2. Except Poland and Switzerland: 2000 and Hungary: 1997.

Source : OECD calculations.

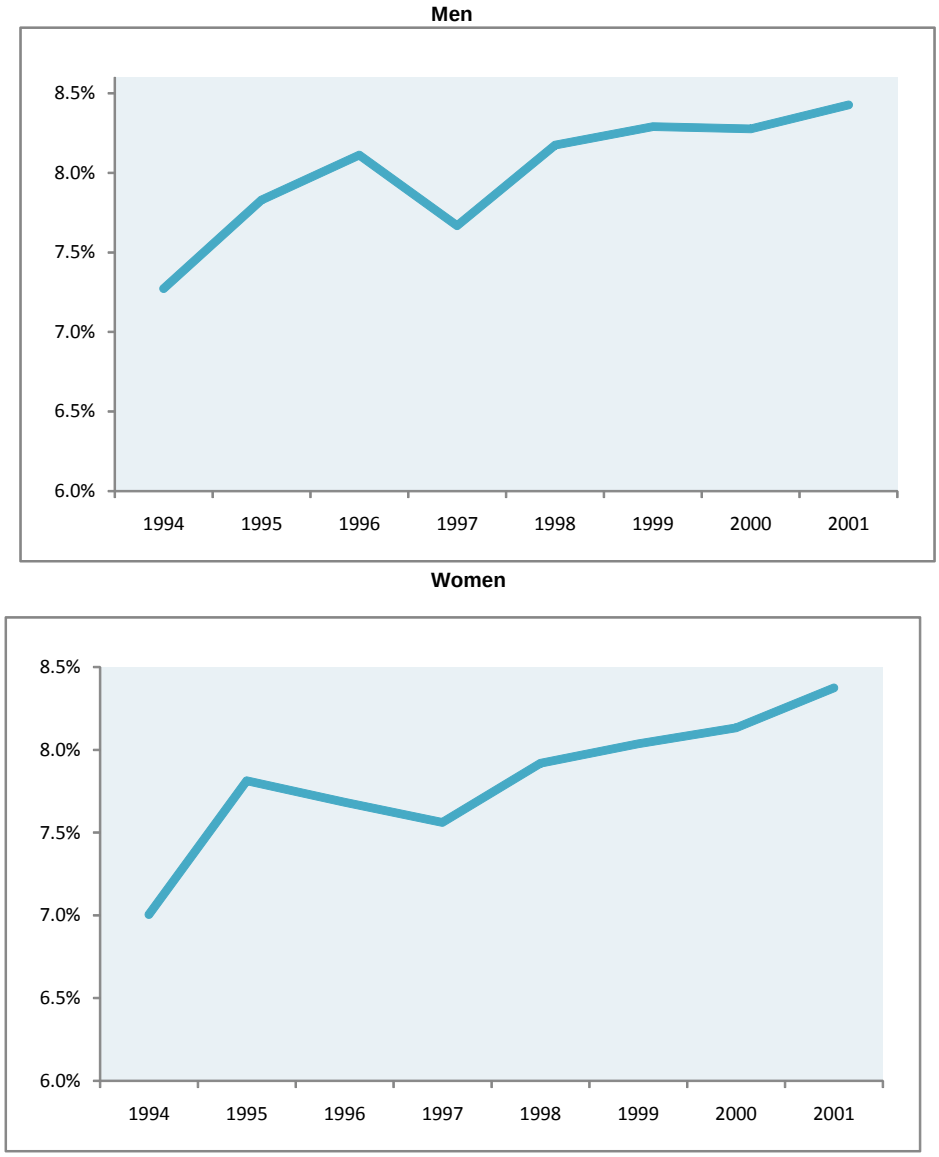
Figure 14 Estimates of the Internal Rates of Return, alternative calculations with part-time student work [1]

2001 [2]



1. IRR computed for taking into account part-time student work (light bars in the chart) build on the assumption that student work 10% of their time and are paid as upper-secondary degree holders, taxed 10% on average and have the same employment probability of upper-secondary degree holders.
2. Except Poland and Switzerland: 2000 and Hungary: 1997.
Source : OECD calculations.

