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Participation in Higher Education: A Random Parameter Logit Approach with Policy Simulations

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ABSTRACT

Participation in Higher Education: A Random Parameter Logit Approach with Policy Simulations

In this paper we present a theoretical model of higher education participation. We assume that young people that complete upper secondary education are faced with three choices, go to higher education, not go to higher education or go to higher education and work part time. Utilizing the Living in Ireland survey data 1994-2001 we model this choice in an Irish context by variation in costs (direct and indirect), the estimated lifecycle returns and household credit constraints. Using a random parameters logit choice model we find that simulated lifecycle earnings positively impact the educational/labour choices of young individuals in Ireland. This positive relationship is also found to be true for a choice-specific household income variable constructed in the paper. From the random parameters logit estimations we also find that preferences for choices with higher simulated lifecycle earnings and household income vary across individuals. We conduct policy simulations from our estimations and found that increasing student financial aid levels by 10% combined with a slight widening of the income limits for these aids can lead to significant movement away from the decision to not enter higher education.

JEL Classification: I23, C35

Keywords: higher education participation, random parameters logit model, lifecycle simulated earnings, higher education policy

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1. Introduction

Encouraging third level education participation has now become a key policy objective for most governments around the world; the participation of young people in higher education has increased significantly in the last twenty years in the majority of developed economies (OECD, 2009). The desire for a highly educated population stems from the belief that education can help economic growth by influencing worker productivity (Mankiw, Romer and Weil, 1992). There are also issues of equity that are taken into consideration as higher education participation from lower socio-economic groups can be seen as a redistributive tool. Higher education levels tend to result in higher wages for individuals and so appropriate education policy may help those in lower socio-economic groups reach higher income levels.

Economic studies on educational issues have been mainly focused upon the estimation of the private rates of return to varying levels of education (the relationship between earnings and education). The main motivation tends to be the correction for endogenetity introduced to wage estimations if associations between education (as an explanatory variable in the estimations) and the residual are not accounted for. Several attempts have been made to correct for this mainly through the use of instrumental variable methods[1]. The economics of education has also extended itself to investigating the influence of varying factors on the decision to take part in education[2]. These analyses mainly use reduced form specifications with household and social characteristics, the main drivers of educational outcomes. Albert (2000) and Black at al (2005) show conflicting results as to the role parental education may have on educational participation. Brannstrom (2007) and Sanbonmatsu at al (2006) investigate the possible role of social environment on educational outcomes and find little evidence of a relationship between the two. The role of financial constraints has also been investigated with varying results on the influence of household income levels and financial aids on educational outcomes. Haveman and Wolfe (1995) review the methodologies and findings of a selection of papers and conclude that lower parental income levels do result in lower educational outcomes for their children while Cameron and Heckman (1999) conclude an insignificant impact of short term credit constraints on educational outcomes. As noted these papers are usually of reduced form arrangement with little ability to impact policy decision making. The need and lack of structural models presented for the educational participation decision is highlighted by Haveman and Wolfe (1995) and Wilson at al (2005).

In this paper we present a structural model of higher education participation adapted from an endogenous schooling model by Card (2001). We will then estimate this empirically using a random parameters logit model (RPL). This will help us determine the key influences on the outcomes of individuals on completion of upper secondary education. We then undertake a number of policy simulations to investigate the possible role for

[1] See Harmon at al (2000) for a overview of these
[2] This area of analysis is mainly focused on the decision to participate in post compulsory schooling or attend higher education.

government action in influencing the decision of individuals to participate in higher education.

In the next section we will outline the theoretical model of higher education participation mentioned above. In section three 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 a random parameters logit model to our data and also provide a description of the impact of certain simulated policy changes and then conclude.

2. Theoretical model

The Basic Model

Early work on human capital theory by Becker (1964) and Ben Porath (1967) suggested a lifecycle aspect to educational choice with lifecycle earnings seen as a key influence on the decision to invest in education or not. Life cycle models have been applied successfully to models of fertility (Walker, 1995) and labour supply (Heckman and MacCurdy, 1980). Stoikov (1977) also uses such a model in developing the human capital model of educational choice. In this paper we will utilise a variant of the life cycle model used by Card (2001) and adapted by Flannery and O'Donoghue (2009) [3]. In this paper, we extend the model to incorporate some new aspects of the lifecycle education decision making process such as unemployment risk.

Individuals are assumed to 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. Lifecycle utility, conditional on education S and a given consumption profile is

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

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.

This is subject to the inter-temporal budget constraint

$$\int_0^\infty c(t)e^{-Rt}dt\ =\ \int_0^\infty y(S,t)e^{-Rt}dt\ -\ \int_0^S T(t)e^{-Rt}dt \tag{2}$$

This indicates that the discounted present value of consumption equals the discounted present value of earnings minus tuition costs. Where y(S,t)indicates earnings at age t of an individual who has completed S years of post secondary education while T(t)

[3] This paper uses the same dataset and sampling frame as the latter study but expands the choice model, improves the model specification, and also policy simulations are included here.

represents tuition costs at time t. We assume individuals can borrow or lend freely at fixed rate R.

The marginal benefits and marginal costs of extra education from this optimisation problem can be derived with the benefit of extra education as

$$\int_{S}^{\infty} \partial y(S,t) / \partial S e^{-Rt} dt \qquad (3)$$

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

$$\int_{0}^{S} y(S,t) e^{-Rt} dt \ + \ \int_{0}^{S} T(t) e^{-Rt} dt \qquad (4)$$

This represents forgone earnings while in education and the tuition fees of education measured in period S euros).Thus, based upon human capital theory discussed above, a person's educational market choice will be based upon the expected rate of return to extra education, the possible level of earnings in the labour market and direct costs such as tuition fees.

Willis and Rosen (1979), Lauer (2002) and Wilson (2005) all find a positive impact on attending post secondary education from higher expected lifetime earnings, supporting the life-cycle theory of an individual choosing an educational outcome that will yield highest lifecycle earnings.

The theoretical model also suggests that higher level of foregone earnings raise the marginal cost of education to the individual. Fuller et al (1982) and Dubois (2002) used the simulated labour market earnings of potential higher education participants as a measure of the opportunity cost of attending university and found that they had a negative relationship. We also see tuition fees as raising the marginal cost of an extra year of higher education and have already noted studies that show that higher tuition fees resulting in lower uptakes of higher education.

