Parental Income and the Choice of Participation in University, Polytechnic or Employment at Age Eighteen: A Longitudinal Study

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ABSTRACT

This paper examines the link between parental income during adolescent years and higher education choices of the offspring at age 18. This study is the first to use a recent longitudinal data set from New Zealand (Christchurch Health and Development Surveys, CHDS), in the higher education context. The paper examines the impact of family income and other resources throughout adolescent years on later decisions to participate in higher education and the choice of type of tertiary education at age 18. A binary choice model of participation in education, and a multinomial choice model of the broader set of choices faced at age 18, of employment, university, or polytechnic participation are estimated. Among the features of the study are that it incorporates a number of variables, from birth to age 18, which allow us to control further than most earlier studies for ability heterogeneity, academic performance in secondary school, in addition to parental resources (e.g., childhood IQ, nationally comparable high school academic performance, peer effects, family size and family financial information over time). The results highlight useful features of intergenerational participation in higher education, and the effect of parental income on university education, in particular.

JEL classifications: I21, J13, J24, J18, I30

Key Words: Parental Income, Demand for Higher Education, Longitudinal

I. Introduction

The association between higher educational choices of young adults and their parental resources is observed in most countries. A general observation is that young adults from disadvantaged families are less likely to participate in university education. In addition, the experience of countries such as Australia and New Zealand, which abolished university fees to increase access throughout the 1970s to the 1980s has shown that the socio-economic background of students is highly stable over time. For example, in Australia 10 years after the abolition of university fees, the socio-economic background of university students had not changed, mainly representing white-collar occupation of the father and higher income (e.g. Williams, 1987; Wran, 1988).[1] Likewise, in New Zealand, in the 1990s, for every *seven* eighteen year olds from the highest income quintile families at universities, there was *one* from the lowest income quintile.[2]

Given that Australia and New Zealand have been generally egalitarian societies, these outcomes highlight the need for better understanding the determinants of participation in higher education across income groups, as a means of breaking cycles of disadvantage. In particular, given the close link between educational qualifications and lifetime earnings, the question of educational participation is important in understanding and addressing the *dynamics of income inequality* across generations.

This study examines higher education choices of young adults, using a rich longitudinal data set from New Zealand. The Christchurch Health and Development Study (CHDS) longitudinal data used in this study provides extensive economic and academic information on a cohort born in Christchurch in 1977. The data set therefore provides a great opportunity to incorporate a number of relevant variables, from birth to age 18, in addition to the parental income and resource variables of interest during the youth's earlier adolescent years, not available in many earlier studies. For example, the availability of information on Scholastic Test (IQ) results as early as age 8 is expected to reduce unobserved ability heterogeneity.

In addition, while eighteen-year-olds are expected to make personal choices to participate in higher education, these choices are by nature constrained by family resources, and earlier academic achievement (Blau, 1999; Feinstein and Symons, 1999; and Ermich and Francesconi, 2001). Another favourable feature of the study is that it can control for information on earlier nationally comparable academic performance results, three years prior

to higher education decisions.

Finally, the study incorporates the longitudinal nature of higher education decision, by modelling the choice to participate at university which is not in isolation, but within a set choices at age eighteen. Therefore, one of the features of the study is to also consider the decision to participate at university as a part of a greater set of options, of participation at a polytechnic, or entering the labour force, to present a fuller examination of the choices made at age 18. Sensitivity analyses of estimated probabilities for parental income and other resources and 'multiple effects' of given sets of combined personal and resource characteristics which resemble reality, perform quite well in predicting the demand for higher education, and the much lower higher education participation rates observed for eighteen year olds from lower income deciles.

The plan of this paper is as follows. A description of the Data is provided in Section II, followed by a brief presentation of the analytical framework for the study in Section III, and a discussion of the characteristics of the sample in Section IV. The models and results are presented in Section V, followed by the conclusions in Section VI.

