Department of Economics

Working Paper Series

WP 04/2012

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Utilising microsimulation to estimate new marginal returns to education: Ireland 1987-2011

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WP 04/2012

Abstract

In this paper we utilise microsimulation techniques in the form of an income generation model and a tax/benefit model to estimate both the fiscal and net private return to education at a marginal level. This is carried out empirically using Irish data across the period 1987-2011 and is the first study to utilise these techniques in such a manner. The results indicate that a more generous tax/benefit system, combined with a greater state burden of the cost of education over the period 2000-2005 may have helped increase the individual's return to education, while reducing the state return from investing in education. However, this trend is revered between 2005-2011, as the fiscal crisis in Ireland forces significant changes to the Irish tax/benefit system. The methodology employed allows us to specifically analyse the impact of various components of the tax/benefit system upon these returns across time and show the role of income tax changes upon the return to education for the individual and the state.

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I INTRODUCTION

The returns to education have formed the basis for much empirical work produced in the past fifty years in the economics of education (See Card, 1999 and Harmon *et al*, 2001). This has focused on comparing the private benefits of extra education, in the shape of higher lifecycle earnings against the private cost to the individual of education. However, several possible issues with the basic specification of these methods have been highlighted. For example, private returns based on pre-tax income may result in over-estimated returns due to progressive taxation (Heckman *et al*, 2008). Also more education may affect labour supply decisions (Booth and Coles, 2007; Trostel and Walker, 2006), which may alter the estimated private return to education. Allied to this, estimates of the fiscal returns to education, the return to public finances in terms of higher taxes and lower benefits as a result of higher education levels, are largely ignored within the literature to date. The fiscal return to education can influence public expenditure decision on education as the as tax receipts and social benefits expenditures are related to gross earnings which are a function of education levels. Fiscal returns in addition to wider social and private returns may help frame policy decision making in relation to the financing of education.

Only a handful of previous studies have attempted to explicitly model returns in terms of net income as defined market income plus benefits minus taxes. Noonemans and Cortens (1997) use micro data for Belgium to estimate fiscal and net private returns using an internal rate of return (IRR) method. However, they only incorporate income tax and social contributions, ignoring benefits and other taxes. They also ignore the possible employment effect of education. O'Donoghue (1999) used the European tax/benefit microsimulation model EUROMOD to estimate the marginal fiscal and net private returns to education for four European countries including Ireland, using 1994 tax/benefit rules. While this study did incorporate the possible employment effect of education in its estimations, it did so at the national average level and not at the micro level. Also, it did not account for education related pension income changes which are related to life-cycle earnings. De la Fuente and Jimeno (2009) estimate the private and fiscal returns to education across

14 European countries. This study, although incorporating some benefits (unemployment and pension benefits), only uses average national wage data to estimate the education impact of gross earnings in place of micro data and assumes each individual is single with no children when applying income tax rates on individuals. The OECD (2008) has also calculated the fiscal and private rates of return for a range of countries. They incorporate an employment effect and income tax effect of extra education similar to that seen in earlier estimates. However, they again use national average tax rates with the assumption that individuals are single with no children and the study does not take into account possible employment effects. Also, these estimates do not include the educational impact on varying social transfer levels.

Modelling the distribution of fiscal returns requires the calculation of counterfactual distributions with different education levels given the highly non-linear nature of the tax-benefit system. Therefore in this article we utilise a microsimulation model to try to capture the fiscal and employment effects associated with a marginal change in education, incorporating the heterogeneity of the population to estimate both the fiscal and net private return to education for the period 1987-2011 using Irish data. Incorporating the tax/benefit system and labour market participation effects at a micro level may help us arrive at a more accurate estimation of these returns.

The following section identifies some possible adjustments and deficiencies within the traditional estimation of the marginal returns to education. Specification of each of our returns, attempting to compensate for any possible adjustments or deficiencies is presented next. In section III we explore the methodologies utilised, including an income generation model. We then present our results for the estimates of the marginal net private and fiscal returns to education. Finally, we conclude the article.

II MINCERIAN RETURNS TO EDUCATION: BACKGROUND AND POSSIBLE ADJUSTMENTS

The basic Mincerian earnings approach to estimating the return to education is specified by equation 1 below and pioneered by the work of Becker and Chiswick (1966) and Mincer (1974).

$$LnY_i = \beta_o + \beta_1 S_i + \beta_2 T_i + \beta_3 T^2 + \beta_4 X_i + \nu_i \quad (1)$$

Where Y is an earnings measure (typically gross earnings) for individual i, S_i is years of schooling and T is the potential labour market experience after education, X_i is a vector of the individuals personal characteristics and ν is unobserved characteristics. Using OLS techniques from the above specification, the coefficient β_1 can be interpreted as the average rate of return to schooling (See Card 1999; Trostel *et al* 2002; Harmon at al 2001 and Harmon *et al* 2002)[1]

Possible Adjustments and Deficiencies

Despite their popular use, a number of potential adjustments and/or deficiencies with the earnings functions methodologies in measuring the returns to education may be raised.

Firstly, if gross earnings is utilised for Y_i, the non-linear impact of the tax/benefit system and consequential bias in the estimate of private returns is ignored (Heckman *et al*, 2008) with the progressive nature of most tax-benefit systems likely to reduce the private return to education. Some studies have incorporated the role of the tax system through the use of net earnings (See Harmon *et al* 2001; Trostel *et al* 2002; and Harmon *et al* 2002). However, this framework does not allow the measurement of fiscal returns, which requires pre and post tax-transfer incomes.

Similarly, theses studies typically ignore the role of employment effects in measuring the net return to education. The specification of the returns to education in equation 1 assumes that that changes in earnings capture the full benefit of investing in education, despite labour supply being influenced by the wage rate. Nickel (1979) and Mincer (1991) show for Great Britain and the USA respectively, higher levels of education reduces the probability of being unemployed. Therefore, the transition

[1] Other studies such as O'Leary and Sloane (2011) use a dummy variable approach to estimate the returns to a specific level of education such as third level graduates but the overall estimation concept is extremely similar.

from unemployment to employment resulting from extra education will increase the return accrued from it. Conversely, the return may close to zero if an individual does not enter or exits the labour market post- education.

In placing the focus on increased earnings as the sole monetary benefit from education, any pension related or financial asset which may be a function of life-cycle earnings are also ignored. As higher education levels are associated with higher earnings, higher education may increase an individual's pension income or the probability of having an occupational pension. With respect to financial assets, Soloman (1975) finds that those with higher levels of education may gain some private benefits from having better portfolio management, with a greater probability of holding investments and seeing higher returns from riskier investments.