However this is a simplified model of higher educational choice outcomes and to work towards the development of a structural model, it is important to acknowledge that further heterogeneity across the choices may be present. As noted above, the parental education level or the social environment of an individual may shape tastes for certain educational outcomes. The key role of both parental education level and social environment may be to vary attitudes and/or perceptions towards education for young people. Struefert (1991) outlines a theory of role models helping to form young people's attitudes towards education. Those with higher parental education may have a different perception of the possible benefits from education from observing them in a direct manner. The same influence can extend to an individual's social circle with the attitudes and composition of one's peers having an influence on educational outcomes. Although capturing exact details of these may be difficult the level of (dis)advantage of the surrounding neighbourhood of an individual is frequently used as a proxy[4]. This leads us to include a convex function Φ(t) in the utility function (1). This captures the relative (dis)utility of education versus alternative outcomes (i.e. working) for individuals during their schooling time.

An individual may also receive financial aid F(t) while in education to help lower the marginal cost involved. Heller (1997) also includes an analysis of the impact of levels of financial aid on higher education participation and note a positive relationship. To incorporate the possibility of an individual generating earnings while in education by working part-time we include the term p(t) in the budget constraint and thus offsetting some of the costs incurred while in education.

The condition of the labour market may also impact on the educational participation decision with a person having a greater likelihood of staying in education when the labour market is depressed, (See Gustman and Steinmeier (1981) and Rice (1999)). This is partially because the expected foregone earnings will be affected by labour market conditions as it is the product of possible earnings and probability of achieving it (being in employment). However the probability of being in employment also extends to the choice to work part time in higher education and also to the lifecycle earnings of an individual. This unemployment risk is represented in the model by the term (1-δ), which implies that expected earnings may be depressed due to an unemployment risk.

Adding these variables, the budget constraint for our participation decision becomes

$$\int_0^{\infty} c(t)e^{-Rt}dt = \int_0^{s} [\mathrm{p(t)(1-\delta)+F(t)-T(t)}]\mathrm{e^{-Rt}dt} + \int_0^{\infty} y(S,t)(1-\delta)e^{-Rt}dt \tag{5}$$

While our utility function is now

$$V(S,c(t)) = \int_0^{S} (u(c(t)-\phi(t)))e^{-\rho t}\ dt + \int_S^{\infty} u(c(t))e^{-\rho t}dt \tag{6}$$

An individual's optimal schooling choice and optimal consumption path maximize

$$\Omega(\mathrm{S,c(t)},\lambda) =$$

$$\mathrm{V(S,c(t))} - \lambda\{\int_0^{\infty} \mathrm{c(t)e^{-Rt}dt} - \int_0^{S}\ \mathrm{F(t)+p(t)(1-\delta)-T(t)-A(t)e^{-Rt}dt} - \int_s^{\infty} \mathrm{y(S,t)(1-\delta)e^{-Rt}dt}\} \tag{7}$$

Where

[4] See the previously mentioned papers by Brannstrom (2007) and Sanbonmatsu at al (2006)

$$V(S,c(t)) = \int_0^S (u(c(t)-\phi(t)))e^{-\rho t}\,dt + \int_S^\infty u(c(t))e^{-\rho t}dt \qquad (8)$$

Which can be written as

$$V(S,c(t)) = \int_0^\infty u(c(t))e^{-\rho t}dt - \int_0^S \phi(t)e^{-\rho t}\,dt \qquad (9)$$

We derive the integrals with respect to S to obtain the derivative of lifetime utility with respect to schooling

This gives us

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

(10)

This can be written as

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

this can also be transformed to

$$\lambda \mathrm{e}^{-\mathrm{RS}}(\int_{\mathrm{S}}^{\infty} \partial \mathrm{y}(\mathrm{S},\mathrm{t})/\partial \mathrm{S})(1-\delta)\mathrm{e}^{-\mathrm{R}(\mathrm{t}-\mathrm{S})}) - (\mathrm{y}(\mathrm{S},\mathrm{S})(1-\delta) + \mathrm{T}(\mathrm{S}) + \mathrm{A}(\mathrm{S}) - \mathrm{p}(\mathrm{S})(1-\delta) - \mathrm{F}(\mathrm{S}) + 1/\lambda\phi(\mathrm{S})\mathrm{e}^{-(\rho-\mathrm{R})\mathrm{S}})$$

Where

$$\int_{\mathrm{s}}^{\infty} \partial \mathrm{y}(\mathrm{S},\mathrm{t})/\partial \mathrm{S})(1-\delta)\mathrm{e}^{-\mathrm{R}(\mathrm{t}-\mathrm{S})}\mathrm{dt} \qquad (11)$$

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

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

(12)

represents the marginal cost of an extra year of education MC(S),

This now makes the marginal cost of extra education dependent on preferences for education captured by the (dis) utility function at the end of the equation. Again 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[5].

3. Data

Data

We utilise the Living in Ireland survey for our analysis. This survey forms the Irish section of the European Community Household Panel (ECHP) dataset and is a household panel dataset which ran from 1994 to 2001[6]. The sampling frame for the survey comes from the electoral register of Ireland[7] and the data is weighted to reflect independent population estimates and to correct for possible attrition[8].

The data details the status of individuals, together with their immediate households and as such we are able to identify the persons in education and what level of education they are in.

In our analysis we wish to investigate those people who are eligible to attend third level education in a given year, grouping two levels of education involving third level primary degree and other third level education as a generic third level education variable[9].

The first wave of this dataset was used by Whelan and Hannon (1999) to investigate the role of parental social class on higher education participation, with a positive relationship found. Smyth (1999) and O'Connell (2006) also found similar results to this using other Irish datasets, with the analysis of educational outcomes limited to the influence of parental social class. Flannery and O'Donoghue (2009) use a simple logit model with this data to show evidence that parental education level and regional youth employments rates are correlated with higher education participation in Ireland.

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[5] The assumption of perfect capital markets can also be relaxed to recognize the impact of different capital constraints on educational choices.

