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The Determinants of Higher Education Participation in Ireland: A Micro Analysis

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Abstract: In this paper we present a theoretical model of higher education participation in Ireland. Utilising the Living in Ireland Survey data we model the impact of costs (direct and indirect), the estimated life cycle returns, environmental and parental influences and also household credit constraints on the higher education participation decision. We find that foregone earnings and youth employment rates have a negative impact on this decision; this suggests weaker labour markets for young people may have a positive impact on higher education participation. The insignificance of credit constraints in the shape of household income and maintenance grant eligibility from our estimations can also help draw some tentative policy conclusions. Our results also show that life cycle returns and parental educational level may influence participation in higher education in Ireland.

I INTRODUCTION

The participation of young people in Ireland in higher education over the past ten to fifteen years has grown considerably. The number of full-time students in third level increased from 86,624 to 115,696 from the period 1994 to 2000, and reaching 136,719 by 2006 (data provided by the Department of Education and Science). While growing incomes and helpful policy changes in this period may have impacted on this participation increase, there is no

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comprehensive study that analyses the factors affecting the decision by young people to attend third level education. The aim of this paper is to fill this gap and construct an educational choice model which considers an individual's decision whether or not to invest in higher education in Ireland.

In Ireland there are three main tiers to the education system, primary, secondary and third level. The structure of the system is summarised in Table 1. Tertiary education comprises Universities and Institutes of Technology, with a competitive system based entirely on grades achieved at the end of the upper secondary level (Leaving Certificate) being the main entry mechanism into this level. Students can attain degrees in both Universities and Institutes of Technology, but the entry level in the latter is primarily at the sub-degree level. Of the 136,719 full-time students in higher education in Ireland in 2006, 59 per cent of them were in the university sector, 39 per cent were in institutes of technology, with the remaining 2 per cent in other colleges such as colleges of education (Department of Education and Science). O'Connell *et al.* (2006) use data on new entrants to higher education in 2004 to show that 40 per cent of new entrants to higher education are studying business, law or engineering. These three fields of study account for over 50 per cent of all male entrants, while areas of study such as humanities and health related fields are more popular with females. This is reflected in the gender breakdown of universities and institutes of technology in Ireland as females have consistently higher numbers in universities relative to males, while males outnumber females in the institutes of technology. This could stem from the fact courses in the areas

Table 1: *Structure of Irish Educational System*

	Ages	*Status*
Primary education		
Duration: 8 years	5-12	Compulsory
Secondary education		
1: Lower Secondary	13-15	Compulsory
Duration: 3 years		
2: Upper Secondary	16-18	Non-compulsory
Duration: 2-3 years		
Tertiary education		
1: Institutes of Technology	18-20	Non-compulsory
Duration: 2-3 years		
2: Universities	18-22	Non-compulsory
Duration: 4 years		

Source: Department of Education and Science.

of health and humanities are more prevalent in the university sector while engineering courses are more common in institutes of technology. The majority of third level institutions in Ireland are supported by government subsidies with the Irish government spending equivalent to 1.1 per cent of GDP on tertiary education in 2002 (OECD, 2006). The private sector of Irish tertiary education is quite small and is mainly concentrated in Dublin with private expenditure on tertiary education in Ireland reaching a level equivalent to .2 per cent of GDP in 2002 (OECD, 2006).

This increase in higher education participation in Ireland in the past fifteen years has come against a backdrop of both a booming economy and important educational policy changes. The economic growth of Ireland is this period is well documented, with regard to educational policy the biggest change came with the abolition of third level tuition fees in 1996. Tuition fees for higher education existed in Ireland for the first two years of our reference time period, with students facing fees of up to €2,500 depending on their course of study. The Irish government abolished tuition fees in 1996, following the recommendation of the De Butleir report (1993), however a "registration fee" still applied which stood at €190 (IR£150) in 1996, rising to €396 (IR£312) by 2001.

A key aim of the introduction of free tuition fees was to help bring more equality into participation in third level education in Ireland. However, studies conducted both before and after the introduction of this initiative highlight the social inequality of higher education participation in Ireland. Clancy (1997 and 2001) using data on college entrants shows that those going on to third level education come predominantly from areas of higher social classes such as professional and managerial areas. O'Connell *et al.* (2006) use a similar methodology to arrive at the same conclusion with higher social group populations having a disproportionate percentage of third level admissions relevant to their population size.

Whelan and Hannon (1999) examined the role class origins had in the transition to various levels of education, finding that the transition from upper secondary education to completing third level education is significantly affected by parental social class. Using the 1994 sample of the Living in Ireland Survey, they show that coming from a lower social class being associated with a lower probability of achieving a higher level qualification. Smyth (1999) uses the Annual School Leavers' data from the period 1979-1994. Here the author concludes that over the sample time frame social class inequality in relation to participation in third level education has remained virtually constant.

These studies show a measure of social inequality exists in the Irish higher educational system, indicating that there are factors that give young

people from higher social classes a greater chance of entering third level education in Ireland. One reason for this could be level of household income; however, Ryan *et al.* (2007) reject this. This study uses Household Budget Survey data from 1995 and 2000 to analyse the characteristics of households that have a member participating in higher education in Ireland. Eligibility for financial support in the form of a grant and factors such as cultural capital are seen as important in determining the participation of a household member in higher education and not household income levels. However, these estimations may suffer from omitting any variables regarding expected returns and costs.

Much theoretical and empirical work, carried out internationally has attempted to understand the type of factors that may impact on a young person making the transition from second level education to a third level institution.[1] Some of these studies highlight the role of the benefits and costs and associated with third level education impacting on young people's decision whether to attend third level education or not. The benefits are seen as the potential extra lifetime earnings from higher education, while costs are both direct and indirect. The direct costs include tuition fees while the main indirect cost looked at is the foregone earnings individuals experience while in higher education. Sociological and economic factors such as parent's education level, extended social environment and household income are also analysed as possible influences on the higher education participation decision.

In this paper we employ a choice model approach to map the key influences on the decision to participate in higher education or not factoring in the impact of the expected benefits and costs and also investigate the role of various economic and social factors in the participation decision.

In the next section we will outline our theoretical model for the decision to attend higher education, we also utilise the relevant literature to support this model in this section. In Section III we provide a summary of the data to be used and outline the methods undertaken to construct our variables. We then present our results from applying this model to our data and conclude.

II THEORETICAL MODEL

A Model of Higher Education Participation

We have seen that in an Irish context, the analysis of the higher education participation decision is limited to providing social class as an influential

[1] See Wilson (2005); Lauer (2002); Dubois (2002); Albert (2000), Hung *et al.* (2000); Hilmer (1998) and Brannstrom (2007) for the most recent work in this area.

factor. In this section we will adopt a life cycle model of the education participation decision. We will also utilise the existing literature relevant to the participation decision to rationalise the theoretical framework.