The relationship between income, education, employment probabilities and the tax benefit system can be illustrated with a simple equation as illustrated below.

$$\mathrm{Y_n} = \mathrm{TB}(\mathrm{Y_g}) \tag{2}$$

$$\mathrm{Y_g} = (\mathrm{p\_Y_e}(\mathrm{S}) \times \mathrm{Y_e}(\mathrm{S}) + \mathrm{p\_Y_m}(\mathrm{S}) \times \mathrm{Y_m}(\mathrm{S})) \tag{3}$$

Where:

Y_n is net income, Y_g is gross income and TB represents the tax/benefit rules which are dictated to by gross income. However, gross income is dependent on gross earnings (Y_e), whether or not an individual is in work (p_Y_e), other non-work income inflows and outflows (Y_m) and the probability of having such inflows or outflows of income (p_Y_m), all of which are dependent on schooling level S.

While β_1 from equation 1 above is equivalent to the average private return to education, accounting for factors such as the employment and tax/benefit effects of education are needed to investigate the net benefits to the individual from extra education. For instance, from equations 2 and 3 above, it can be seen that the effect of education on employment may augment the earnings effect, while the effect of

education on obtaining other potential non-labour income may also influence the overall gross income-education differential. However, the redistributive nature of the tax-benefit system can alter this differential by reducing benefits and higher tax rates as gross incomes rise. Using equations 2 and 3 we can derive the potential fiscal return to education via the interaction of education and tax/benefit liabilities.

Perhaps the most considered critique in measurements of the returns to education stem from the potential bias in the OLS estimates using the Mincerian earnings function specification due to endogenity. This bias may come from the error term in equation 1 being correlated with education due to omitting ability as a control in estimations. While this potential bias is not within the focus of the research presented in this article it is worth mentioning some of previous work that has addressed the issue. Instrumental variable (IV) estimates such as those conducted by Harmon and Walker (1995) for the UK show that OLS estimates may be negatively biased as a result. However, Card (2001) and Harmon *et al* (2002) acknowledge that some caution must be shown in relying on IV estimates, mainly due to choice of instrument. Also, Callan and Harmon (1999) suggest that OLS estimates are not significantly biased downwards when compared to IV estimates in a study using Irish data.

Alternative Measures of the Returns to Education

We use a methodology similar to O'Donoghue (1999) to measure the marginal returns to education. This is defined as the ratio of the benefit to the cost from a marginal change in education[2] from both a private and fiscal viewpoint. We first specify the marginal private rate of return as

$$r_{private} = \frac{[((1 - \mathrm{ss_{ee}} - \mathrm{t}) \times (\mathrm{p\_e_w} \times (\mathrm{Y_{s+1}} - \mathrm{Y_s}))] + [\mathrm{p\_Y_m} \times (\mathrm{Y_{ms+1}} - \mathrm{Y_{ms}})(1-t)] + (\mathrm{bY_{s+1}} - \mathrm{bY_s})}{[(1 - \mathrm{ss_{ee}} - t) \times (\mathrm{p\_e_s} \times \mathrm{Y_n})] + E_p + \mathrm{bY_n}} \quad (4)$$

[2] As with O'Donoghue (1999) it is acknowledged that these costs and benefits may not take place at the same time and so an assumption of the discount rate equating to the growth rate may be used for convenience.

The numerator specifies the net benefits to the individual from a marginal change in education. The tax/benefit element is broken down into various elements and the change in earnings from a one year increase in education is highlighted.

Specifically, $Y_{s+1} - Y_s$ is the change in gross income from moving from level s education to level s+1 (Y_s is the actual gross wage without an increase in education level, Y_{s+1} is the gross salary after one more year of schooling). If we assume that gross wage increases with education, this benefit should be a positive value. However, this may be conditional on the fact an individual is in work and is captured by the term p_e_w . If an individual is not in work, either before or after the change in level of education this benefit may be zero.

$Y_{ms+1} - Y_{ms}$ is the change in miscellaneous other incomes and payments that may vary due to changes in education. These include income from capital investments, income from an occupational pension and outflows such as pension contributions that may impact the taxable income of an individual. As with earnings, the probability of having such income or contributions may also be dependent on education level, a fact captured by p_Y_m . The term ss_{ee} is the employee rate of social insurance contributions while t is the income tax rates, all of which are conditional gross earnings and the probability of being in work, but may also be dependent on other inflows and outflows such as capital income and pension contributions. bY_{s+1} are the benefits received at level s+1 of schooling, while bY_s represents the benefits that one might receive with level s of education. These benefits are generally contingent on gross income and include unemployment benefit, pension benefit and child benefit. Benefits with schooling level s+1 may be expected to be lower than bY_s in a progressive tax/benefit system, thus the term $bY_{s+1} - bY_s$ is expected to be negative, lowering the return to the individual.

The denominator of equation 4 represents the costs to the individual of changing from one level of education to another where $Y_n = Y'1 - Y'0$ and is the net wage

foregone during schooling (Y'1 is the foregone wage while in education and Y'0 is the wages while a student) and $\mathrm{p\_e_s}$ is the probability of being employed while in schooling. The term $\mathrm{ss_{ee}}$ is the employee social insurance contribution, t is the income tax rate, all of which will be dependent on $\mathrm{Y_n}$. $\mathrm{bY_n}$ are the benefits foregone while in education and may include benefits such as unemployment assistance. E_p is the direct private costs involved in moving from one year of education to another and captures only the individual's contribution to this change. The net private return is the value $r_{private}$ takes when the ratio of the marginal benefits and marginal costs is calculated.

We also specify a measure of the marginal return to education from a fiscal viewpoint

$$r_{fiscal} = \frac{[((\mathrm{ss_{ee}} + \mathrm{ss_{er}} + t) \times (\mathrm{p\_emp_w} \times (\mathrm{Y_{s+1}} - \mathrm{Y_s})) + [(\mathrm{p\_Ymx}(\mathrm{Y_{s+1}} - \mathrm{Y_s})) \times t_m] - (\mathrm{bY_{s+1}} - \mathrm{bY_s})}{[(\mathrm{ss_{ee}} + \mathrm{ss_{er}} + t) \times (\mathrm{p\_e_s x Y_n})] - \mathrm{bY_n} + E_g} \quad (5)$$

Marginal net benefits to the state are now the numerator of our equation, with the notation of the terms seen in equation 4 remaining the same. Equation 5 illustrates that higher employment probabilities, higher earnings and other incomes from a change in education levels may entail higher taxes, social insurance contributions and lower benefits and represent a positive return to the state. The term $\mathrm{bY_{s+1}} - \mathrm{bY_s}$ is now subtracted within the numerator, as the expected drop in benefits received from increasing education will now create a positive fiscal return to the state. We also now have the term $\mathrm{ss_{er}}$ included in our equation, representing employer social insurance contributions, which do not influence the private return to education as it is incident on the employer.