[6] A brief overview of the data and sample will be presented here as a more detailed summary of this data and the sample used in our analysis can be seen in Flannery and O'Donoghue (2009).

[7] See Watson (2004) for further detail on the Living in Ireland Survey

[8] 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).

[9] The decision not to segment this variable into two separate variables representing universities and institutes of technology respectively is due to data restrictions

Our sample consists of the young people (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[10]. This left us with a sample of 1078 individuals from across the panel. The next step was to identify within this sample the individuals that proceeded to higher education and those that did not. The cohort identified as those that went to higher education are further segmented into those that work while in education[11] and those that do not.

4. Statistical Model

Within our statistical model the main goal is to construct explanatory variables from our dataset to estimate how young people make their educational/labour choices. To incorporate the decision to work while in higher education we follow a framework that is similar to the discrete choice labour supply models of Van Soest (1995) and Haan (2006) with S_i representing the higher educational choice of individual i. this will take the value 0 if an individual who has the opportunity to proceed to higher education but chooses not to. It will take a value of 1 if an individual in higher education and does not work, while 2 will represent those that are in higher education and also work on a part time basis[12]. We present the distribution of these individuals in our sample by age in table 1.

We estimate the education/labour decision by maximum likelihood using the random parameters logit model RPL (also known as the mixed logit model) outlined by Train (2003)[13]. The RPL model allows us to capture unobserved individual effects when estimating our parameters as it separates the parameter into a fixed and random element

$$\beta_i = \beta + \mu_i \tag{13}$$

Where μ_i where $\mu_i \sim N(0, \sigma_\mu)$

With the RPL model when choosing across m alternatives the probability that individual i chooses labour/schooling choice j is

$$\Pr(\text{i chooses j}) = \int \frac{\exp(\beta_i' Z_{ij})}{\sum_{l=1}^{m} \exp(\beta_i' Z_{il})} f(\beta_i) d\beta_i \tag{14}$$

Where Zij is a vector of attributes that vary across alternatives available and the probability is a weighted average of the logit formula evaluated at different values of β_i, with weights given by the density $f(\beta_i)$.

[10] This was seen as those that complete upper secondary education in one particular wave and then in the next wave they are in third level education or they are not.
[11] The definition of being in work here for students is identified as those that are in higher education full time but have part time work, with part-time work being any work that consist of <30 hours
[12] Both Van Soest (1995) and Haan (2006) present 25 and 13 alternatives of labour supply in their respective specifications.
[13] This estimation was run using the mixlogit programme in stata, see Hole (2007) for a detailed description of the module.

However it may be the case that various random parameters may be correlated. If we assume this to be the case then we now specify

$$\beta_i = \beta \sim N(\overline{\beta}, \Omega) \tag{15}$$

where the random part of the coefficient vector is now

$$\beta_i = \overline{\beta} + LM \tag{16}$$

where L is a lower-triangular Cholesky factor of the preference variance–covariance matrix Ω such that $LL' = \Omega$, and M is a vector of independent standard normal deviates. $\overline{\beta}$ and L are then estimated to help determine whether this correlating exists.

In estimating the RPL model we need to create the choice specific variables that reflect the possible outcomes for a given choice an individual might make. These parameters are then estimated as the attribute coefficients specified above using the RPL model[14].

Opportunity Cost

We first consider the opportunity cost of entering third level education which we present as foregone earnings from entering education. We specify this foregone earnings variable as the income an individual would have expected to gain if they had gone into the labour force minus the expected income from any work while in education.

Separate wage equations are estimated for the labour market earnings and student earnings, for both males and females to obtain our earnings values. To correct for sample selection bias we use the two stage estimation process outlined by Heckman (1979) to obtain our wage predictions.

$$EMP_t = X_{1t}\beta_1 + U_{1t} \tag{17}$$

$$Y_t = X_{2t}\beta_2 + U_{2t} \tag{18}$$

Equation (17) 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 consists of young people with an upper secondary education, while the second is young people in third level education. The dependent variable in our wage equation is log of monthly earnings, while explanatory variables include age and regional location dummies and an inverse mills ratio derived from the participation estimations to correct for sample selection bias (See Heckman (1979). The estimation of student wages includes the same explanatory variables. The results can be seen for both male and females separately, and for both non-students and students in tables 2 and table 3 respectively. For the wage estimations of the first sample we see age does not have a

[14] We also include some individual level taste shifters as interact terms and these are outlined later in the paper

significant impact on wage levels. We instead find that the significant areas of variation in wage levels come from the time effects and regional dummies included in the model. From table 3 we see that for student wage levels, age regional location and time effects do present as significant across both sexes. We also note that sample selection may have been an issue for the male population here, as evidenced by the significance of the inverse mills ration term included in the model.

Utilising these equations, we simulate a value for foregone earnings for each individual for each depending on which schooling/labour outcome they choose. For $S_i = 0$, an individual has foregone earnings equal to zero. We assume that the individual does not forego any earnings if he chooses to enter the labour market without attending third level education. When $S_i = 1$, (choosing to participate in third level education), an individual will face foregone earnings $E(e_{LM})$, potential labour market earnings. Finally, when an individual choose $S_i = 2$ (studying while working part-time)will face $E(e_{LM}) - E(e_{STU})$, due to the fact earnings as a student reduces the foregone earnings from the labour market. In each case

$$E(e_{LM}) = \qquad (\mathrm{y(S,S)}(1-\delta) \tag{19}$$

$$E(e_{STU}) = \qquad \mathrm{p(S)}(1-\delta) \tag{20}$$

Where equation 19 represents the predicted earnings of an individual aged 17-22 years of age with an upper secondary education times the probability of that person being in employment (one minus the probability of being unemployed/inactive). Meanwhile equation 20 is the predicted earnings of a student working part time while in higher education times the probability of them being employed

Policy Tools

In Ireland tuition fees are based on the type of course being pursued. However our dataset does not contain this information on an individual basis. Instead we use an average weighted yearly fee across each individual. This is constructed using information on the yearly levels of tuition fees for both universities and institutes of technology and also the percentages of students taking each type of course in both institution types for every year. This weighted average fee varies over time as tuition fees were abolished with students only required to pay a student registration fee after 1996. After this point we apply the replacement (lower) charge, a flat rate registration fee required to each individual in our sample. This registration fee varies over time it has increased every year since its introduction.