The life cycle nature of the education decision was first outlined with the work of Mincer (1958) Becker (1964) and Ben Porath (1967), which identified the link between the life cycle of earnings and an individual's investment in human capital, so that the investment decision in human capital will be based on expected returns and costs of that investment. In the context of a decision to undertake higher education, these returns are the extra lifetime income earned from having a higher education level. The costs involved are the direct cost of the education itself (fees, books etc.) and also the cost associated with the foregone labour market earnings from choosing to go to education. In this paper we will use a variant of the educational life cycle model used by Card (2001a).

In our model, we assume that individuals have an infinite planning horizon that begins at the age (t=0). They accumulate a flow of utility in period t that depends on consumption c(t) in period t, which depends on whether they are in education or out of education. Life cycle utility, conditional on education S and a given consumption profile is

$$V(S,c(t)) = \int_0^S (u(c(t) - \phi(t)))e^{-\rho t}\, dt + \int_S^\infty u(c(t))e^{-\rho t} dt \qquad (1)$$

where $u(\ )$ is an increasing concave function. We also assume that individuals discount future utility flows at a subjective discount rate, ρ and make a once for-all decision on when to leave education. The term $\Phi(t)$ is a convex function that captures the relative disutility of being in education to other possible outcomes such as working that individuals may have.

This is subject to the inter-temporal budget constraint

$$\int_0^\infty c(t)e^{-Rt} dt = \int_0^S \left[F(t) - T(t) - A(t)\right]e^{-Rt} dt + \int_S^\infty y(S,t)e^{-Rt} dt \qquad (2)$$

Where $y(S,t)$ indicates earnings at age t of an individual who has completed S years of post secondary education while $T(t)$ represents tuition costs at time t. $F(t)$ is included to capture any financial aid that an individual may receive while in education, while $A(t)$ any costs relating to spatial distance from educational facilities which may play a role in the decision to participate in education, including transportation costs and possible extra living costs. We assume individuals can borrow or lend freely at fixed rate R.

We can show that the derivative of lifetime utility with respect to schooling[2] is

$$\lambda e^{-RS}\{MB(S) - MC(S)\} \tag{3}$$

where λ is the Lagrangean multiplier associated with the lifetime budget constraint and MB(S) is the marginal benefits of extra education which is shown as

$$\text{MB(S)} = \int_{S}^{\infty} \partial y(S,t)/\partial S) e^{-Rt} dt \tag{4}$$

This represents the extra lifetime earnings expected from the additional time spent in education. Meanwhile the cost of extra education MC(S) can be seen as

$$y(S,S) + T(S) + A(S) - F(S) + 1/\lambda e^{-(\rho - R)S}\ \phi(S) \tag{5}$$

These terms represent forgone earnings, tuition fees and spatial costs of education, minus any financial aid received while in education. We also see that the marginal cost of extra education dependent on preferences for education captured by the (dis) utility function. Represented by the term at the end of the MC(S) equation, this is the euro equivalent of the relative disutility of schooling in period S. The optimal educational decision will be made when MC(S) = MB(S), so this implies that if costs are large and marginal benefits are low educational participation will be low, with the opposite scenario for costs and benefits bringing about high participation.

The international literature supports these theoretical foundations as Willis and Rosen (1979) show the positive influence of expected gains in lifetime earnings in young people's decision to attend college. Using data on male World War II veterans, they use a probit analysis to highlight the role on expected income gains. Mattila (1982) uses a time series approach to outline that variations in American college enrolments can be explained by the changing rate of return to a college education, with higher rates of return associated with higher enrolment rates. Both Lauer (2002) and Wilson (2005) use micro level data to investigate the role of expected lifetime earnings on the decision to attend post secondary education. Their findings also support the role of higher expected lifetime earnings in the educational participation

[2] The workings of this are presented in Appendix A.

decision. Expected income returns from extra education play a positive role on the participation decision in both papers.

Foregone earnings due to participating in education represent an extra opportunity cost to the individual undertaking education and so we would expect a higher level of foregone earnings to be associated with lower participation. Fuller *et al.* (1982) and Dubois (2002) also found this result using predicted wages of potential higher education participants as a measure of the opportunity cost of attending university.

Tuition fees provide another cost to the individual wishing to participate in education and so higher levels of fees would be expected to have a negative impact on participation. Leslie and Brinkman (1987) complied results from 25 previous studies that investigated the responsiveness of higher education students with changes in tuition fees. They transformed each of these studies to conform to one single methodology and discovered that increasing tuition costs had a negative effect on college enrolment. Heller (1997) provides an update to this work and provides the same results. An increase in tuition fees impacts on an individual's third level education participation in a negative manner.

Costs relating to spatial distance from educational facilities also play a role in the decision to participate in education A(t), including transportation costs and possible extra living costs. This is most relevant when looked at in an urban-rural context. Those living in a rural setting will face these extra costs as the majority of higher education facilities are located in urban areas. The magnitude of these costs may play a role in the educational participation decision, especially in an urban-rural context. Frenette (2006) found that larger travel distances impact negatively on university participation in Canada, with students in upper secondary education that live further away from third level institutions having a lower probability of enrolling in these universities. However Frenette does not look at the role of spatial cost factors explicitly. James (2001) points to social factors within rural communities that negatively impact the educational participation decision. He acknowledges the role of extra financial burdens such as rural living and higher education participation but fails to find any link between the two. Instead he points to social preferences in rural areas that may have a negative impact on people's educational decisions in these areas.

Financial aid F(t) in the budget constraint will offset some of the cost burden imposed by the tuition fees T(t) and spatial costs A(t). Heller (1997) reviews the literature on the impact of financial aid on higher education participation and finds that educational grant variations impact on the educational decisions of young people; reductions in the amount and availability of educational grants have a negative effect on the participation decision.

A disutility term appears in our objective function which attempts to capture the fact that individuals may have varying preferences for staying in education. This term may increase or decrease the marginal cost associated with an extra year's education and, therefore, have an effect on the participation decision. The reasons behind varying preferences for education across individuals can be wide-ranging; two possible explanations are an individual's parental education level and/or social environment.

An individual with higher parental educational attainment may show stronger preferences for education, because they may have first hand experience of the gains of higher education through their parents and so order their educational preferences accordingly. Also a positive role model effect may occur, where individuals with higher parental education may use their parents as role models and make their education decisions with this influence. Neighbourhood and cohort effects may also impact on the relative preference for education for an individual. The level of (dis) advantage experienced in neighbourhood peer groups may impact upon a person's preference ordering involving educational/labour choices. An individual's beliefs or expectations of the gains of higher education may be influenced by their secondary social environment.

Osterbeek and Van Ophem (2000) construct a structural model of educational choice to include this differing educational preference into the educational choice. They employ a utility function including a variable to capture the relative (dis)taste for schooling. They find that preferences for education do vary with respect to social background. A higher maternal educational level is associated with a greater preference for education for children. Card (2001b) also notes the possible impact of parental educational level on the child's preference for education in his model of schooling choice. Albert (2000) highlights the role of the parent's education level in the demand for higher education in Spain. The educational attainment of the mother in the household is shown to be particularly significant, with higher levels of maternal education associated with a higher probability of entering third level education for children. Black *et al.* (2005) dispute this hypothesis. They suggest that while OLS estimates indicate a strong relationship in the two, a casual relationship between intergenerational transfers of educational attainment does not exist. The exception being among mothers and sons, where the maternal educational level was shown to have a casual effect on the son's educational attainment.