The marginal cost element in the denominator of the fiscal return to education is similar to equation 4. However, they are again arranged in a different manner to reflect the measurement of return to the state rather than the individual. Higher

levels of social insurance and income tax amounts foregone due to extra education now reduce the return while the term E_g replaces the direct private cost of education and represents the public cost of varying education levels. The fiscal return is the value r_{fiscal} when the ratio of the marginal benefits and marginal costs of education to the state are calculated.

III DATA AND METHODOLOGICAL CONSIDERATIONS

The data used in this article comes from the Living in Ireland survey; a household panel dataset collected from 1994 to 2001, containing income, social, demographic and labour market variables at the individual and household levels. The sampling frame for the survey comes from the electoral register in Ireland with the original sample size of 4,048 interviewed households, with over 14,000 individuals in these households. Like any other panel dataset attrition was a problem and by the final wave the number of interviewed households fell to 2,865, with just over 9,000 individuals in the final wave. The data is weighted to reflect independent population estimates and to correct for possible attrition. It also includes information on individual's highest level of education completed in the 9 categories.[3]

For the purpose of estimating the marginal returns to education, the above education attainment variables have been transformed into the number of years of education and are described in table 1a[4]. The distribution of the education level in the seventh wave of the data (the wave to be specifically used in our analysis) is described in table 1b.

To estimate the marginal rates of return to education from a net private and fiscal viewpoint at a micro level, a detailed breakdown of the possible tax/benefit implications of varying incomes levels is needed. This is achieved using a tax/benefit

[3] Higher degree, Primary degree, Diploma or equivalent , Post Leaving Certificate courses, Leaving certificate (State exam at the end of 2nd level education), Junior or Intermediate certificate (State exam after 3 years of 2nd level education), Some 2nd level, no exams, Primary certificate, No education beyond primary

[4] As a note of caution, these transformations are purely approximate as they do not allow for variation in the number of years to complete, however, we have opted on the conservative side if the number of years for each level can vary.

static microsimulation model that applies all tax and benefit rules on an individual or household based upon their gross income (or the gross income of the household) for Ireland for the years 1987, 1994, 2000, 2005 and 2011. The tax/benefit rules in Ireland for each of these years are simulated upon the 2000 population of our data with the income levels of individuals and households scaled up or down by a GDP deflator depending on the year of tax/benefit rules being applied to the data[5]. Static microsimulation models such as this have been developed previously to analyse complex interactions at the micro level, especially the impact of tax and social benefit systems on individuals and households with model developed for the UK (POLIMOD), the USA (TRIM), Canada (SPSD) and Australia (STINMOD)[6] and for Ireland with the SWITCH model of the ESRI (Callan, *et al* 1996).

As this article uses the tax/benefit systems from 1987 to 2011 for Ireland, table 2 illustrates the main changes in the system between for a selected number of years during this period. This shows that social benefits increased substantially in real terms in the years 1987 to 2011 in Ireland, with most of the benefits rising over 50% in this period. We also see falling income tax rates and the removal of an upper third tier of income tax as we move to 2011. With respect to the returns to education to be estimated, this would point to a falling tax on human capital accumulation, benefiting the individual and costing the state. However, the table does not include some notable changes to the Irish tax/benefit system seen between the period 2005 and 2011 with both a new universal social charge based on gross incomes and a levy on pension income introduced which may entail this trend is reversed[7].

Estimating Direct Costs and Indirect Costs of Education

To gauge the private and public costs of education we use expenditure per student by education level from the OECD for the years 1997-2008, adjusted from US$ to

[5] A key aspect involved in using a tax/benefit microsimulation model is to provide validation of the simulated results, the results or our model are broadly in line with the similar validation measures undertaken for the Irish component of EUROMOD (Callan *et al*, 2005) and can be provided upon request to the author.

[6] See Merz (1991) and Gupta and Kapur (2000) for a description of these particular models.

[7] For more detail see Department of Finance (2010).

Euro and for purchasing power parity.[8] To separate the burden of this cost across private/public contributions we multiply by the public/private share.[9]

We see from table 3 that the private and public expenditures are both increasing in absolute levels in nearly every year across all education levels[10], with public expenditure increasing at a higher rate than private expenditure. This may result in decreasing fiscal returns to investing in education throughout our reference period as the public cost (E_g from equation 5) increases substantially across all education levels.

The indirect costs of education will vary depending on which type of return is being estimated. However, they all depend on foregone earnings, $\mathrm{Y_n}$. This term is derived using age-earnings and employment profiles of cohorts for different education levels. Utilising this we are then able to simulate the foregone costs in terms of the fiscal and private return. More specifically, to calculate $\mathrm{Y_n}$ we first assume that foregone earnings are zero for an individual that currently has primary level education. This suggests that if this individual had a marginal increase in education, the earnings they would forego would be zero. We then create three sub samples within our data based upon age and highest education completed indentifying as follows

A. Those aged 16-17 that have indicated lower secondary as their highest level of education complete.
B. Those aged 17-18 that have indicated upper secondary as their highest level of education complete.
C. Those aged 21-22 that have indicated tertiary as their highest level of education complete.

[8] We use OECD Education at a Glance for various years – only 2008 is included in the references.
[9] As no expenditure figure and the public/private breakdown of this expenditure could be obtained from the OECD for 1987 and 1996 for Ireland, the 1987 figure is the 1994 figure multiplied by a GDP deflator while the 1996 figures are calculated in a similar fashion using the 1997 figures available.
[10] Expenditure levels are also seen to increase in constant terms across the period but are not presented, see OECD (2010) for more details.

For each of these three sub samples, we specify four labour states an individual may be in:

1. In employment and not attending education
2. Unemployed,
3. Part-time employment and attending education,
4. Attending education full time with no employment.