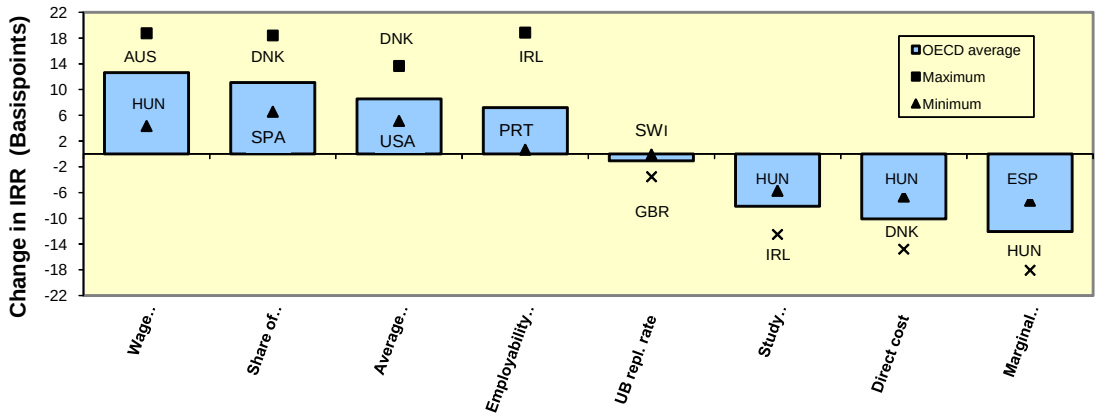
Figure 15 Evolution of OECD Average IRR between 1994 and 2001



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

Figure 16 Sensitivity Analysis on the Internal Rates of Return [1], 2001 [2]

Male-female average

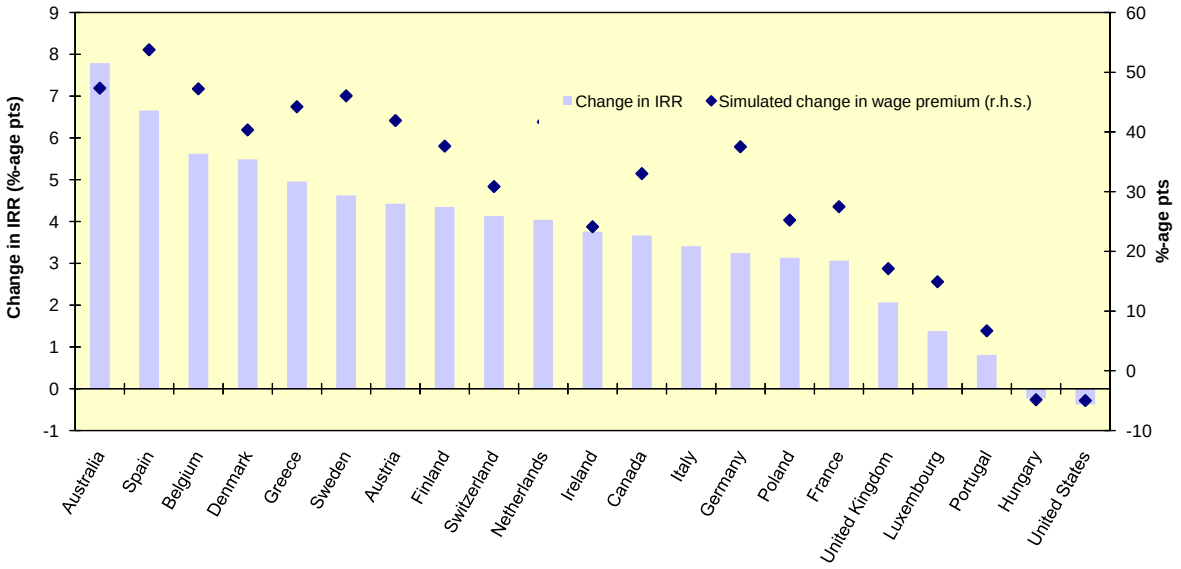


1. All drivers of IRR are changed by 1% point except for study duration, that is changed by 1%.
2. Except Poland and Switzerland: 2000 and Hungary: 1997.