With regard to environmental factors, the spatial concentration of youths from less advantaged households in particular neighbourhoods may imply a range of factors that would cause a lower preference for education. Stufert (1991) presents a theory of role model to explain why young people's

educational decision making may be affected by neighbourhood composition. The assumption is made that children infer the returns to education by examining the outcomes of adults in their neighbourhood and then base their educational decisions on this information. Therefore, a young individual who lives in a disadvantaged area may not see the real potential returns to education by looking at adult outcomes in his neighbourhood, and so lower his preference for education. Brannstrom (2007) reinforces this theory as he notes that insufficient educational information may lead to lower educational aspirations and so a greater preference for outcomes other than education. However, evidence from his empirical work suggests that individual specific neighbourhood effects do not impact greatly on higher education participation for young people in Sweden. Sanbonmatsu *et al.* (2006) find that changes in neighborhood environments do little to impact on the academic achievement of young people while Overman and Heath (2000) find that teenagers are more likely to dropout of secondary education if the average dropout rate in their neighbourhood is high, indicating neighbourhood effects having some measure of impact on educational outcomes.

The assumption of perfect capital markets within the model may be relaxed to acknowledge the role of differing capital constraints. This is related to the discussion of financial aid for educational participation seen above. Individuals who come from a household of low income may face difficulties in financing participation and so face a higher R. They may have poor access to credit and so participation in education may be too costly, as we saw above financial aid may help to offset this. However, if we are faced with a situation of imperfect capital markets, household income may play a major role in the decision to participate in education or not. The role of household or parental income on a child's educational decisions is a topic that has generated a great deal of debate in the empirical work carried out.

Haveman and Wolfe (1995) provide a survey of the literature and conclude that lower parental income levels do result in lower educational outcomes for their children. Therefore, by implication we can suggest that households with lower income will have a negative impact on a young person's decision to participate in education. Ackemoglu and Pischke (2001) support these findings using change in the distribution of family income to estimate the impact of parent income on their children's education. They find that an increase in family income is associated with a higher probability of a child participating in higher level education. Cameron and Heckman (1999) dispute the impact of credit constraints faced by lower income families on educational outcomes. While they acknowledge the negative impact of lower household's incomes on educational participation, they maintain that it is not as a result of short-term credit constraints but rather due to more long-term factors. They believe that

family income level influences higher education participation by impacting the ability and college-readiness of children and its key role is not in financing college education.

The condition of the labour market may also be an influence on the educational participation decision with a person having a greater likelihood of staying in education when the labour market is depressed, Gustman and Steinmeier (1981), Light (1995), Rice (1999) and Giannelli and Monfardini (2003). This is related to the opportunity costs associated with entering higher education. If there are many jobs opportunities for young people leaving upper secondary they may wish to take advantage of this and reject participating in third level education.

III STATISTICAL MODEL AND DATA

Data

The data used in this paper comes from the Living in Ireland Survey. This survey is a household panel dataset which ran from 1994 to 2001. It contains a variety of 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.[3] We have also included a model in the paper that includes an alternative attempt to correct for any possible attrition bias.[4]

The data contains information on the current activities of the individuals within the household and as such we are able to identify the persons in education. We can also identify what type of education these individuals are currently undertaking. The Living in Ireland survey contains information on the type of education being pursued by individuals in the following categories:

[3] All models (wage estimations and participation estimation) in the paper are based on weighted data. Sample weights are used which attempt to compensate for any biases in the distribution of characteristics in the completed survey sample compared to the population of interest, whether such biases occur because of sampling error, from the nature of the sampling frame used, differential response rates or attrition, for more detail on these weights see Watson (2004).

[4] More details of this are provided in the next section.

- Third level post-graduate degree.
- Third level (primary degree, diploma level or certificate level).
- V.P.T. or P.L.C. Course.
- Leaving Certificate.
- Junior Certificate.
- Primary.

In our analysis we wish to investigate those people who are eligible to attend third level education in a given year. To this end, we group the two levels of education involving third level primary degree and other third level education as a generic third level education variable.[5] We do not include post-graduate level education in this as the choice to pursue this level of education is different to the choice of initial higher education entry and so may not be based on the same factors.

The Living in Ireland Survey also has information on those in employment such as their earnings and highest education level achieved. There is a spatial element to the data with the individuals and households in the dataset separated into ten NUTS3 regions of Ireland. The data can also be divided along an urban/rural divide based on the size of the location. The survey also helps with regard to intergenerational analysis as it provides information on the parent's of the individuals questioned in the survey.

Another feature of the survey is that it asks questions relating to the sociological environment surrounding each household. These questions look into issues such as vandalism and crime in the surrounding area and so provide an insight into some of the social problems that may affect some neighbourhoods in the survey.

Sample

For our sample we identified the individuals (17 to 22 years old) in the sample that were faced with the decision to participate in higher education at some stage in the panel. The sample consists of young people as we do not wish to capture adult or mature entry into higher education as these individuals are likely to have different preferences and factors that influence their entry. The decision for adults to participate in higher education may involve a greater range of occupational choices and be influenced by factors not presented in our theoretical model and so they are not of interest to this paper.

The individuals that were faced with the decision to participate in higher education are defined as those that were not in higher education in the

[5] The decision not to segment this variable into two separate variables representing Universities and Institutes of Technology respectively is due to data restrictions.

previous wave but are currently in higher education, and also those that were in upper secondary one year, and then absent from education the following year. We therefore discount the individuals in wave one as we do not have information on their education status in the previous year. We, remove, all individuals that have not responded to any questions relating to the variables we will use. The most prevalent of these is household income.[6] This left us with a sample of 1,078 individuals from across seven waves of the panel. The age distribution of these individuals can be seen in Table 2.1 with the majority of our sample concentrated in the 18 and 19 year old age groups. The next step was to identify within this sample the individuals that proceed to higher education and those that did not. The simple use of a binary choice variable was enabled to distinguish between the two groups. The distributions of these across age can be seen in Table 2.2.

With this sample frame we will construct a statistical model based on the theoretical model outlined above. The educational outcomes of individuals will be a function of educational costs (direct and indirect), the estimated life cycle returns, environmental and parental influences and also household credit constraints.

Table 2.1: *Individuals Aged 17-22 Years that had the Opportunity to Participate in Higher Education*

Age	*Female*	*Male*	*Total*
17	72	78	150
18	218	249	467
19	150	154	304
20	36	55	91
21	15	23	38
22	15	13	28
Total	506	572	1,078

Source: Author's Calculations – Living in Ireland Survey (1995-2001).