Y_n is obtained using the cross sectional weighted averages of earnings of the population of those in work and not in education. This provides the term $Y'1$ (earnings foregone while in education) for three separate education levels. We also get the weighted average earnings of the individuals in the sample that go to full time education and work part time to arrive at the term $Y'0$. This is then performed across the three cohorts we have with the varying age and education levels.

Expected foregone earnings in obtaining an extra years education $p\_e_s x Y_n$ may also vary due to the probability of working. This is calculated using the employment probability per age/education cohort, giving us expected foregone earnings for different education levels. A similar methodology is used to obtain terms for the foregone taxes, benefits and social contributions needed for fiscal returns by applying the tax and social contribution rules to the level of foregone earnings. The foregone benefit term bY_n is the average benefit received from those in work reduced by the average benefit received by individuals while in education and in work. This completes the terms required to calculate each of the costs elements of the fiscal and net private returns to education.

Simulating a Marginal Change in Education

We next simulate the impact of a marginal increase in education upon gross income. Gross income is a function of different income sources, pre taxes and transfers (equation 3). Given the role education may have in shaping these components, we utilise an income generation model (IGM) to simulate the variations in this income that may come from a marginal change in education.

The IGM forms its origins from the work of Oaxaca (1973) and Fields and Schultz (1982). It is described in detail in Bourguignon and Ferreria (2005) and Bourguignon *et al* (2003) where it has been used to assess the redistributive impact of economic change in developing countries. More specifically, they use a series of reduced form models which include; labor force participation models, employee earnings models, self-employed earnings models and capital earnings models to help calculate both the distribution of total household income for East Asian and Latin American countries and simulate the impact of various policy changes. The methodology employed involves modelling the choice outcomes (such as labour market outcomes) and incomes of individuals using various econometric regressions with residuals being interpreted as individual fixed effects. Simulations can then be performed based on the deterministic estimations of these choice outcomes and incomes.

We wish to model the impact of a marginal change in years of education on various outcomes that may have an eventual influence on the gross income level and hence the tax/benefit situation of a household/individual. For the sake of simplicity we limit ourselves to two econometric specifications for our IGM estimations. Logit models were used when faced with a binary choice situation while OLS regressions were employed in the case of continuous dependent variables.

With the former estimation procedure we use the binary decision of labour force participation as an example of the methodology employed. In our model this is a discrete choice, with an individual either participating in the labour force or not; you are in the labour force if you have some form of working income and are over the working age (>=16). We represent this with equation 6 below

$$IW_i = \alpha + \beta X_i + \varepsilon_i > 0 \qquad (6)$$

Where IW_i is a binary variable equal to unity if individual i if earning some form of work income or zero otherwise. Individuals chose between the two according to some criteria the value of which is specific to the alternative. The option with the highest criterion value is selected. The criterion value associated with non

participation in the labour market is set to zero, whereas the value of being in work is a function of intercept α, individual characteristics βX_i and unobserved effects ε_i. An individual will prefer work if the value of the criterion associated with that activity is higher than that associated with inactivity (set as zero). This is the situation represented in equation 6 above. The opposite can also be true, if the criterion associated with being in work is less than zero, the individual will prefer inactivity. The terms α and βX_i can be estimated simply using the logit model estimations. The unobserved fixed effects ε_i are drawn randomly from the relevant distribution[11]. This methodology is employed for a range of binary choice model outcomes that may alter the tax/benefit situation of an individual or household, the full list of these can be seen in appendix A of the article.

To illustrate the methodology used in the context of continuous income variables, we take the example of employee earnings. This can be represented by equation 1 seen previously where the logarithm of employee earnings of individual i LnY_i is a function of his/her years of education S_i, labour market experience T, personal characteristics X_i and unobserved characteristics ν_i. This is viewed as estimating the relationship between gross employee earnings and years of education. The relevant coefficients and residual terms can be estimated using ordinary least squares regression on a sample of individuals that are seen to draw their income from being in employment. For non-working individuals in the base data, ν_i is missing. We sample from the relevant distribution to get an estimate of ν_i for this group[12].

In our estimations an attempt was made to keep the explanatory variables for the various estimations consistent with one another where appropriate, with years of education, regional dummies, age and its square (or potential experience and its square) and martial status included as regressors. The complete list of independent

[11] See Bourguignon *et al* (2003) for more details on this process

[12] A possible econometric issue within this specification is that the error term drawn for the labour supply estimations may not be independent of the random terms in the various earnings estimations and so some bias may also be introduced in this manner. However, Bourguignon and Ferreira (2005) suggest this is not a problem unless there is substantial bias present within the earnings equations.

variables used for the various models run can be seen in table A1. Separate estimations for all the models were run for males and females and for the sake of parsimony all estimations are not presented[13]. The results for the employee and self employee earnings and in/out of work estimations are presented in appendix B. We briefly note that employee earnings, self employee earnings the probability of being in work are positively related to the years of education obtained and the other estimations do behave as expected with regard to education.

Simulation using the IGM and Tax/benefit models

From the deterministic part of each model we simulate the impact of an extra year of education on each of the outcomes from table A1. To simulate a marginal increase in schooling we simply hold all estimates constant with the exception of the years of education explanatory variable which is allowed to increase by one year for all individuals. This simulated change may shift individuals from previous states, such as being out of work, to being in work by adjusting the criteria value we saw in equation 6. If this occurs and the individual now satisfies the stipulated criteria, their status is changed. This then feeds into estimates of income levels such as employee income, capital income or pension income. For instance, if the individual is found to have moved into work, they are now assigned some level of work income (employee, self-employed or farm income) based upon our previous OLS estimations with unobserved characteristics ν_i treated as fixed effects.

When the simulation is complete we now have two datasets. We have the base year 2000 data and the year 2000 data with a simulated increase in education. The latter incorporating the various changes brought about from our simulation, such as higher gross earnings and more individuals in work. These two datasets can be used as inputs into the static tax/benefit microsimulation module outlined above to arrive at our measures of the marginal returns to education. Tax/benefit microsimultion models, by simulating tax liabilities and benefit entitlements, can estimate the net impact of government policies on an individual. A Tax/benefit microsimulation model can thus be described in mathematical terms as follows:

[13] Results of all the estimations conducted are available upon request

$$Y^n = f(Y_{i,j}, G_{k,j}, X_j \mid \forall\, i \in I, \mid \forall\, k \in K, \forall\, j \in H) \qquad (7)$$

where $Y_{i,j}$ is the set of exogenous incomes i, such as wages, self employment income, investment income and other incomes for individuals j in household H. $G_{k,j}$ is the set of government incomes, k simulated in the model, such as pension and unemployment benefits. X_j is the vector of other characteristics such as marital status, employment status, number of children, number of years of education etc. Using the output of the IGM model combined the simulated taxes and benefits we obtain a 'before and after' picture of all of these exogenous incomes and government incomes with respect to a marginal change in education, thus providing us with the platform to estimate the fiscal and net private return to education as outlined in equations 4 and 5.