Source : OECD calculations.

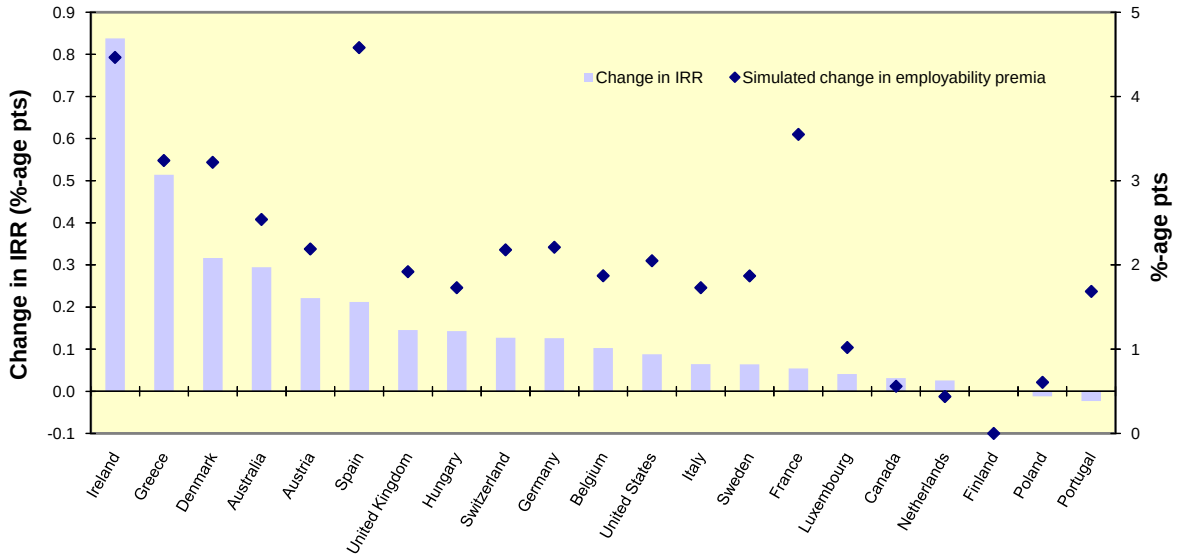
Figure 17 Changes in IRR induced by higher gross wage premia [1], 2001 [2]

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, the IRR would fall.
2. Except Poland and Switzerland: 2000 and Hungary: 1997.
Source : OECD calculations.