Direct Costs and Opportunity Costs

In looking at the impact of tuition fees our dataset is limited. It does not contain any information on the type of course taken by the individuals that are in higher education (i.e. whether it is in commerce, medicine, arts etc.). Tuition

[6] As household income is an important factor in our model the removal of such individuals may raise concerns regarding sample selection, however, the number of individuals removed by this process is 25 and so may be considered too small to impact hugely in sample selection. Also a table of these individuals by equivalised income deciles based upon nearest lagged income level is presented in Appendix B, this suggests these individuals may be distributed quite evenly across income levels and sample selection may not be an issue.

Table 2.2: *Distribution of Participating in Higher Education by Age*

Age	*Not in Higher Education*	*In Higher Education*	*Total*
17	85	65	150
18	260	207	467
19	160	144	304
20	61	30	91
21	19	19	38
22	11	17	28
Total	596	482	1,078

Source: Author's Calculations – Living in Ireland Survey (1995-2001).

fees for higher education (before they were abolished) were based upon the type of course being pursued and so an exact analysis of the impact of tuition fee levels is not possible. However, we do have information on the yearly levels of tuition fees across courses on a national basis for Ireland for both Universities and Institutes of Technology. We also have the percentages of students taking each type of course in both institution types for every year. With this we constructed a weighted average tuition fee faced by an Irish student when making the decision to enter higher education. This weighted average fee varies over time as tuition fees were abolished with students only required to pay a student registration fee after 1996. This registration fee also carries some annual variation as it has increased every year since its introduction.

With regard to financial aid in the form of higher education grants, again our data limits our analysis. In Ireland, grant eligibility is based on household income, with the level of grant based on distance from the higher education institution and number of children in the household. As we do not have any relevant distance related data, we cannot incorporate the level of these grants into our model. However, we can incorporate some grant eligibility variation based on household income and number of dependent children in the household. We use this information to construct a dummy variable to indicate whether an individual would be eligible for any form of maintenance grant while in higher education.[7]

To capture the role of labour market effects we derive a regional youth employment rate and include it in our statistical model. This is represented as the percentage of those under 25 that are in employment (expressed as a percentage of those not in education) in an individual's region.

[7] A positive outcome for this variable indicates the individual is eligible for either a full or partial maintenance grant.

We also consider the foregone earning of entering third level education; this represents an indirect cost on behalf of the student while they are in education. Foregone earnings for those faced with the decision to enter higher education can be seen as the income they would have expected to gain if they had gone into the labour force minus the expected income from any work while in education.

The data does not provide these expected earnings and so separate wage equations were estimated for the labour market earnings and student earnings, for both males and females. Sample selection bias may be a problem in our data and so we follow the two stage estimation process outline by Heckman (1979) to obtain our wage predictions.

$$EMP_t = X_{1t}\,\beta_1 + U_{1t} \tag{6}$$

$$Y_t = X_{2t}\,\beta_2 + U_{2t} \tag{7}$$

Equation (6) represents the probability of individual t working in relation to being unemployed or inactive. We estimate this for male and female separately, with two different samples. The first simply represents young people with an upper secondary education, while the second involves young people in third level education. We derive an inverse mills ratio for each of these models and include them in our wage regression, represented by Equation (7). The dependent variable in our wage equation for both labour market earnings and student earnings is log of monthly earnings, while explanatory variables are age, regional dummies, and time dummies. This reduced form wage estimations provides us with predictions of post secondary school earnings and potential earnings while in higher education for each individual with variation for both coming across gender, age, regions and time. The results can be seen for both male and females separately, and for both students and non-students in Tables 3 and Table 4 respectively.

The measure of foregone earnings will simply be

$$E(e_{LM}) - E(e_{STU})$$

Where $E(e_{IM})$ is the expected earnings in the labour market while $E(e_{STU})$ is the expected earning while in education. For those in the labour market full time, we use actual earnings as the first term, while actual student earnings are used for those in education and work.

Earnings Differential

A key benefit to higher education is the extra lifetime income a person may earn due to their higher educational achievements. The basic human capital

Table 3: *Earnings Equation (Sample: Workers and Unemployed Aged 17-22 Years that have an Upper Secondary Education)*

Variables	*Males*		*Females*	
Log monthly earnings	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Age	0.013	0.96	0.0098	0.98
Age2	0.0016	0.79	0.0008	0.9
Dublin	–0.049	0.05	0.18	0.064
Mid-Eastern region	–0.087	0.4	0.19	0.09
Midlands region	–0.071	0.41	0.036	0.7
Mid-West region	–0.16	0.08	0.13	0.23
South-East region	–0.19	0.05	–0.24	0.05
South-West region	–0.100	0.26	0.16	0.08
Western region	–0.16	0.1	0.17	0.3
Wave2	0.085	0.18	0.016	0.86
Wave3	0.1	0.24	0.17	0.1
Wave4	0.21	0.002	0.07	0.38
Wave5	0.27	0.01	0.25	0.001
Wave6	0.34	0.005	0.12	0.3
Wave7	0.39	0	0.32	0.04
Wave8	0.48	0	0.40	0.05
Inverse Mill's ratio	–0.39	0.2	–0.65	0.35
Constant	5.67	0.1	6.08	0.30
Observations	1,213		Observations	927
R^2	0.20		R^2	0.21

Source: Author's Calculations – Living in Ireland Survey (1995-2001).
Note: The border region is used as the base category for the regional dummies.

model suggests that an individual may expect higher lifetime earnings if he/she obtains a higher as opposed to only holding a second level education and thus this earnings differential may have a positive impact on the higher education participation decision.

We have data on individual's wage and educational levels and so we can use these to construct a viable earnings differential variable. The aim is to generate predicted life cycle earnings with an upper secondary education qualification, and to do the same with a higher education qualification, the difference between the two will give us our life cycle earnings differential.

We again employ the two stage Heckman procedure as seen above for both males and females to construct an estimation of expected life cycle earnings for those with upper secondary education, and those with a third level qualification. Reduced form earnings estimations are again run separately for

Table 4: *Student Earnings Equation (Sample: Students Aged 17-22 Years)*

Variables	*Males*		*Females*	
Log monthly earnings	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Age	1.27	0.05	6.54	0.059
Age2	0.30	0.047	–0.17	0.057
Dublin	1.58	0.077	2.44	0.046
Mid-Eastern region	–1.42	0.065	0.878	0.068
Midlands region	–0.30	0.487	0.804	0.076
Mid-West region	–0.57	0.087	0.77	0.119
South-East region	–0.09	0.822	0.878	0.027
South-West region	–1.17	0.183	1.861	0.015
Western region	–0.23	0.508	1.25	0.001
Wave2	1.14	0.022	–0.0519	0.847
Wave3	0.21	0.62	0.137	0.723
Wave4	2.50	0.038	–0.37	0.334
Wave5	1.56	0.03	–0.462	0.13
Wave6	2.14	0.027	1.444	0.033
Wave7	–1.55	0.094	1.117	0.011
Inverse Mill's ratio	–4.56	0.031	2.138	0.125
constant	19.29	0.041	–2.84	0.081
Observations	101		Observations	134
R^2	0.21		R^2	0.20

Source: Author's Calculations – Living in Ireland Survey (1995-2001).
Note: The border region is used as the base category for the regional dummies.

males and females with years of education,[8] experience,[9] regional and time dummies and social class of parents included as regressors with log monthly earnings as our dependent variable. We first run wage estimations for everybody in the LII dataset aged 25-60 years and obtain wage predictions base on the regressors above, the results of these can be seen in Table 5. We then impose a set level of upper secondary education and restrict age to 25 years on each individual and obtain the expected earnings of each individual

[8] The inclusion of education may introduce endogeneity to the model and returns to education in our estimates may be underestimated. An IV approach may be more suitable but Harmon *et al.* (2000) note that there are many problems associated with an IV approach to estimating education returns. Also as the focus of this variable is attempting to capture life cycle earnings difference between two schooling levels and not the actual estimation of returns to schooling the simple OLS specification is adopted.