IV EMPIRICAL RESULTS

The results of the average marginal fiscal and net private return to education for Ireland using the 1987-2011 tax/benefit rules are presented in table 4. We analyse our results in a number of different ways, first comparing the results across the varying tax/benefit rules.

Marginal Rates of Return over Time

Looking at the various measures of returns over time, we see there is a decline in the fiscal return to education in Ireland as we move from the 1987 tax/benefit rules and education cost structure to 2005, but then a significant rise in this return by 2011. From table 4 we see the fiscal return under the 1987 tax/benefit rules at 8.9%, falling to 7.3% by 2005 and rising back to 8.9% for 2011. The net private return to education trends in the opposite direction, increasing from 9.0% in 1987, to a high of 11.0% in 2005, but decreasing to 7.1% by 2011. As the movement across the period 1987-2011 is the result of variations in the tax/benefit rules and education cost structures, it can be suggested that variations in tax liabilities and educational cost burden initially reduced to such an extent that it has helped increase the return to the individual from education while at the same time reducing the state's return.

However, the substantial changes seen across the period 2005-2011 demonstrate the impact of the current fiscal crisis in Ireland upon both our returns measures. The net private and fiscal returns to education fall back to 1987 levels or below, demonstrating the relatively rapid manner in which policy changes can influence the magnitude of these returns to education. The results are consistent with the changes seen in both the Irish tax/benefit system seen in table 2 as well as the changes in the distribution of higher education costs shown in table 3.

The results from the private return to education are in line with Callan and Harmon (1999) who use the gross earnings of workers in Ireland to estimate the private returns to education in Ireland using an earnings function approach with data from 1987 and find a marginal private rate of return to year of schooling of between 7%-10%[14]. Therefore, incorporating tax/benefit and employment effects of a marginal increase in education may nullify each other and bring out estimates close to the gross earnings estimates. O'Donoghue (1999) showed a fiscal and net private return to education for Ireland of 5.3% and 14.4% respectively using 1994 tax/benefit rules with 1987 data, indicating our estimates using the 2000 dataset slightly higher with respect to the fiscal return and lower with respect to the net private return. However, given the differences in methodological approaches between the two papers it is difficult to draw any firm reasoning for such a divergence.

McGuinness *et al* (2008) show decreasing marginal private returns across the 1990's for Ireland using gross earnings data, while our results show an increasing trend. This may be explained by the fact the McGuinness study uses different sample populations in its estimates and so the varying returns to education within this study are driven by labour market/macro economic affects. The increasing returns to education presented within our study are solely as a result of policy changes with regard to tax/benefit rules and education cost structures with the sample population constant. This may indicate that incorporating the tax/benefit system within estimates of the returns to education over time for Ireland may offset some of the

[14] This paper uses both OLS and IV methods in their calculations

possible reductions in the private return to education due to the shifting education/earnings distribution that may have occurred across the period[15].

The variations in the tax/benefit system over our reference period initially combined to reduce the state return to education, therefore, a move towards placing the financial burden of education on the individual may have been warranted. However, the most recent changes to the Irish tax/benefit system and the increasing private cost of education in Ireland has brought the fiscal return back to 1987 levels.

Decomposition of Marginal Rates of Return

We next breakdown our estimates of the fiscal and net private return to education by the various benefits that drive them. This is seen in tables 5 and 6, with a segmentation of the different components of the respective numerator (benefits). The cost element is held constant across these estimates for each respective tax/benefit year. This may help establish the particular elements of the tax/benefit changes from 1987-2011 that drove the varying private and fiscal returns to education. Also, as the cost element varies from 1987-2011, this procedure may also allow us to comment on the impact of varying costs on the returns estimated.

The return to the individual is initially presented under the scenario of no tax/benefit system in place, no employment effect and no pension or capital income effect of a change in education. Therefore, column A of table 5 represents the net private return with the benefits stemming solely from the change in earnings a marginal increase in education may entail. As this marginal benefit will remain constant within the sample population, the varying return across 1987-2011 can be explained by the changes in the marginal cost to the individual. These costs consists of both the direct and indirect costs, however, given the methodology in constructing the indirect costs of education from a private viewpoint, these will remain relatively constant across

[15] Although not presented within this article for parsimony, the authors have estimated the fiscal and net private return to education across the 1987-2005 tax/benefit rules using the 1994 wave of the Living in Ireland dataset with the results supporting this viewpoint of a decreasing marginal private return to education due to labour market variations but an increasing marginal private return due to tax/benefit and education polices.

reference period. This, allied to the magnitude of the changes in column A (of table 5) as we move from 1987-2011 indicate that variations in direct private costs of education across these years have a relatively small positive impact on the private return, however they largely explain in small drop in the private return to the individual in moving from the period 2000-2005.

As we move across columns in table 5 we first add the market related components of the marginal benefit to education. These include the employment effect as well as the pension and capital income effects of a marginal change in education. This manner of decomposition helps illustrates that the return to the individual rises as more of the market related elements of a marginal change in education are accounted for. We then add the policy related components of our measure of the net return to the individual, including income taxes, social benefits and social insurance contributions and see a sharp reducing in the net private return across all years. In looking across columns A-G we can see from the size and variation of the respective returns measures that the initial earnings effect, the role of taxes and the employment effect have the greatest on the net private return to education. Private pension income is also seen to have a substantial impact on the return to the individual, while SIC's and capital income effects are relatively small. As we vary the tax/benefit year analysed we see that the negative impact of taxes on this return falls substantially as we move towards the tax/benefit rules of 2005 but rises again towards 2011. This provides further evidence that changes in the tax system played a significant role in increasing the marginal net private return to education in Ireland up to the year 2005, while more recent changes have resulted in a substantial decrease in this return. Also, although we see that the impact of incorporating changes in social benefits and SIC's on this return falls over the period 1987-2005, they are not as substantial as those seen for income tax.