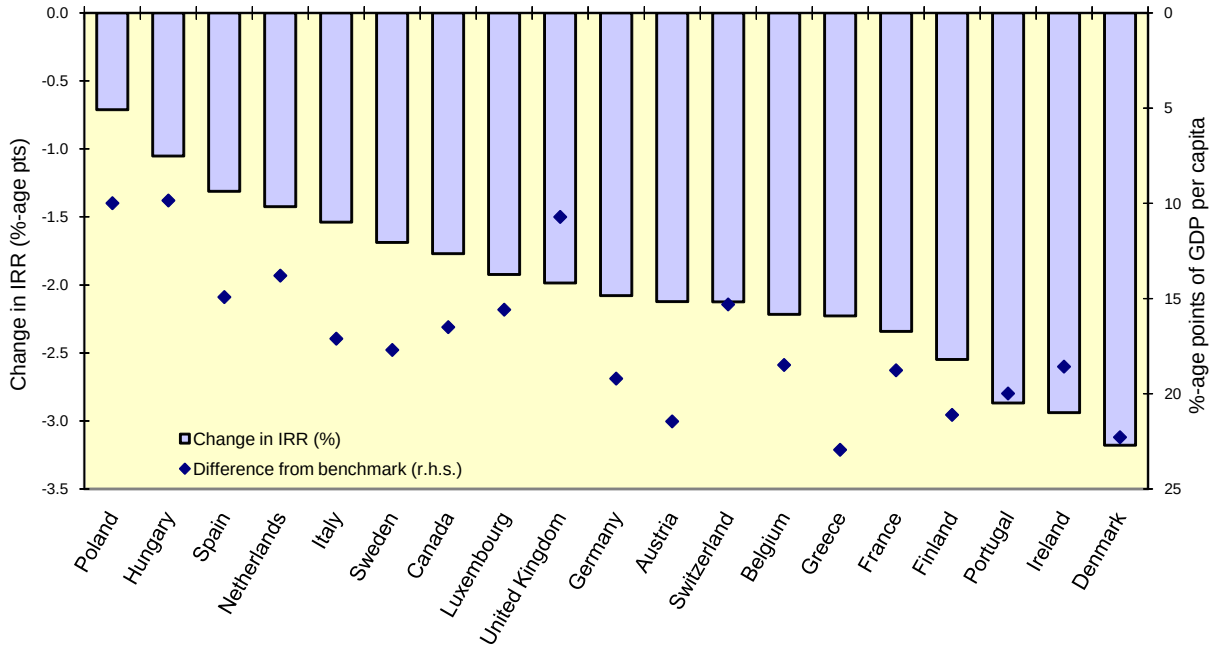
Figure 18 Changes in IRR induced by higher gross employability premia [1], 2001 [2]
Male-Female Average



1. In this simulation the gross employability 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, the IRR would fall.
2. Except Poland and Switzerland: 2000 and Hungary: 1997.
Source: OECD calculations.

Figure 19 Changes in IRR induced by higher direct costs [1] , 2001 [2]

Male-Female Average

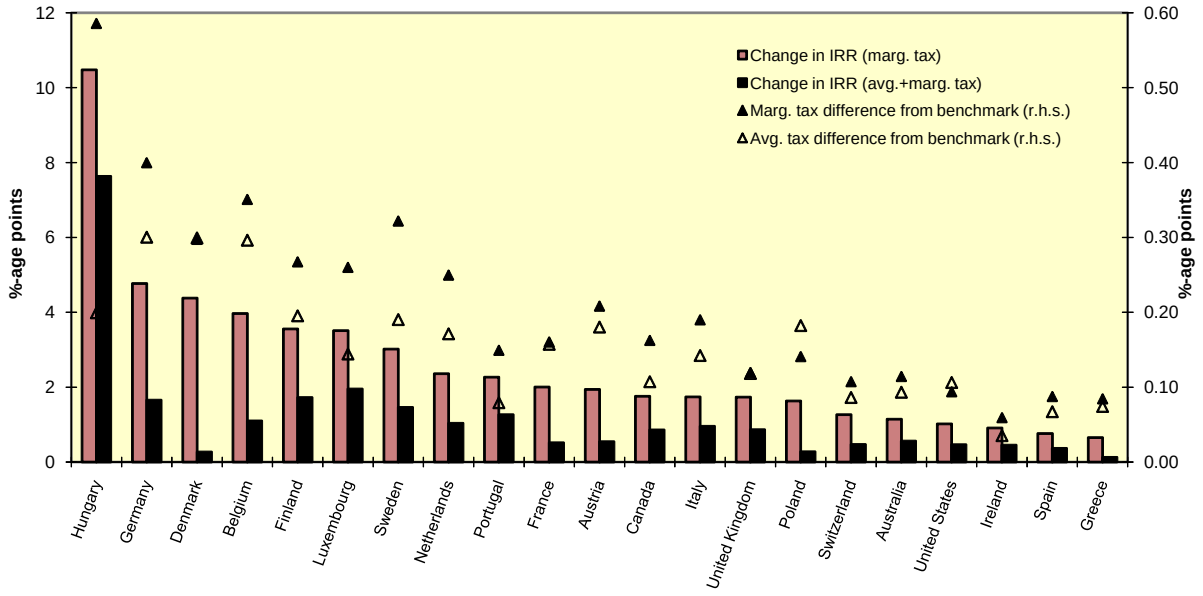


1. Net private costs are set to the country mean plus two standard deviations.
2. Except Poland and Switzerland: 2000 and Hungary: 1997.