Financial aid to third level participants takes the form of higher education maintenance grants. Grant eligibility is based on household income levels, with the level of grant aid based on distance from the higher education institution and household income. Specifically for our time period, two different income thresholds existed to determine whether an individual gains a full grant aid or partial grant aid. With respect to the variation in maintenance grant levels due to distance, there are two different amounts based on whether the individual going to third level education is living adjacent[15] to the higher education institution they attend.

We do not have any relevant distance-related information in our dataset and so a number of assumptions are made to model this variable. Our first step was to identify the households that are eligible for higher education grants in our sample[16]. In order to distinguish between the adjacent and non-adjacent recipients of the financial aid we make the assumption that those living in rural areas and eligible for a higher education grant receive the non-adjacent grant. We also randomly assign non-adjacent grant status to some urban dwellers to ensure that our sample of non-adjacent grant recipients reflects the actual level on a regionally differentiated basis. The same procedure was carried out for those eligible for a partial grant also. We can then identify those in our sample that are eligible for the differing levels of higher education financial aid. The individuals eligible for higher education maintenance grants in Ireland are also eligible for full cover or partial cover of any tuition/registration fees for third level education. There also exists a higher level of income limits which determines whether individuals are eligible for full or partial aid towards tuition/registration fees while not receiving any form of maintenance grants which is also incorporated. Also a special top-up grant was introduced for those starting higher education in 2000. This provided a top-up on the original maintenance grant for those going to higher education from household with very low incomes.

To incorporate these policy tools into our model we develop a choice-specific household income variable. To make household income conditional on our specified choices we first assume that the household bears the incidence of direct educational costs such as tuition fees. We also assume that the household has a direct benefit from any educational financial aid such as grants, and also the earnings benefit from either working while in education. The final assumption is that the household enjoys the possible financial benefits of an individual within that household choosing to ignore higher education and instead enter the labour market after second level education. We use the specifications for costs, financial aid and earnings seen above to construct the three alternatives for household income conditional on the choice made

$$Y_{t-1} + E(e_{LM}) \tag{21}$$

$$\mathrm{Y}_{t-1} + \mathrm{F}(t) - \mathrm{T}(t) \tag{22}$$

$$\mathrm{Y}_{t-1} + \mathrm{E}(e_{STU}) + \mathrm{F}(t) - \mathrm{T}(t)) \tag{23}$$

[15] The adjacent rate of maintenance grant is payable where the student lives 24 kilometers or less from the third level institution he/she plans to attend, the non-adjacent rate is applicable is all other cases
[16] This was achieved using the Income limits for higher education grants from 1994-2001 provided by the department of education and eligibility was established regardless of the choice to participate in higher education or not.

Where Y_{t-1} is the household income from the year before the decision is made. Tuition fees T(t) in choice (1) and (2) are based on the weighted average fee specified earlier. We have already specified in a previous section how we determined the eligibility and possible maintenance grant levels associated with each individual in our sample. The grant levels are then added as appropriate, dependent on which outcome is chosen. It is also taken into account the fact that individuals eligible for maintenance grants are also eligible for free or partial tuition fees, and also some individuals may not be eligible for any maintenance grants but are eligible for full or partial aid towards fees[17].

Simulated Lifecycle Earnings

In order to capture the differential returns to education for different education assumptions, we require a measure of the differential lifetime earnings stream. We do this via simulation. We construct lifecycle earnings predictions for each individual in our sample using reduced form wage specifications, using the information we have in our data on wage and educational levels.

The aim of this process is to generate three different simulated lifetime earnings streams for each individual in our sample, consisting of simulated lifecycle earnings with (a) an upper secondary education qualification, (b) a higher education qualification, and (c) a stream of simulated earnings incorporating work experience gained while in third level education respectively, assuming that those who work part-time will have slightly higher work experience. This thus gives us choice specific lifetime earnings attributes.

Reduced form earnings functions are estimated for males and females with years of education[18], experience[19], regional and time dummies and social class of parents included as regressors with log monthly earnings as our dependent variable[20], with the results presented in table 4. The model seems to be well specified with years of education, our experience variable and social class are proving significant across both sexes. We also see that significant wage variation across different regions of Ireland with a strong effect for the Dublin region compared to others. There are also noticeable time effects seen by the significance of our time dummies. A simulated earnings level is then estimated for each individual with the assumption of upper secondary education and age 25. We then vary the education level to reflect a third level education and estimate earnings for each individual if they were aged 25 with the higher education level. The third variation is to

[17] These figures are aggregated together and represented as an average monthly household income figure in our model

[18] 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.

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

The potential work experience if an individual works as a student is calculated in a similar manner with the average yearly working hours of students on a regional basis by four and adding this to the potential experience variable, a new lifecycle earnings stream for each individual aged 17-22 is then estimated with this increased experience.

[20] The Heckman procedure to correct for sample selection is again used here

assume the individual has a third level education but also worked part-time while in higher education. This process is carried out to obtain simulated wages for each individual at the three possible outcomes at five year intervals beginning at age 25 and ending at age 60. This gives the expected monthly wage levels of each individual at eight different stages of their life cycle across the three possible outcomes they may take post secondary education . These eight separate estimations can be average for each individual to obtain an indication of the average simulated monthly income they may receive over the course of their lifecycle dependent on which one of the three choices they take. This approach is similar to that of Lauer (2002) and Wilson et al (2005) with the latter study simulating incomes for youths over a period of 14 years (ages 18-32) for those that did/did not graduate from high school in the USA using a tobit model. The former study simulates predicted earnings from ages 19-55 using a regression analysis similar to the specification above.

Individual characteristics

We also include some individual characteristics of individuals as interactions with our choice specific variables; these are also included to establish whether or not unobserved heterogeneity is present even after these individual characteristics. The interaction terms included aim to investigate variability by parental education level and environmental surroundings[21]. The parental education variable ranges from no education beyond primary to higher degree level with the mother's education level used as the default indicator. From the environmental indicator variable principal component analysis is used on a key number of social unrest indicators such as crime, vandalism etc to obtain a social environment indicator. A higher value for this indicator is associated with a more disadvantaged social setting; see Flannery and O'Donoghue (2009) for more. Quadratic expressions and cross products of the three choice specific variables are also included to allow for nonlinear relationships in estimation. The mean values of all explanatory variables in the model are presented in table 6 broken down across the three possible choices available.