In viewing columns A through G of table 5 one prominent feature is the wide fluctuations in the return to the individual as different components of this return are accounted for. Given the fact most studies of the private rate of return to education only account for the earnings effect of education (usually only the earnings of

employees) in their estimates, our results illustrate the wide variation in these estimates that may occur, given the various other components that may be included in their estimation. This is particularly evident in comparing the various policy components in 2005 and 2011 where the tax effect plays the most prominent role in driving down the 2011 net private return.

The various components of the marginal fiscal returns for the respective samples are seen in table 6. They are presented in a slightly different fashion to that seen for the private returns above. Table 6 presents the return to the state incorporating variations in taxes, benefits and SIC separated into just those arising from the earnings effect of education, but also from the from the earnings effect and employment effect. Such a breakdown helps illustrate not only the varying magnitudes components such as taxes and SIC contribute to the fiscal return to education, but also demonstrates the impact of including the movement from inactivity to in-work that a marginal change in education may bring about on this return.

The first element of column A illustrates the fiscal return will range from 5.5% to 5.7% across the period 2005-2011 if income tax variations driven by earnings changes are the sole component of the fiscal return to education. When the possible employment effects are accounted for we see this component of the fiscal return range from 6.8% to 6.6% over the same period, highlighting the fact that the movement from inactivity to in-work brought about by higher education may augment the return to the state significantly. In moving across to columns B and C we add different elements of the tax/benefit system and see the fiscal return rise, as measured with just the earnings impact of education and the combination of the earnings and employment effect. The results again highlight the substantial positive impact the inclusion of the employment effect of education may have upon the return to the state.

Table 6 also helps us analyse the particular elements of the tax/benefit that contribute towards the fiscal return to education and given the size and variation

within the different elements it would seem that income tax related charges are the main manner in which the state receives it's return on education. Relative to this, the role of varying benefits and SIC is small. It is also important to note that the tax component of the fiscal returns is falling as we move from 1987 to 2005. This highlights the falling tax rates and also the increasing marginal cost for the state of education over this period. The latter issue can be explained due to higher public financing of education through our reference period (as demonstrated in table 3). However, this trend changes significantly from 2005-2011 as the more individuals fall within income tax bands and a greater burden is placed on the individual rather than the state with regard to the cost of education.

Marginal Rates of Return across gender and age group over Time

Table 7 segments the net private and fiscal return across the period 1987-2011 for both males and females with the key trends seen before remaining. We see a rising private return and falling fiscal return up to 2005 and a decrease/increase in these returns respectively for 2011 for both sexes. Previous studies of the private return to education for Ireland using OLS or IV techniques estimate higher returns for females than males (McGuinness et al, 2008 and Trostal et al, 2002). Our results indicate that when other market effects and the tax/benefit system are accounted for, the private returns to education are relatively similar across gender. However, this finding becomes redundant when using the 2011 tax/benefit system as males see a far larger decrease in their returns relative to females. This suggests that the new tax/benefit polices within Ireland such as the introduction of a pension levy and a universal social charge have penalized male returns to education rather than female[16].

Table 8 presents our two measures of returns segmented across three different age groups, those aged 16-29, 30-49 and 50-65 respectively. Our results indicate that both the highest fiscal and net private returns accrue from/to the eldest age group. This is unsurprising given that capital income and pension income effects will be

[16] This is confirmed by performing a decomposition of the policy components of these returns across gender, but the results are not presentd for reasons of brevity.

focused in these age groups. Also, lifecycle earnings generally peak in this age group and so any increases in earnings will likely be captured by the higher rates of income tax. Table 8 also illustrates that each age group follows the observed trend of increasing net private returns until 2005, and then falling for 2011. It is the eldest age group that sees the largest drop in the private return to education in this period, again not surprising given the recent changes to the Irish tax/benefit system have targeted pension incomes and higher earners. It is the same age group which sees the largest increase in the state return to education in 2005-2011 period, with the fiscal return from the youngest age group remaining quite stable despite the tax/benefits adjustments. The results imply that with the progressive structure of the tax/benefit system in Ireland, both the state and the individual may accrue the highest returns to education later in the lifecycle. From an education policy perspective, this may not be desirable, especially if short term returns are sought. Also from the individual's perspective, returns focused in this manner may cause a certain myopia with respect to the individual's decision to undertake education.

V CONCLUSION

The main focus of empirical estimates of the rate of return to education has centred on the return to the individual based upon the relationship between gross earnings and education. The incorporation of the tax/benefit system, labour market transitions and other possible interactions that may impact the returns to education has largely been ignored. The return to the state emanating from this relationship between education, gross income and the tax/benefit system has also rarely featured in studies concerning the returns to education. Studies that have attempted to estimate these returns to education have done so using national representation of tax/benefit systems and may not fully capture the full effects of a marginal increase in education. In this article we show that microsimulation techniques can be utilised to estimate a marginal net private and fiscal return to education at the micro level, while also facilitating an analysis of the key components of the tax/benefit system that influence these measures. This is illustrated for Ireland for the period 1987-2011.

Within the empirical results we find that the average marginal net private rate of return to education in Ireland has increased as the tax/benefit rules have moved from 1987-2005, but has dropped significantly in the period 2005-2011. We also find that the average marginal return to the state follows the opposite trend, falling over the period 1987-2005 but rising more recently. This indicates that a more generous tax/benefit system, combined with a greater state burden of the cost of education may have helped increase the individual's return to education, while reducing the state return from investing in education. However, this has been reversed with more recent changes to the tax/benefit and education finance systems. A decomposition of the estimates show that the employment effect and income taxes have a huge positive impact on the return to the individual. The marginal fiscal return to education is also largely influenced by these two particular effects, with the role of varying benefits and SIC's having a minor impact on the return to the state. The results also indicate that the tax/benefit system may equalise the private returns to education across gender, but the most recent changes within the Irish system have penalised males more than females.

From a methodological viewpoint, given the fact that many countries have static micro tax/benefit models already established, the techniques presented here could be utilised internationally. For instance, the European tax-benefit micro simulation model Euromod, combined with the income generation model presented here could be used to estimates similar types of net private and fiscal returns across Europe. Also, using larger datasets could also help develop the methodology behind these estimations, possibly correcting for any potential endogeneity bias present.

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TABLES AND FIGURES

Table 1a: Transformation of the education variables for Living in Ireland survey.