Source : OECD calculations.

Figure 20 Changes in IRR induced by lower income taxes [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 Poland and Switzerland: 2000 and Hungary: 1997.

Source : OECD calculations.

ANNEX 1

Box A1. Data Sources and Variables for Employment Equations

Data Sources

The data on which the estimation of employment probabilities and the employability *premia* relies are taken from six different datasets: the European Community Household Panel (ECHP), the Consortium of Household Panels for European Socio-Economic Research (CHER), the British Household Panel Survey (BHPS), the US Current Population Survey (CPS), the Survey of Labour and Income Dynamics (SLID), and the Household, Income and Labour Dynamics in Australia Survey (HILDA).

Selection of the sample

All active and inactive individuals between 15 and 64 are part of the sample with the exception of those already retired or in long-term sickness/disability leave (when this information was made available).

Variables

The *schooling* variable is defined as in the wage *premia* estimation (see Strauss and de la Maisonneuve, 2007 for more details): lower than upper-secondary degree, upper-secondary degree; higher than upper-secondary degree.

Labour Force Status: For the 13 European countries surveyed through the ECHP, the activity status is defined using the ILO definition (variable p003 in the ECHP), which classifies as active individuals who "work more than 15 hours a week", "work less than 15 hours a week", or are currently "unemployed'. It classifies as inactive those individuals who are "discouraged unemployed" and "inactive". For Luxembourg (ECHP data) the question pe001 (self-assessment of activity status) is used since in the respective national files there is no explicit question discriminating between the employed and the unemployed. In this country active individuals are defined as either working with an employer in paid employment/apprenticeship/in training under special schemes (more than 15 hours a week); as being self-employed; doing unpaid work in a family enterprise; working less than 15 hours a week; or unemployed. Inactive individuals are either "in education or in training", "doing housework, taking care of children or other household members" or "other economically inactive". For United Kingdom (BHPS) active people are defined as either being self-employed, in paid employment, in government schemes, or unemployed. Inactive people are students, taking care of family and other inactive. For Canada (SLID) the activity status is defined on the basis of the annual labour force status. On this basis, active individuals were those being employed or unemployed all year, and those employed and/or unemployed part of the year. Inactive individuals were those not in the labour force all year. For Australia (HILDA) active people are those currently either employed or unemployed. For Hungary, Poland and Switzerland (CHER) they were considered as active those employed (i.e. usually working more than 15 hours per week or currently working more than one hour without being unemployed) or unemployed. Finally for the US (CPS) active were defined as currently either employed or unemployed, while inactive are those not in the labour force.

Children: For European countries (ECHP and BHPS) the variable used is "having children under 12 at home". For Canada to the presence of adult children; for the US to the presence of less than 18 years old children; for Australia to the presence of children less than 15; for CHER countries to the presence of less than 16 years old children.

Persistent unemployment (for ECHP countries only): This variable is defined as being unemployed for more than one year at least once in the five years preceding the survey.

Regional dummies (for ECHP countries only): The variable is defined with three modalities: living in poor regions, living neither poor nor rich regions, and living in rich regions; a poor (rich) region is defined as having higher (lower) unemployment rate than the national average and lower (higher) GDP per capita than the national average. The construction of the dummies relies on the OECD Territorial Database.