5. Results 1. Empirical results and simulated policy changes

The results of two separate specifications of the RPL model are presented in tables 7 and 8, within these models both household income and simulated lifecycle earnings are the parameters assumed to be random.[22]. For comparative purposes we also estimate a conditional logit model[23] in table 6 which assumes homogeneity across preferences. These three specifications are presented with coefficients and corresponding p-values. All three models seem well specified with regards to our theoretical expectations with the results suggesting simulated lifecycle earnings have a positive impact on utility with this

[21] A more detailed description of these is found in table 5

[22] Ruud (1996) and Train (2003) explain that including all variables as random is not advisable as there can be difficulties in the model converging, therefore we only specific two of our variables as random. The model is run with Halton sequences with 500 draws.

[23] This is based on the choice modeling approach proposed by McFadden (1973) and includes the exact same covariates as the two RPL models

impact decreasing. This is consistent with the results seen in Willis and Rosen (1979) and Wilson et al (2005).

With the significance of our choice-specific household income variable we can imply that the level of direct costs such as tuition fees and financial aid tools may play a part in young people's educational outcomes. While it is difficult to separate the actually impact of educational costs and financial aids from the impact variation in household income levels in our analysis it is plausible that credit constraints on the household do have an impact on educational/labour outcomes of young people. This is in line with the findings of Acemoglu and Pischke (2001) that highlights the role of family income in college enrolment and Heller (1997) who outlines the responses of student to changes in higher education fees and financial supports.

The positive impact of simulated lifecycle earnings and household income on utility may indicate that when making their tertiary education decisions young people do consider the potential impact of their decision on lifecycle earnings and the financial health of the household. This would help explain the increasing higher education participation in Ireland in our reference period[24], while the rate of return to tertiary education remained quite static over this period Barrett at al (2002), this combined with the lower direct cost of education from the abolition of tuition fees in Ireland may have contributed to increased participation.

Our earnings foregone variable also presents as significant and in the expected negative direction, indicating a negative impact on utility from increasing the indirect cost of participation in third level education. Again this is consistent with the international literature such as Dubois (2002). Growing participation in higher education in our time period could also be partly explained if the opportunity costs of this participation had fallen. However there is no evidence available to suggest that this occurred.

As we have noted in the theoretical model the impacts of these variables may be subject to a (dis)utility factor arising from individual level. The results of all three models show that the interaction effect between our simulated lifecycle earnings variable and parental education level is positive and significant, suggesting that there is a positive marginal utility effect of parental education on the impact higher lifecycle earnings on our choice outcomes.

We see from the first RPL model where no correlation across the random parameters is assumed that there is evidence for unobserved heterogeneity in individuals making their educational choices. This is seen by the significance of the estimated standard deviation terms at the bottom of table 7. There is also evidence from our second specified RPL that there is preference heterogeneity even after allowing for correlations to exist between attribute parameters. This is seen by the significance of the standard deviations terms at the bottom of table 8. This suggests that we should reject the fixed coefficient model (conditional logit model) in favour of a RPL specification. This is supported by

[24] See O'Connell et al (2006) for more

performing a likelihood ratio test between the conditional logit model and the two RPL models[25]. The conditional logit model is rejected in both cases.

When comparing the two separate specifications of the RPL models we find that there is no evidence that any correlation exists between the two random parameters. The insignificance of the covariance term at the end of table 8 and the results of a likelihood ratio test[26] comparing the two models shows that we cannot conclude that individuals that have a preference for higher lifecycle earnings also have a preference/dislike for household income. Due to this finding any analysis presented in the rest of the paper is based upon the estimations contained in the second specification of the RPL model in table 7 where no such correlation is assumed.

As highlighted above, the results from this specification shows evidence that even when controlling for individual effects such as parental education level and social environment the impact of lifecycle earnings and household income on education outcomes still varies across individuals.. This may suggest that some manner of personal attitude and/or perception of the value of education may shape the decisions of these individuals. This unobserved heterogeneity across individuals can vary the marginal cost of education by changing the (dis)utility term outlined in the theoretical model above.

6. Results 2. Policy Simulation

As our results show, household credit constraints may have an influence on the higher educational outcomes of young people. This is captured in our model by the choice specific household income that varies across the potential costs and benefits to participating in higher education or not. Using our estimations seen in table 7 we can now simulate policy changes to vary the direct costs and financial aid associated with higher education and investigative the impact of numbers deciding to participate.

The educational policy tools available to simulate can vary from country to country, in Ireland government educational policy can vary the financial constraints of higher education by two main methods,

- changing tuition fees or
- changing the scope and level of financial aid available.

The last ten years has seen significant growth in the scope and level of higher education maintenance grants in Ireland with the aim of increasing higher education participation. This policy has also been recommended by the department of education and science as a key tool in supporting equity in higher education (Department of Education and Science, 2003).

[25] This test implies 2 degrees of freedom for testing CL versus RPL with no correlations and 3 degrees of freedom for testing CL versus RPL with correlations
[26] This test implies 1 degrees of freedom for testing these two specifications against one another

Therefore we focus our simulated policy changes on changes to both the level and scope of higher education grants throughout our reference period and changes to the level of tuition fees; we can then gauge the possible impact of each of the three policy options on higher education participation.

The simulation process is based on the calibration method outlined by Duncan and Weeks (1998). This process involves drawing a vector of unobserved stochastic elements for each individual from the extreme value distribution and a value for β_{inc} (coefficient for our choice-specific household income variable) from the estimated distribution such that predicted choice probability is maximised at the state that is observed. This entails that we begin our transitions where each individual occupies their chosen educational outcome. We will then modify the household income variable and compute new probabilities that will show each individuals preferred choice after this shock.

For our analysis we simulate three policy options, two involve extending the income limits and actual amounts of the maintenance grant system, while the third varies the level of tuition fees:

- Policy option 1 involves extending the upper income limits for receiving any form of government support by IR£1000 on each type of support for each year of our analysis. We also increase the level of the adjacent and non-adjacent aspects of both full and partial grants by 10% for every year.