[9] This is constructed for each individual by multiplying potential years worked by the regional average working hours of those aged 25-60 years, different averages are constructed across gender and differing educational levels.

Table 5: *Life Cycle Earnings Equation (Sample: All those Aged 25-60)*

Variables	*Males*		*Females*	
Log monthly earnings	*Coefficient*	*p-value*	*Coefficient*	*p-value*
Years of education	0.111	0	0.158	0
Potential Experience	0.055	0	0.020	0.049
Potential Experience^2	–0.0011	0	–0.0006	0
Social Class	–0.010	0.065	–0.043	0.004
Dublin	0.304	0	0.257	0.002
Mid-Eastern region	0.1	0.024	0.132	0.009
Midlands region	–0.024	0.766	0.026	0.651
Mid-West region	–0.048	0.477	0.146	0.059
South-East region	–0.29	0.027	–0.070	0.25
South-West region	–0.013	0.799	0.0009	0.983
Western region	–0.238	0.044	–0.113	0.387
Wave2	0.098	0.005	0.110	0.018
Wave3	0.10	0.007	0.0160	0.656
Wave4	0.170	0.001	0.157	0.001
Wave5	0.286	0	0.168	0.001
Wave6	0.271	0	0.185	0.015
Wave7	0.330	0	0.310	0.002
Inverse Mill's ratio	0.849	0.024	0.342	0.42
constant	4.658	0	4.233	0
Observations	9,556		Observations	7,710
R^2	0.28	R^2	0.24	

Source: Author's Calculations – Living in Ireland Survey (1995-2001).
Note: The border region is used as the base category for the regional dummies.

under the assumption of being aged 25 years with an upper secondary level of education. We then change the years of education variable to reflect a third level education and obtain the expected earnings of each individual under the assumption of being aged 25 years with a third level education. This is carried out to obtain predicted wages for each individual at both possible education levels at five year intervals beginning at age 25 years and ending at age 60 years. This gives us the expected monthly wage levels of each individual at eight different stages of their life cycle with two possible education levels. These eight separate estimations can be average for each individual to obtain an indication of the average predicted monthly income they may receive over the course of their life cycle. The simulated life cycle earnings differential of each individual in our sample is simply their predicted life cycle earnings with a higher education level minus the predicted life cycle earnings with second level education.

Environmental Factors

We now consider the possible impact of an individual's social environment on their participation in higher education. The main area of interest is to investigate the difference between advantaged and disadvantaged areas and the potential influence of living in one of these areas has on an individual's decision making. The level of advantage/disadvantage in an area is seen to impact individual's decision making on a number of levels.

Although the ability to label a social environment in a positive or negative light may traditional be based on factors such as employment rates or income levels, the Living in Ireland Survey provides us with a number of social indicators that will be utilised. The survey asks the respondent about the levels of social disturbance in their areas. The extent of crime, litter, drunken public behaviour and a number of other social indicators are quizzed and provide a good insight into the social environment surrounding each respondent.

An assumption is made that the higher the levels of these social phenomenon, the more disadvantaged an area is said to be. To incorporate the social environment impact into our decision model we first construct dummy variables to indicate whether or not the social unrest indicators above occur in an area. We then use principal component analysis (PCA) on a number of key indicators, levels of drunkenness in public, crime, litter, vandalism. The eigenvalues and eigenvectors obtained are presented in Table 6. This enabled us to use the predicted score from one of these components to develop a variable that captures the variation in social environments. A higher index of this environmental variable would indicate a more disadvantaged social setting and may impact on the higher education participation decision.

Participation in higher education across an urban/rural setting is also included here. We have data indicating the size of the location an individual resides in, this ranges from open countryside to urban settings such as Dublin City. We capture this effect in our model by including a range of dummy variables indicating where an individual lives, for instance for an individual living in Dublin city, the dummy variable Dublin city will indicate 1, it will be 0 for anybody not living in this area. This will help us investigate the possible role a rural setting may have on higher education participation.

Household Factors

We include total net weekly income from all sources within the household in the last year before the participation decision had to be made as a regressor to capture possible credit constraint effects. The expectation would be that households with higher income would have a greater ability to bear the cost of attending higher education and so increase the probability of doing so. The

Table 6: *Principal Component Analysis of Social Environment Variables*

Component	*Eigenvalue*	*Proportion*	*Cumulative*
Component 1	2.66	0.532	0.532
Component 2	0.776	0.155	0.688
Component 3	0.607	0.121	0.809
Component 4	0.533	0.1067	0.916
Component 5	0.418	0.08	1
Observations	85,971		
Rho	0.5327		

	Eigenvectors for Component 1	
Variable	*Comp1*	*Unexplained*
Crime	0.4125	0.5467
Graffiti	0.4501	0.4604
Litter	0.4345	0.4971
Vandalism	0.49	0.3604
Public Drunkenness	0.4454	0.4717

Source: Author's Calculations – Living in Ireland Survey (1995-2001).

greater the number of dependents in the household may also play a role within this. A high number of children in the household would mean income would be spread more thinly and so the cost of attending higher education may become unaffordable for the household. Therefore, we include the number of under-16 year olds in the household in our model.

Parental education level is also included in our statistical model with the expectation that those with parents with a higher education level will have a greater probability of participating in higher education. We use a variable that captures the highest education level achieved by parents in the household with the level of education ranging from primary level to higher degree level. The education level of the mother in the household is used when possible.

As parental education level and household income may act together we include these terms as an interaction term in our model. This will enable us to analyse the impacts of household income and parental education level in a better way. For simplicity of analysis we include these terms in our model as centred variables.[10] A summary of the variables by entry/non entry to higher education is outlined in Table 7.

[10] When we centre a variable, we subtract the mean from each case and then compute the interaction term from these.