Table A1. Descriptive statistics for the variables used in the two-step estimation of employment and participation equations

	1994-2001 average									2001								
country	*Employed**	*Active*	*Women*	*Married*	*With children*	*Living in economically strong region*	*Living in economically weak region*	*Living in other regions (than econ. strong/weak)*	*Being unemployed for more than one year*	*Employed**	*Active*	*Women*	*Married*	*With children*	*Living in economically strong region*	*Living in economically weak region*	*Living in other regions (than econ. strong/weak)*	*Being unemployed for more than one year*
DEU	0.92	0.82	0.50	0.56	0.33	0.58	0.42	na	0.09	0.94	0.82	0.51	0.54	0.30	0.61	0.39	0.07	0.07
DNK	0.94	0.86	0.51	0.53	0.34	na	na	na	0.12	0.96	0.88	0.51	0.57	0.34	0.00	0.00	0.10	0.10
NLD	0.98	0.87	0.47	0.69	0.35	na	na	na	0.04	0.99	0.87	0.46	0.75	0.36	0.00	0.00	0.04	0.04
BEL	0.95	0.78	0.52	0.65	0.33	0.42	0.46	0.13	0.13	0.97	0.76	0.53	0.60	0.29	0.43	0.45	0.11	0.11
LUX	0.97	0.75	0.51	0.57	0.32	na	na	na	0.00	0.98	0.75	0.51	0.62	0.36	0.00	0.00	0.00	0.00
FRA	0.91	0.78	0.51	0.66	0.38	0.28	0.29	0.43	0.07	0.94	0.79	0.51	0.66	0.39	0.27	0.19	0.07	0.07
GBR	0.94	0.90	0.52	0.58	0.30	na	na	na	na	0.94	0.89	0.53	0.56	0.31	na	na	na	na
IRL	0.92	0.70	0.51	0.59	0.39	na	na	na	0.11	0.95	0.70	0.51	0.55	0.37	na	na	na	0.09
ITA	0.88	0.72	0.49	0.64	0.31	0.47	0.39	0.14	0.16	0.89	0.71	0.50	0.64	0.32	0.42	0.45	0.17	0.17
GRC	0.90	0.67	0.52	0.67	0.31	0.12	0.00	0.88	0.11	0.93	0.67	0.52	0.66	0.31	0.13	0.00	0.11	0.11
ESP	0.82	0.65	0.51	0.59	0.30	0.44	0.22	0.34	0.20	0.89	0.67	0.51	0.58	0.28	0.42	0.26	0.18	0.18
PRT	0.95	0.73	0.51	0.63	0.33	0.00	0.16	0.84	0.08	0.97	0.75	0.51	0.64	0.35	0.00	0.08	0.07	0.07
AUT	0.96	0.74	0.50	0.58	0.34	0.17	0.25	0.58	0.04	0.97	0.76	0.51	0.56	0.31	0.33	0.26	0.03	0.03
FIN	0.91	0.78	0.50	0.57	0.31	0.24	0.00	0.76	0.11	0.94	0.78	0.51	0.54	0.29	0.26	0.00	0.10	0.10
SWE	0.91	0.92	0.50	0.45	0.33	na	na	na	na	0.95	0.91	0.50	0.44	0.32	0.19	0.34	0.00	0.00
AUS	0.94	0.79	0.52	0.63	0.34	na	na	na	na	0.93	0.77	0.52	0.63	0.35	na	na	na	na
USA	0.95	0.78	0.52	0.55	0.49	na	na	na	na	0.96	0.78	0.51	0.54	0.48	na	na	na	na
POL	0.97	0.65	0.51	0.65	0.29	na	na	na	na	0.97	0.64	0.51	0.63	0.26	na	na	na	na
CHE	0.98	0.82	0.56	0.60	0.32	na	na	na	na	0.98	0.83	0.55	0.60	0.32	na	na	na	na
HUN	0.93	0.84	0.53	0.61	0.38	na	na	na	na	0.93	0.84	0.53	0.59	0.39	na	na	na	na

** Conditional on partecipation*

na: not applicable

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