- Policy option 2 is very similar but each income limits is extended upward by IR£2000 for each year and each maintenance grant increased by 15% in this instance[27].

- Policy option 3 in our paper is a simulated increase in tuition fees. We employ the same methodology seen earlier to construct a weighted average tuition fee for each year of our dataset. This involves using information on the yearly levels of tuition fees[28] and percentages of students taking each type of course on a national basis for Ireland for both universities and institutes of technology to arrive at our weighted average fee. Because it is simulated changes in the grant system and tuition fees, it is our choice-specific household income variable that will vary in our simulations.

When we compare the vector of original educational/labour outcomes generated from our original model with the three different outcomes estimated with our simulated policy changes we can see that these changes lead to changes in the educational choices young people make[29]. The expectation is that the increased household income from going to

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[27] Both these policy options are based upon policy options explored by the Department of Education and Science (2003) and include increases both the income limit and amount of the top-up grant

[28] The tuition fees used here are the levels that would have been charged to a student if the free tuition scheme was not adopted.

[29] As the simulated policy changes are based on a random numbers simulation methodology they are both run 25 each separately resulting in 25 different transition matrices, the average outcomes across these are presented here

higher education will lead people to switch their choices from not going to higher education at all to one of the choices available that involve participation in higher education Heller (1997).

We can see from table 9 that the overall impact of policy option 1 is to have 1.3% less young people in our sample choosing to not go to higher education at all. The increased grant seems to have the desired effect in attracting more people to participate in higher education. We can also see what choice these individuals make with regard to their working status when they enter higher education with the majority of this increase coming from people switching to being in higher education and not working. Policy option 2 has a marginally better impact with 1.9% less individuals making the choice to not go to higher education. It has a similar impact to policy option 1 on those making the transition from no higher education to higher education and working, while the bulk of this 1.9% move away from choosing not to go to higher education is driven by those choosing to now solely go to higher education. Policy option 3 has the opposite impact of the first two simulated changes with overall participation in higher education falling with the increase in tuition fees. This is expected due to the increased strain on household credit. We can see that nearly 7% more of our sample choose the option of not going to higher education with the simulated increase in fees. These results shows that if tuition fees had remained in place during our reference time period it may have had a significant impact on higher education participation. The scale of the impact of increasing these fees would seem substantial; however as we use a weighted average fee and not actual fee level a note of caution must be taken when drawing any conclusions with regard to the policy impact of varying tuition fees in our simulations. It is also important to note that it is difficult to conclude retrospectively what may/may not have occurred had tuition fees been in place in Ireland, but these simulations do show the possible impact they can have on the decision to participation in higher education through their influence on household credit constraints.

To form a suitable policy option from this work, costs estimates for all three and possibly more options would have to be undertaken. However the results suggest that shifting people's choice towards participating in higher education can be influenced by changing the financial position of the household they come from.

7. Conclusion

The main focus of previous studies on higher education participation has focused upon reduced form models that explore the impact of factors such as parental education level and household income constraints. In this paper we follow a similar approach as the labour supply estimations of Van Soest (1995) and present a structural model of higher education participation incorporating factors from the human capital investment framework of education decision-making and other household and sociological variables. We model educational participation and labour outcomes as a function of the costs (direct and indirect), choice-specific household credit constraints and incorporate possible social and intergenerational effects.

Using a random parameters logit model of choice on Irish data we find that simulated lifecycle earnings and household income levels positively impact the educational/labour choices of young individuals in Ireland. We also find that even when controlling for observed heterogeneity there is evidence that the impact of these variables on preferences varies across individuals due to some unobserved individual effects. The specification of our RPL model is tested against homogenous preferences across choices and the possible presence of correlations across random parameters.

We also conducted some policy simulations from our estimations in order to gauge the impact of varying direct costs and financial aid associated with higher education participation. It was found that increasing higher education maintenance grant levels by 10% combined with a slight widening of the income limits for these grants can lead to a 1.3% movement away from the decision to not enter higher education. We also find evidence that if tuition fees had remained in place over our reference time period, it may have significantly reduced participation in higher education.

Future work on this topic can potentially apply this education choice model to a host of other countries to gauge the possible influence of household credit constraints on higher educational participation. Various simulations besides those presented here can be applied depending on the education finance system and the government support schemes for those entering higher education. Another possible avenue of added value to the participation model here may be to include taxes and benefits to explore the role of net lifecycle and foregone earnings in the decision process we have outlined.

References

Albert, C. (2000). "Higher Education Demand in Spain:The influence of Labour Market Signals and family Background". *Higher Education* 40: 147-162.

Barrett, A. Fitzgerald, J. and Nolan, B. (2002). "Earnings Inequality, Returns to Education and Immigration into Ireland", Labour Economics, 9, 665-680.

Becker, G., (1964) *Human Capital theoretical analysis with special reference to education*. New York: Columbia University Press for NBER

Ben Porath, Y. (1967) "The Production of Human Capital and the Life Cycle of Earnings". *The Journal of Political Economy*, Vol 75, No. 4, part 1: 352-365.

Bourguigon, F. Ferreira, F.H.G. Leite, P.G. (2003). Conditional Cash Transfers, Schooling and Child Labor: Micro-Simulating Bolsa Escola. Delta Working Paper no. 2003-07.

Cameron, S.V. Heckman, J. (1999). "The Dynamics of Educational Attainment for Blacks, Hispanics and Whites", NBER working paper 7249.

Card, D., (2001) "Estimating the return to schooling: Progress on Some persistent Econometric Problems". *Econometrica*, Vol. 69, No. 5. 1127-1160.

Department of Education and Science. (2003). Supporting Equity in Higher Education, Government Publications, Dublin.

Dubois, J. (2002). What Influences Young Canadians to Pursue Post-Secondary Studies?, Final Report, Strategic Policy, Human Resource Development Canada.

Duncan, A, and M. Weeks (1998), "Simulating transition probabilities using discrete choice models", *Proceedings of the American Statistical Association*, 106, 151-156.

Flannery, D. and O'Donoghue, C. (2009) "The Determinants of Higher Education Participation in Ireland: A Micro Analysis", *The Economic and Social Review*, Vol. 40, No.1, pp 7-107.