Table 7: *Descriptive Statistics of Variables for those that Did and Did Not Enter Higher Education*

Variable	*Those Not in Higher Education*			*Those in Higher Education*		
	Mean	*Min*	*Max*	*Mean*	*Min*	*Max*
Gender (male =1)	0.588	0	1	0.458	0	1
Earnings foregone	223.552	–119.01	793.165	193.25	–117.98	686.69
Regional Youth Employment Rate	0.57	0.34	0.80	0.55	0.34	0.80
Earning differential	475.06	362.319	882.55	452.74	159.87	836.87
No. of children < age 16 in Household	3.7	0	8	3.36722	1	8
Net weekly household income last year	467.21	48.5	1597.83	540.81	12.44	2,000
Educational level of Parent	5.065	0	12	6.763485	1	12
Tuition Fees	356.64	150	726	354.0637	150	726
Grant Eligibility	.374	0	1	.284	0	1
Social environment	0.137	–0.75	6.7	–0.25	–0.75	6.7
Open countryside	0.37	0	1	0.46	0	1
Village	0.09	0	1	0.05	0	1
Town pop (1500-2999)	0.03	0	1	0.03	0	1
Town pop (3000-4999)	0.01	0	1	0.01	0	1
Town pop (500-9999)	0.08	0	1	0.06	0	1
Town pop (>10000)	0.08	0	1	0.11	0	1
Waterford City	0.006	0	1	0.01	0	1
Galway City	0.01	0	1	0.02	0	1
Limerick City	0.01	0	1	0.01	0	1
Cork City	0.05	0	1	0.02	0	1
Dublin City	0.16	0	1	0.12	0	1
Co. Dublin	0.06	0	1	0.06	0	1
Observations	596			Observations	482	

Source: Author's Calculations – Living in Ireland Survey (1995-2001).

As we have seen above, the theoretical model suggests that the decision to participate in higher education will be taken if the marginal benefits of extra education out weight the marginal costs. We have now specified our explanatory variables within this theoretical model with the expectation that higher marginal benefits impact positively on the decision to participate in higher education with the opposite true for marginal costs. We can now test the validity of this model empirically for young people in Ireland using a logit model to estimate our results. This will enable us to observe changes in the probability of participating in higher education due to variation in the

marginal benefits and costs of making such a decision for individuals in Ireland.

Correction for Sample Selection Bias

As noted earlier, as we are using a panel dataset attrition may be an important issue. People may leave the survey over the eight waves and so a selection bias may arise. Although the weights used within our models should correct for this we also specify an alternative correction and are able to compare the two. Our first step is to develop an attrition model to identify the probability of people leaving the survey. A dummy variable [0,1] is constructed to indicate whether a household leaves the survey or not from one year to the next. This resulted in the individuals from wave 8 being dropped from the sample as the attrition variable is unable to incorporate their next year into the model. Our attrition dummy then used as the dependent variable in a probit model with explanatory variables include sex, age, household income, duration of the last interview for the survey, number of persons in the household, and a range of regional specific variables such as regional employment rate, the results are presented in Table C1 in Appendix C. This model was then used to create an inverse mills ratio which will be included in our participation model to help correct for any possible selection bias.[11]

IV EMPIRICAL RESULTS

The results of the logit model on the decision to participate in higher education in Ireland are presented in Table 8.[12] We also include a breakdown of the varying predicted probabilities of participating in higher education as changes in the values of our explanatory variables occur in Table 9; this table also includes marginal effects. Robust standard errors have been employed within the estimation to allow for the possibility of heteroscedasticity.[13]

[11] See Miller and Wright (1995) and Nicholetti and Peracchi (2002) for a fuller discussion.

[12] The results of the model that include our own correction for attrition bias are presented in Table C2 in Appendix C, it is seen that these results are very similar to the model in Table 8 while the inverse mills ratio term is highly insignificant and so we choose to focus our analysis on the estimations from Table 8.

[13] The issue of multicollinearity has also has to be considered, Becker (2004) notes there is the strong possibility of this occurring in estimating higher education participation but this does not justify dropping possible collinear variables as their effect will only be picked up in the residual and so we rely on our theoretical framework to dictate the variables we have included.

Table 8: *Results for Logit Model on Decision to Participate in Third Level Education (Sample: Individuals Aged 17-22 Years that had the Opportunity to Participate in Higher Education)*

Explanatory Variables	*Coefficient*	*p-value*
Gender	–0.72	0.025
Earnings foregone	–0.0021	0
Regional Youth Employment Rate	–4.14	0.024
Earning differential	0.00033	0.1
No. of children in Household	–0.19	0.004
Net weekly household income last year (centred)	0.00015	0.80
Educational level of Parent (centred)	0.33	0
Interaction term: ed level of parent*HH income	–0.00016	0.37
Tuition Fees	–0.00065	0.32
Grant eligibility	–0.23	0.47
Social environment	–0.044	0.57
Open countryside	0.199	0.64
Village	–0.99	0.163
Town pop (1500-2999)	0.53	0.34
Town pop (3000-4999)	0.45	0.61
Town pop (500-9999)	–0.51	0.36
Town pop (>10000)	0.0079	0.9
Waterford City	0.826	0.52
Galway City	0.044	0.95
Limerick City	0.41	0.57
Cork City	0.048	0.94
Co. Dublin	–0.175	0.69
Wave3	–0.345	0.19
Wave4	–0.617	0.083
Wave5	–0.54	0.15
Wave6	–1.012	0.023
Wave7	–0.419	0.3
Wave8	–1.297	0.01
Constant	3.77	0.002
Observations	1,078	
Prob > chi^2	0.000	
Pseudo R^2	0.21	

Source: Author's Calculations – Living in Ireland Survey (1995-2001).
Note: Wave 2 was used as the base category for time variation.
Note: Dublin City was used as the base category for urban/rural dummies.

Household and Social Impacts

In our model we include an interaction term to gauge the influence of parental education level and household income. Both the interaction term and the main effect of household income do not prove significant. The main effect

of the household income variable implies the effect household income has on an individual who has an average level of parental education, but our results show that this does not does shape the participation decision. We interpret the main effect of the parental education level variable as the impact of parental educational level on an individual with an average level of household income. We find a positive relationship between this and participating in higher education. It can be suggested that the intergenerational impact on higher education is of more importance then the financial situation of the household. The presence of an educated parent would seem to focus individual's preferences upon education. This influence may extend to giving the child a clearer indication of the benefits to higher education and seems to be more powerful then the effect of household credit constraints.

The potential influence on higher education participation by social environment is seen as insignificant in our model. This implies that when factors such as parental education and household income are controlled for, the social environment of an individual in Ireland may not explain whether he/she goes to higher education. However, a note of caution must be urged when drawing conclusions from this result as our indicator of social environment is a simplified variable.