Level of education attained	Number of years taken
No Education beyond Primary	6
Primary Cert. Or equivalent	8
Some 2nd. Level	9
Junior or Inter Certificate.	11
Leaving Certificate.	13
Post Leaving Certificate	14
Diploma	15
Primary Degree	16
Higher Degree	18

Source: Living in Ireland Survey

Note: These figures are approximations. The numbers denoted here are the typical times taken to achieve that qualification.

Table 1b: Distribution of years of education for Ireland (Sample: those aged over 16 not in full time education)

Number of years taken of education	Proportion of Sample
6	4.08%
8	11.71%
9	8.02%
11	21.27%
13	26.59%
14	4.83%
15	9.98%
16	7.53%
18	5.98%

Source: Living in Ireland Survey (2000)

2: Individual social welfare amounts and income tax rates in Ireland for selected years between 1987-2005(all € amounts are in 1987 prices)

Scheme	1987(€)	1994(€)	2000(€)	2005(€)	2011(€)	% Real growth rate 1987-2011
Unemployment Benefit	69.97	74.38	86.49	106.97	104.4	49.21
Contributory Old age Pension	0.00	0.00	79.74	97.66	127.9	N/A
Carer's Benefit	53.72	63.90	69.82	88.77	113.87	111.97
Disability Benefit	53.72	61.43	69.82	88.77	104.4	94.34
Non-Contributory Old age Pension	59.82	63.90	77.03	99.03	121.65	103.36
Lone Parent Allowance	73.40	61.43	69.82	88.77	104.4	42.23
Unemployment Assistance	48.00	61.43	69.82	88.77	103.21	115.02
Child Benefit	19.11	20.95	31.09	78.51	77.77	306.96
Tax Rates						
Rate 1	35%	27%	22%	20%	20%	N/A
Rate 2	48%	48%	44%	42%	42%	N/A
Rate 3	58%	.	.	.	.	.

Source: Department of Social and Family Affairs (1998, 2001 and 2006).

Note: Social welfare amounts are in current prices converted to Euro using the Euro/IR punt exchange rate where necessary

Table 3: Expenditure per student in 1987-2011 by level of education and public/private share

Year	Primary		Secondary		Tertiary	
	Private (€)	Public (€)	Private (€)	Public (€)	Private (€)	Public (€)
1987	59	1425	96	2319	1620	3780
1994	68	1629	110	2651	1851	4321
2000	129	3111	177	4263	2228	8384
2005	187	5668	245	7419	1711	8986
2011	126	6168	175	8351	2295	10847

Source: OECD, 1997-2008

Note: all the figures presented here are in current prices

Table 4: Average net private and fiscal marginal returns to education for Ireland with selected tax benefit years 1987-2011

Tax/benefit Year	Private	Fiscal
1987	9.0%	8.9%
1994	9.3%	8.4%
2000	11.2%	6.2%
2005	11.0%	7.2%
2011	7.1%	8.9%

Source: Author's Calculations – *Living in Ireland Survey*, (2000).
Note: This sample includes all those aged over 16 and not in full time education

Table 5: Decomposition of average net private marginal returns to education (in %)

Tax/benefit Year	**Market Effects**				**Policy Effects**		
	Earnings effect A	+Employment effect	+ pensions C	+ capital income D	+taxes E	+benefits F	+ SIC G
1987	9.6	14.3	17.4	17.5	10.1	9.5	9.0
1994	9.0	13.4	16.3	16.4	10.3	9.7	9.3
2000	9.6	14.3	17.4	17.5	12.1	11.5	11.2
2005	9.3	14.2	17.3	17.4	12.1	11.2	11.0
2011	8.6	13.0	15.9	16.0	8.6	7.5	7.1

Source: Author's Calculations – *Living in Ireland Survey*, (2000).

Note: SIC indicates social insurance contributions

Note: The tax element includes income tax levies and the universal social charge introduced in Ireland in 2011

Table 6: Decomposition of average fiscal marginal returns to education across earnings effect and employment effect (in %)

Tax/benefit Year	Taxes A		+ benefits B		+ SIC C	
	Earnings effect only	+Employment effect	Earnings effect only	+Employment effect	Earnings effect only	+Employment effect
1987	5.5	6.8	6.0	7.6	6.9	8.9
1994	5.1	6.3	5.8	7.2	6.6	8.4
2000	3.7	4.4	4.2	5.0	5.0	6.2
2005	3.9	4.7	4.7	5.8	5.8	7.3
2011	5.7	6.6	6.5	7.5	7.5	8.9

Source: Author's Calculations – *Living in Ireland Survey*, (2000).

Note: SIC indicates social insurance contributions

Note: The tax element includes income tax levies and the universal social charge introduced in Ireland in 2011

Table 7: Average net private and fiscal marginal returns to education for Ireland with selected tax benefit years 1987-2011 across gender

Tax/benefit Year	Private		Fiscal	
	Male	Female	Male	Female
1987	9.1%	8.9%	9.7%	8.1%
1994	9.5%	9.2%	9.3%	7.6%
2000	11.3%	11.2%	7.0%	5.4%
2005	11.3%	10.7%	8.0%	6.5%
2011	6.0%	8.2%	10.8%	7.1%

Source: Author's Calculations – *Living in Ireland Survey*, (2000).
Note: This sample includes all those aged over 16 and not in full time education

Table 8: Average net private and fiscal marginal returns to education for Ireland with selected tax benefit years 1987-2011 across age groups

	Private			Fiscal		
Tax/benefit Year	Age Groups			Age Groups		
	Aged 16-29	Aged 30-49	Aged 50-65	Aged 16-29	Aged 30-49	Aged 50-65
1987	5.3%	8.6%	13.0%	5.2%	9.4%	11.9%
1994	5.4%	8.9%	13.3%	4.8%	8.9%	11.4%
2000	6.5%	11.1%	15.7%	3.5%	6.4%	8.7%
2005	6.1%	11.0%	16.0%	4.5%	7.5%	9.4%
2011	4.9%	7.2%	10.1%	4.8%	9.1%	11.7%

Source: Author's Calculations – *Living in Ireland Survey*, (2000).
Note: This sample includes all those aged over 16 and not in full time education