Fuller, W. C. Manski, C.F. Wise, D.A. (1982). "New Evidence on the Economic Determinants of Postsecondary Schooling Choices", *The Journal of Human Resources*, Vol. 17, No. 4. (Autumn, 1982): 477-498.

Gustman, Alan and Thomas Steinmeier (1981), "The Impact of Wages and Unemployment on Youth Enrollment and Labor Supply", *Review of Economics and Statistics* 63: 553-560.

Haan, P. (2006) "Much ado about nothing: conditional logit vs. random coefficient models for estimating labour supply elasticities", *Applied Economic Letters*, 13, 251-256.

Harmon, C., Oosterbeek, H., Walker, I. (2000). “The Returns to Education: A review of the Evidence, Issues and Deficiencies in the Literature”, Centre for the Economics of Education, Paper No' CEEDP0005.

Haveman, R. and Wolfe, B. (1995). “The Determinants of Children’s Attainments: A Review of Method and Findings”, *Journal of Economic Literature*, Vol. 33, No. 4 (Dec 1995), pp 1829-1878.

Heckman, J. 1979, “Sample selection bias as a specification error", *Econometrica*, Vol. 47, pp. 153-161.

Heckman, J. and Macurdy, T. (1980). “A Life Cycle Model of Female Labour Supply”, *The Review of Economic Studies*, Vol. 47, No. 1, Econometrics Issue. (Jan., 1980): 47-74.

Heller, D.E. 1997, “Student Price Responses in Higher Education: An Update to Leslie and Brinkman", *The Journal of Higher Education*, Vol. 68, No. 6 (Dec 1997) pp. 624-659.

Hole, A. (2007). “Fitting mixed logit models by using maximum simulated likelihood”, The Stata Journal, Vol. 7, No. 3, pp. 388-401.

Lauer, Charlotte. (2002). “Participation in Higher Education: The role of cost and return expectations”, *International Journal of Manpower*, vol. 43, 5

Mankiw N., D. Romer and D. Weil, 1992. “A Contribution to the Empirics of Economic Growth”, *Quarterly Journal of Economics*, Vol. 107.

O’Connell, P.J., Clancy, D. and McCoy, S. (2006). Who Went to College in 2004? A National Survey of New Entrants to Higher Education. Dublin: Higher Education Authority.

OECD, 2009. Education Today, The OECD Perspective. OECD Publishing, Paris

Rice, P.G. (1999), “The Impact of Local Labour Markets on Investment in further Education: Evidence from the England and Wales Cohort Studies”, *Journal of Population Economics*, Vol. 12, No 2, pp. 287-312.

Ruud, P. (1996), “Approximation and simulation of the multinomial probit model: An analysis of the covariance matrix estimation”, Working paper, Department of Economics, University of California, Berkeley.

Sanbonmatsu, L. Kling, J.R. Duncan, G.J. Brooks-Gunn, J. (2006). “Neighborhoods and Academic Achievement, Results from the Moving to Opportunity Experiment”, *The Journal of Human Resources*, 41(4): 649–691.

Smyth, E. (1999). “Educational inequalities among school leavers in Ireland 1979-1994”. *The Economic and Social Review* 30(3): 267-284.

Struefert, W. (1991). The effect of underclass isolation on schooling choice, processed. Univeristy of Wisconsin.

Stoikov, V. (1977). “On Some Models of the Educational Decision”, *Kyklos*, Vol. 30,: 74-87.

Train, K. (2003) Discrete Choice Methods with Simulation. New York: Cambridge University Press.

Walker, J.R. 1995. “The Effect of Public Policies on Recent Swedish Fertility Behaviour”, *Journal of Population Economics,* Vol. 8. pp 223-251.

Watson, D. 2004. “Living in Ireland Survey- Technical Report and Codebook for Data Users”, ESRI working paper no. 163.

Whelan, C.T. and Hannan, D. (1999). “Class Inequalities in Educational Attainment among the Adult Population in the Republic of Ireland”. *The Economic and Social Review* 30(3): 285-307.

Willis, Robert J. Rosen, Sherwin. (1979). “Education and Self Selection”, *The Journal of Political Economy*, vol. 87, 5, S7-S36.

Wilson, K. Wolfe, B. Haveman, R. (2005). “The Role of Expectations in Adolescent Schooling Choices: Do Youths Respond to Economic Incentives?” *Economic Inquiry*, Vol. 43, No. 3, July 2005: 467-492.

van Soest, A. (1995). “Structural models of family labor supply: A discrete choice approach”. *Journal of Human Resources*, 30, 63–88.

Tables and Figures

Table 1: Distribution of educational/labour choice by age

Age	Go to Higher Education	Not Go to higher education	Go to Higher Education and Work	Total
17	51	85	13	149
18	144	261	62	467
19	87	161	58	306
20	22	61	7	90
21	12	19	8	39
22	10	11	6	27
Total	326	598	154	1078

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

Table 2: Earnings equation (Sample: workers and unemployed aged 17-22 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	1213		Observations	927
R-squared	0.20		R-squared	0.21

Source: Author’s Calculations – Living in Ireland Survey, (1994-2001).
Note: The border region is used a the base category for the regionally dummies

Table 3: Student earnings equation (sample: students aged 17-22)

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-squared	0.21		R-squared	0.20

Source: Author's Calculations – *Living in Ireland Survey*, (1994-2001).
Note: The border region is used as the base category for the regionally dummies.