From an urban/rural context we use Dublin city as our base category and find there is no major influence of location on higher education participation. This would suggest that living in a rural setting does not impact on an individual's probability of entering higher education in a negative manner. This result reflects the regularly strong admission rates to third level education in Ireland from more rural orientated counties.[14]

We have also included a male/female dummy variable in our model to investigate gender differences across higher education participation. We can see in Table 9 that males have a .18 lower predicted probability of entering higher education in Ireland relative to their female counterparts, again holding the other variables constant. This result reflects the greater retention rate of females to upper secondary and the growing rate of females in higher education in Ireland during our reference time period.[15]

Benefits and Costs

From the results we can see a positive and significant relationship between the earnings differential and the probability an individual will attend third level education. Although the coefficient is quite small, it is significant and provides us with the insight into the role of lifetime earnings expectations

[14] See O'Connell *et al.* (2006) for a greater analysis.
[15] See Clancy (2001) for a deeper analysis.

Table 9: *Changes in Probabilities for Participating in Higher Education for Given Changes in the Explanatory Variables*

Variable	*0-1*	*Marginal Effects*
Gender	–0.18	–0.18
Grant Eligibility	–0.059	–0.059
Open countryside	0.049	0.049
Village	–0.23	–0.23
Town pop (1500-2999)	0.13	0.13
Town pop (3000-4999)	0.11	0.11
Town pop (500-9999)	–0.12	–0.12
Town pop (>10000)	0.002	0.002
Waterford City	0.19	0.19
Galway City	0.01	0.01
Limerick City	0.1	0.1
Cork City	0.012	0.012
Co. Dublin	–0.043	–0.043
Variable	*Min-Max*	*Marginal Effects*
Regional Youth Employment Rate	–0.44	–1.034
Tuition Fees	–0.093	–0.0002
Earning differential	0.44	0.0006
No. of children in Household	–0.32	–0.048
Net weekly household income last year (centred)	0.077	0
Educational level of Parent (centred)	0.76	0.084
Interaction term: ed level of parent*HH income	–0.41	0
Earnings foregone	–0.90	–0.0005
Social environment indicator	–0.081	–0.011

Source: Author's Calculations – Living in Ireland Survey (1995-2001).
Note: Changes in probability for one explanatory variable are based on holding all other explanatory variables at their mean.
Note: Min-Max: this indicates the change in predicted probability of participating in higher education as chosen explanatory variable changes from its minimum to its maximum.
Note: 0-1: this indicates the change in predicted probability of participating in higher education as chosen explanatory variable changes from 0 to 1.

on higher education participation. This lends support to the role of marginal benefits outlined in the theoretical model, with a positive influence on higher education participation. We can see from Table 9 that as our earnings differential variable moves from its minimum to its maximum value, the predicted probability of an individual participating in higher education rises substantially, holding all the other explanatory variables at their mean. In a more subtle sense, if we increase the average monthly life cycle earnings

differential by IR£50 above its mean, the predicted probability of participating in higher education for an individual jumps from .48[16] to .52, again holding all the other explanatory variables at their mean. From our results it is reasonable to suggest that young people in Ireland follow a rational approach with regard to higher education participation, the higher the returns the higher probability of entering third level education. We know that there has been substantial growth in higher education participation in Ireland over the past fifteen years and one possible reason for this may be a greater appreciation of the potential benefits extra education can bring. Young people in Ireland may be more aware of the greater lifetime earnings they can command with a higher education and so use this as motivation to participate.

We find a negative and significant relationship between foregone earnings and participation in higher education. This would follow the theoretical hypotheses that as the opportunity cost of attending third level education increases, the less chance an individual will participate in higher education. This again lends support to the human capital framework, with an increased marginal cost of participating in higher education proving to lower the probability of participation. We can illustrate this by fluctuations in the foregone earnings variable. If we increase the mean level of monthly foregone earnings of a young person in Ireland by IR£100 we see a drop from .48 to .43, in the predicted probability of them going to higher education, holding the other variables at their mean. A similar decrease from the mean level foregone earnings leads to an increase in the predicted probability to .56. The attraction of high earnings in the labour market proves too difficult for some individuals to ignore. The higher earnings lead young people in Ireland to turning their back on higher education, and preferring to take advantage of the high earnings on offer.

The regional employment rate variable constructed in our model can also be used as a proxy for the opportunity cost of entering third level education and is presented as statistically significant. A higher regional employment rate would expect to effect the decision on attending third level education by increasing the opportunity cost and thereby decreasing the probability of making the transition to higher education. The expected negative relationship is present in our model with a strong relationship indicated between the regional employment rate and the decision to attend third level education. From the results in Table 8, we see that as the regional employment rate grows from its minimum value to its maximum value we see a declining probability of people choosing to enter higher education.

[16] The predicted probability of .48 is for an individual with the average attributes of all the explanatory variables.

This is related to the role of foregone earnings above, as individuals who find themselves in a booming labour market may be reluctant to pass up the opportunity to take advantage of this boom. On the other side, in times of economic downturn this could results in an increase in young people in Ireland participating in higher education. With limited opportunities in the labour market they may see no alternative but to enter third level. As Giannelli and Monfardini (2003) note, higher unemployment may end up having a positive side with more young people investing in education. This could result in possible economic benefits in the long run with a higher educated workforce but more significant analysis would be needed to substantiate such suggestions.

We find no evidence that the existence of tuition fees reduces the probability of participating in higher education. While we have the expected sign, the results do not prove to be significant. However, this is an imperfect measure of tuition fees in Ireland with limited variation and so any significant results for policy suggestions cannot be suggested. With regard to grant eligibility we also find that this is insignificant. Again while no major policy recommendations regarding grants can be drawn from this, the results do suggest a limited role for maintenance grants in determining higher education participation.

The insignificance of both household income and grant eligibility in our model suggest that credit constraints may not be a huge barrier to young people in Ireland. While direct costs in the form of tuition/registration fees were relatively low in our reference period and thus may have reduced the role of credit constraints it is still important to note that neither the availability of financial aid nor a wealthier income background seems to play a major role in the higher education participation decision. This result can be of major policy interest at a time when a restructuring of the higher education financing system is being considered. While this paper cannot comprehensively comment on the possible participation impact of changing the current higher education system of free tuition, the insignificance of credit constraints on the participation decision may suggest that the reintroduction of tuition fees or any other higher education system that places more financial burden on the household may not impact enormously on the decision to go to third level education.

V CONCLUSION

Until now, the main focus on higher education participation in Ireland has been on the role of social class on the decision to enter higher education. In this paper we present a theoretical model of higher education participation in

Ireland incorporating factors from the human capital investment framework of education decision-making and other household and sociological variables. In our model the participation decision is a function of the costs (direct and indirect), the estimated life cycle returns, environmental and parental influences and also household credit constraints. We then test this model using the Living in Ireland Survey. This is achieved empirically using a binary logit model to estimate the role of the above factors on the probability of participating in higher education for young people in Ireland.

We find strong evidence to support the human capital approach to educational participation. Those with lower opportunity costs and a higher expected return on higher education are more likely to participate in this level of education. This would support the view that individuals may see education participation in an investment context as outlined by the human capital framework. We also find that both the level of tuition fees and maintenance grant eligibility do not present as significantly impacting on the participation decision.