Appendix A: List of estimations performed in income generation model

Table A1: List of Estimations Performed in Income Generation Model

Model Estimated	Specification	Sample	*Regressors*
Is an individual in work or out of work?	logit	those >=16 years of age and not in education	*Experience, experience^2, yrs of education, marriage dummy, regional dummies, no. of children and disability dummy.*
Are those that are in work in employed work or not?	logit	those >=16 years of age, not in education and in work	*Experience, experience^2, yrs of education, marriage dummy, regional dummies, and no. of children.*
Whether those out of work are retired or not.	logit	those >=50 years of age and out of work	*Experience, experience^2, yrs of education, marriage dummy, regional dummies, and no. of children.*
Whether those out of work are classed as unemployed or not	logit	those >=16 and <=64, years of age, not in education, out of work and not retired	*Experience, experience^2, yrs of education, marriage dummy, regional dummies, and no. of children..*
Whether those out of work receive invalidity benefit.	logit	those >=16 years of age, not in education, and out of work	*Experience, experience^2, yrs of education, marriage dummy, regional dummies, and no. of children.*
Whether those receiving invalidity benefit receive for short term or long term.	logit	Those >16 years of age and receiving some form of invalidity benefit	*Experience, experience^2, yrs of education, marriage dummy, regional dummies, and no. of children.*
Are employees in public service or not?	logit	those >=16 years of age, not in education, in work and employed	*Experience, experience^2, yrs of education, marriage dummy, regional dummies, and no. of children.*
The no. of hours worked by an individual.	OLS	those >=16 years of age, not in education and in work	*Experience, experience^2, yrs of education, marriage dummy, regional dummies, and no. of children.*
Whether an individual has an contributory pension or not.	logit	those >=65 years of age and not in work	*Age, age^2, yrs of education, marriage dummy, regional dummies, and no. of children.*
Whether an individual has	logit	those >=65 years of age and not in	*Age, age^2, yrs of education, marriage dummy, regional dummies, and no. of*

occupational pension income or not.		work	*children.*
The level of income from an occupational pension income.	OLS	Those >=65 years of age and in receipt of occupational income	*Age, age^2, yrs of education, marriage dummy, regional dummies, and no. of children, duration in work (in years)*
Whether an individual is contributing to an occupational pension.	logit	Those >=16 and <=65 years of age and working as an employee	*Age, age^2, yrs of education, marriage dummy, regional dummies, and no. of children, duration in work (in years)*
The level of occupational pension contributions.	OLS	Those >=16 and <=65 years of age and contributing to an occupational pension	*Age, age^2, yrs of education, marriage dummy, regional dummies, and no. of children, duration in work (in years)*
The level of employee earnings.	OLS	All those >=16 years of age, not in education, in work and employed	*Potential experience, potential experience^2, yrs of education, regional dummies.*
The level of self employed earnings.	OLS	those >=16 years of age, not in education, in work and self employed (not farming)	*Potential experience, potential experience^2, yrs of education, regional dummies.*
The level of farming income.	OLS	those >=16 years of age, not in education, in work and in farming	*Potential experience, potential experience^2, yrs of education, regional dummies.*
Whether an individual has capital income or not.	logit	those >=16 years of age and not in education	*Age, age^2, yrs of education, marriage dummy, regional dummies, and no. of children, total work income.*
The level of capital income.	*OLS*	*those >=16 years of age, not in education and with capital income*	*Age, age^2, yrs of education, marriage dummy, regional dummies, and no. of children, total work income.*

Appendix B: Selected income generation model estimations

Table B1: Results of in/out of work logit model

Variables	Males		Females	
In/out of work dummy	Coefficient	*p*-value	Coefficient	*p*-value
Years of Education	0.11	0	0.20	0
Marriage Dummy	0.10	0.20	-0.091	0.26
No. of Children	0.17	0	.019	0.543
Dublin	-0.15	0.17	0.327	0.004
Mid-Eastern region	0.009	0.94	0.16	0.242
Midlands region	0.38	0.008	0.18	0.209
Mid-West region	0.064	0.63	0.273	0.051
South-East region	0.227	0.06	0.423	0.001
South-West region	-0.466	0	-0.092	0.453
Western region	-0.016	0.89	-0.13	0.35
Potential Experience	0.058	0	0.056	0
Potential Experience^2	-0.0012	0	-0.0015	0
Chronic Illness Dummy	-1.38	0	-1.67	0
Constant	-1.7	0	-3.13	0
Observations	5352		Observations	5318
R-squared	0.166		R-squared	0.15

Table B2: Results of employee earnings OLS model

Variables	Males		Females	
Log monthly gross earnings	Coefficient	*p*-value	Coefficient	*p*-value
Years of Education	0.052	0	0.74	0
Potential Experience	0.062	0	0.021	0
Potential Experience^2	-0.001	0	-0.0005	0
Dublin	0.201	0	0.039	0.54
Mid-Eastern region	0.088	0.15	-0.02	0.7
Midlands region	0.064	0.3	0.019	0.82
Mid-West region	0.02	0.7	-0.052	0.51
South-East region	-0.05	0.4	-0.132	0.08
South-West region	-0.013	0.8	-0.06	0.37
Western region	0.016	0.7	-0.01	0.8
Inverse Mill's ratio	-.95	0	.2	.625
Constant	9.2	0	8.84	0
Observations	2056		Observations	1778
R-squared	0.329		R-squared	0.25

Source: Author's Calculations – *Living in Ireland Survey*, (2000)

Note: The in/out of work dummy is specified with 1 = in work and 0 = out of work

Note: The marriage dummy is specified with 1 = married and 0 = not married

Note: The Chronic illness dummy is specified with 1 = having a chronic illness and 0 = not having a chronic illness

Note: The border region of Ireland is used as the base category for the regionally dummies

Note: The sample specifications are outlined in table A1

Table B3: Results of self employed earnings OLS model

Variables	Males		Females	
Log monthly gross earnings	Coefficient	*p*-value	Coefficient	*p*-value
Years of Education	0.07	0	0.08	0.44
Potential Experience	0.027	0.01	0.019	0.4
Potential Experience^2	-0.0004	0.05	-0.0006	0.26
Dublin	0.62	0	0.46	0.3
Mid-Eastern region	0.51	0.009	0.59	0.24
Midlands region	0.178	0.4	0.44	0.4
Mid-West region	0.3	0.13	0.68	0.24
South-East region	0.41	0.02	0.75	0.1
South-West region	0.24	0.19	1.55	0.005
Western region	0.25	0.2	0.94	0.09
Inverse Mill's ratio	-1.05	0	1.9	.233
Constant	8.25	0	8.2	0
Observations	305		Observations	74
R-squared	0.14		R-squared	0.21

Source: Author's Calculations – *Living in Ireland Survey*, (2000)

Note: The border region is used as the base category for the regionally dummies

Note: The sample specifications are outlined in table A1