Table 4: Lifecycle 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	9556		Observations	7710
R-squared	0.28		R-squared	0.24

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

Table 5: Summary of Explanatory Variables by Choice

	Go to Higher Education	Not Go to higher education	Go to Higher Education and Work
Variable	Mean	Mean	Mean
Life-Cycle (LC) Simulated Earnings (per month)	1194.9	729.2	950.37
Foregone Earnings (per month)	799.6	0	727.3
Choice-Specific HHY (per month)	2091.4	2281.95	2106.7
Choice-Specific HHY^2	565.57	664.47	573.1
Foregone Earnings^2	90.7	0	76.8
LC Simulated Earnings^2	169.59	68.37	105.55
Choice-Specific HHY* LC Simulated Earnings	258.67	174.24	208.5
Choice-Specific HHY* Foregone Earnings	180.1	0	164.6
Foregone Earnings* LCSimulated Earnings	108.97	0	78.7
LC Simulated Earnings*Parents Ed Level	598.53	366.33	476.19
Choice-Specific HHY *Parents Ed Level	1159.74	1265.97	1163.3
Foregone Earnings *Parents Ed Level	425.33	0	384.59
LC Simulated Earnings*Social environment	-12.23	-9.471	-8.3
Foregone Earnings *Social environment	-112.62	0	-114.93
Choice-Specific HHY *Social environment indicator	-324.45	-346.54	-320.0
Observations	1078	1078	1078

Source: Author's Calculations – *Living in Ireland Survey*, (1994-2001).
Note: The square terms and cross products have been divided by 10000 for simplicity
Note: The term HHY indicates household income

Table 6: Conditional Logit Model Estimation Results

Independent Variables	Coefficient	p-value
Lifecycle Simulated Earnings	0.0020	0.02
Foregone Earnings	-0.010	0.008
Choice-Specific HHY	0.0039	0.06
Choice-Specific HHY^2	-0.0021	0.06
Foregone Earnings^2	0.014	0
Lifecycle Simulated Earnings^2	-1.15E-06	0.8
Choice-Specific HHY* Simulated Earnings	-6.6E-05	0.03
Choice-Specific HHY* Foregone Earnings	-0.003	0.19
Foregone Earnings* Simulated Earnings	-0.0003	0.13
Lifecycle Simulated Earnings*Parents Ed Level	0.0011	0.03
Choice-Specific HHY *Parents Ed Level	0.0023	0.32
Foregone Earnings *Parents Ed Level	0.0051	0.04
Lifecycle Simulated Earnings*Social environment	-0.0027	0.02
Foregone Earnings *Social environment	-0.00021	0.24
Choice-Specific HHY *Social environment indicator	-0.0022	0.02
Individuals		1078
Observations		3234
Log Likelihood		-1011.12

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

Note: The term HHY indicates household income

Table 7: Random Parameters Logit Model Estimation Results with no assumption of correlated random coefficients

Independent Variables	Coefficient	p-value
Lifecycle Simulated Earnings	0.0050	0.04
Foregone Earnings	-0.004	0.08
Choice-Specific HHY	0.009	0.01
Choice-Specific HHY^2	-0.004	0.09
Foregone Earnings^2	0.0009	0.1
Lifecycle Simulated Earnings^2	-0.002	0.01
Choice-Specific HHY* Simulated Earnings	-0.0008	0.15
Choice-Specific HHY* Foregone Earnings	-0.0018	0.24
Foregone Earnings* Simulated Earnings	-0.0008	0.4
Lifecycle Simulated Earnings*Parents Ed Level	0.0037	0.05
Choice-Specific HHY *Parents Ed Level	0.00078	0.89
Foregone Earnings *Parents Ed Level	0.0036	0.03
Lifecycle Simulated Earnings*Social environment	-0.00018	0.73
Foregone Earnings *Social environment	-0.0051	0.09
Choice-Specific HHY *Social environment indicator	-0.0019	0.03
Standard Deviation(Lifecycle Simulated Earnings)	0.012957	0
Standard Deviation (Choice-Specific HHY)	0.012671	0.009
Individuals		1078
Observations		3234
Log Likelihood		-974.411

Source: Author's Calculations – *Living in Ireland Survey*, (1995-2001).
Note: The term HHY indicates household income

Table 8: Random Parameters Logit Model Estimation Results with assumption of correlated random coefficients

Independent Variables	Coefficient	p-value
Lifecycle Simulated Earnings	0.0048	0.07
Foregone Earnings	-0.003	0.19
Choice-Specific HHY	0.011	0..06
Choice-Specific HHY^2	-0.055	0.09
Foregone Earnings^2	0.0084	0.22
Lifecycle Simulated Earnings^2	-0.027	0.02
Choice-Specific HHY* Simulated Earnings	-0.009	0.1
Choice-Specific HHY* Foregone Earnings	-0.021	0.22
Foregone Earnings* Simulated Earnings	-0.012	0.32
Lifecycle Simulated Earnings*Parents Ed Level	0.0035	0.07
Choice-Specific HHY *Parents Ed Level	-0.0009	0.8
Foregone Earnings *Parents Ed Level	0.0038	0.03
Lifecycle Simulated Earnings*Social environment	-0.0001	0.79
Foregone Earnings *Social environment	-0.004	0.15
Choice-Specific HHY *Social environment indicator	-0.0018	0.04
Standard Deviation(Lifecycle Simulated Earnings)	0.0125	0
Standard Deviation (Choice-Specific HHY)	0.0129	0.07
Co-Variance(Lifecycle Simulated Earnings-Choice-Specific HHY)	-0.0046	0.59
Individuals		1078
Observations		3234
Log Likelihood		-974.169

Source: Author's Calculations – *Living in Ireland Survey*, (1995-2001).
Note: The term HHY indicates household income

Table 9: Simulated effect on higher educational outcome and working status of alternative higher education grant systems

Choice	Original	Policy Option 1	Policy Option 2	Policy Option 3
Go to Higher Education	30.2%	31%	31.4%	26.5%
Not Go to Higher Education	55.5%	54.2%	53.6%	62.4%
Go to Higher Education and Work	14.2%	14.8%	15%	11.1%
TOTAL	100%	100%	100%	100%

Source: Author's Calculations – *Living in Ireland Survey*, (1995-2001).
Note: These are based on the estimates from table 7
Note: the percentages expressed above are the percentages our sample that choose that particular educational/labour outcome
Note: Policy option 1 involves extending the upper income limits for receiving any form of government support by IR£1000 on each type of support for each year of our analysis. We also increase the level of the adjacent and non-adjacent aspects of both full and partial grants by 10% for every year.
Note: Policy option 2 involves extending the upper income limits for receiving any form of government support by IR£2000 on each type of support for each year of our analysis. We also increase the level of the adjacent and non-adjacent aspects of both full and partial grants by 15% for every year.
Note: Policy option 3 involves a simulated tuition fee increase to approximately the level they would have been without the free tuition fee scheme; this was achieved with the use of a weighted average fee.