Higher parental education level is associated with the probability of entering higher education in Ireland while household income does not present as significant. This is an interesting result as it indicates that in Ireland intergenerational impact on higher education is of more importance then the financial situation of the household. There is also evidence for strong gender effects in our model, while urban or rural does not impact on the participation decision.

Some tentative policy implications can be drawn from the results. The insignificance of credit constraints such as household income and maintenance grant eligibility on the participation decision suggests that a change in the finance structure of higher education that places more of a financial burden on the household may not impact on participation. While more comprehensive research would have to take place to gauge a more exact impact of changing the finance structure, it is important to highlight the limited role of credit constraints seen here.

The strong negative relationship between regional youth employment rates, foregone earnings and higher education participation also display the possible implications for higher education demand in times of economic downturn. The negative relationship seen here suggests that lower labour market opportunities for young people in Ireland may lead them to enter higher education. This points to a possible positive role for youth unemployment in Ireland in forcing individuals to invest more in human capital in times of economic downturn, the long-term implications of which could see a higher educated work force in Ireland.

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APPENDIX A

Higher Education Participation Model

Using Equations (1) and (2) an individual's optimal schooling choice and optimal consumption path maximise

$$\Omega(S, c(t), \lambda =$$

$$V(S, c(t)) - \lambda\{\int_0^{\infty} c(t)e^{-Rt}dt - \int_0^{S} T(t) + F(t) - A(t)e^{-Rt}dt - \int_S^{\infty} y(S, t)e^{-Rt}dt\}$$

Where

$$V(S, c(t)) = \int_0^{S} (u(c(t) - \phi(t)))e^{-\rho t}\,dt + \int_S^{\infty} u(c(t))e^{-\rho t}\,dt$$

Which can be written as

$$V(S, c(t)) = \int_0^{\infty} u(c(t))e^{-\rho t}dt - \int_0^{S} \phi(t)\,e^{-\rho t}\,dt$$

We derive the integrals within Equation (6) with respect to S to obtain the derivative of lifetime utility with respect to schooling.

This gives us

$$-\phi(S)e^{-\rho S} - \lambda(y(S, S) + T(S) + A(S) - F(S)e^{-RS} + \int_S^{\infty} \partial y(S, t) / \partial S)\,e^{-Rt}$$

This can be written as

$$-\lambda(y(S, S) + T(S) + A(S) - F(S)e^{-RS} + 1/\lambda\phi(S)e^{-\rho S} + \int_S^{\infty} \partial y(S, t) / \partial S)e^{-Rt})$$

this can also be transformed to look like

$$\lambda e^{-RS}(\int_S^{\infty} \partial y(S, t) / \partial S)e^{-R(t-S)}) - (y(S, S) + T(S) + A(S) - F(S) \cdot$$

$$+ 1/\lambda\phi(S)e^{-(\rho - R)S})$$

Where

$$\int_S^{\infty} \partial y(S,\ t) / \partial S)\,e^{-R(t-S)}\,dt$$

Is marginal benefit MB(S) of an extra year in education while

$$(y(S,S)+T(S)+A(S)-F(S)+1/\lambda\phi(S)e^{-(\rho-R)S})$$

represents the marginal cost of an extra year of education MC(S), which is shown to be Equation (3).

APPENDIX B

Table B1: *Distribution of Individuals Dropped from Sample Due to Data Limitations Across Equivalised Household Income Deciles*

Income Decile	*Frequency*
1	2
2	2
3	4
4	2
5	3
6	2
7	3
8	4
9	2
10	1
Total	25

Source: Author's Calculations – Living in Ireland Survey, (1995-2001).
Note: These individuals were dropped due to the unavailability of household income data and their location in the income deciles above are based on nearest lagged available information on household income.

APPENDIX C

Table C1: *Probit Model of Attrition (Sample: All Individuals Aged 17-25 Years, Household Integer Weight Applied)*

Variable	*Coefficient*	*p-value*
Gender	–0.08	0.4
Household income	–0.0002	0.06
Age	0.43	0.51
Age^2	–0.010	0.52
Wave2	0.16	0.39
Wave3	–0.19	0.31
Wave4	–0.12	0.56
Wave5	0.31	0.10
Wave6	0.10	0.68
Wave7	0.71	0.001
Duration of Interview	0.0011	0.09
No. of Visits by Interviewer	–0.008	0.81
Regional Sex Ratio	20.44	0.1
Regional Population Density	–2.90	0.2
Regional Employment Rate	–3.38	0.49
No. of persons in the household	–0.029	0.47
Open countryside	0.41	0.13
Village	0.72	0.02
Town pop (1,500-2,999)	0.40	0.3
Town pop (3,000-4,999)	1.58	0.004
Town pop (500-9,999)	0.74	0.02
Town pop (>10,000)	0.50	0.09
Waterford City	–0.34	0.5
Galway City	1.32	0.01
Limerick City	1.31	0.03
Cork City	0.843	0.01
Co. Dublin	0.05	0.85
constant	–11.43	0.17
Observations	2,206	
Prob > chi^2	0	
Pseudo R^2	0.08	

Source: Author's Calculations – Living in Ireland Survey (1995-2001).
Note: Wave 1 was used as the base category for time variation.
Note: Dublin City was used as the base category for urban/rural dummies.

Table C2: *Results for Logit Model on Decision to Participate in Third Level Education with Correction for Attritional Bias (Sample: Individuals Aged 17-22 Years that had the Opportunity to Participate in Higher Education)*

Explanatory Variables	*Coefficient*	*p-value*
Gender	–0.67	0.003
Earnings foregone	–0.002	0
Regional Youth Employment Rate	–3.95	0.006
Earning differential	0.00030	0.09
No. of children in Household	–0.19	0
Net weekly household income last year (centred)	0.0003	0.41
Educational level of Parent (centred)	0.23	0
Interaction term: Ed level of parent*HH income	8.63E-05	0.47
Tuition Fees	–0.0005	0.2
Grant eligibility	–0.34	0.3
Social environment	–0.05	0.28
Open countryside	0.81	0.01
Village	–0.3	0.38
Town pop (1,500-2,999)	0.99	0.05
Town pop (3,000-4,999)	0.27	0.7
Town pop (500-9,999)	0.10	0.8
Town pop (>10,000)	0.45	0.2
Waterford City	1.63	0.07
Galway City	0.20	0.7
Limerick City	–0.003	0.99
Cork City	–0.10	0.8
Co. Dublin	0.11	0.74
Wave3	0.60	0.14
Wave4	–0.15	0.5
Wave5	–0.16	0.5
Wave6	–0.74	0.02
Wave7	0.0301	0.9
Inverse Mills Ratio	–0.34	0.81
Constant	3.34	0.01
Observations	934	
Prob > chi^2	0.000	
Pseudo R^2	0.21	

Source: Author's Calculations – Living in Ireland Survey (1995-2001).
Note: Wave 2 was used as the base category for time variation.
Note: Dublin City was used as the base category for urban/rural dummies.
Note: As noted on page 93 of the paper the no. of observations drops for this specification due to the nature of our attrition model.