II. Data

The Christchurch Health and Development Study (CHDS) used in the study is a longitudinal data set, which provides detailed annual information on a cohort born in Christchurch in 1977 throughout their childhood and as they leave school and make their transition to further education, training, and work. The information used in this study is from birth to when the respondents were 18. This data set is particularly advantageous because of the extensive amount of information on the youths' academic and home environments.[3] For example, we have information on the youth's parental income decile during adolescent years (ages 11 to 14), home ownership, number of siblings, extent of beneficiary (welfare) status, parental education, information on childhood IQ for personal cognitive and academic ability, peer information, nationally administered School Certificate examination scores at age 15 on Academic Performance, and earlier expressions of interest in higher education. While this data set has a long history and is well established in the medical and psychological literature, this study is among the first to use the educational and labour market features of the data set in an economics context.[4]

While the data set follows a cohort and is localized by nature, it provides a rather rare and special opportunity in providing a natural control of general environmental, social, and political conditions for the entire sample. This characteristic of the data set is important for examining the impact of variables, such as family resources, on teenage academic performance, and higher education and employment choices.

The education system in New Zealand is in many ways comparable with other English speaking countries. Education in New Zealand starts at age 5, with a year equivalent to a rigorous kindergarten year, and it continues for 12 additional years. Students at school at age 15 were expected to take the national level School Certificate Examinations at the end of their US, and Australian equivalent year of the 10th Grade (now called Year 11 in New Zealand, including the kindergarten year at age 5, also known as Fifth Form). These examinations that were nationally administered for decades in New Zealand, were based on the same set of questions, and unified grading scales for all participants. This is a great advantage from a data point of view, as it eliminates the problems with potential inconsistency in comparing grades a few years earlier across schools in lower and higher income localities, where standards may not be uniform for assessing academic achievement.

Polytechnics have a long tradition in New Zealand, Australia and the U.K, offering a wide range of vocational degrees, as an alternative to university education. Polytechnics degrees last from one to three years in duration. Examples are diplomas in Carpentry, Plumbing and Electrician training, Information Technology (IT), Tourism and Hospitality, etc. [5] Most degrees last around two years.

III. Analytical Framework

The theoretical framework, which is widely adopted in the economic literature on participation in higher education focuses on individual choice for long term investment in human capital and the inter-temporal nature of the investment decision (e.g. Becker, 1993; Schultz, 1961).

The decision to participate in higher education and training is intrinsically related to a number of factors. For example, investment in higher education is expected to result in higher returns for those with greater ability and a taste for life-time labour force participation. In addition,

household financial constraints would influence the cost of obtaining education. Moreover, family socio-economic background can affect the demand for post-compulsory and higher education through tastes, and the costs of obtaining information (see for example, Borjas, 1995, and Montgomery, 1991). Therefore, *ceteris paribus* those individuals who have higher academic ability are more likely to invest in higher education. Likewise, keeping ability constant, a greater potential to finance education will lead to greater participation.

An extended framework for analysing participation in higher education is based on the model developed by Willis and Rosen (1979) in estimating participation in university studies in the U.S. and applied to secondary school leaving in Britain by Rice (1987). In this framework, if Y_{io} represents the stream of potential life-time earnings net of education costs for the ith individual if the person chooses to leave education at an earlier age, and Y_{ij} the stream of life-time earnings if the individual undertakes a period of further education:

$$Y_{ij} = E_j (S_i), \quad j= 0,1. \tag{1}$$

then potential life-time earnings at each level of educational attainment (j) are expected to be a function (E_j) of the educational attainment at that level, as influenced by individual talents and abilities (S_i). The net expected present value of choosing the jth level of education for the ith individual is denoted by V_{ij}, and

$$V_{ij}, = V \{E_j (S_i), X_i, u_i\}, \quad j= 0,1. \tag{2}$$

where V_{ij} is the utility of net expected present value of life-time earnings at that level of education, and X_i represents observable family income and other resources, and personal and environmental characteristics which determine the individual's tastes (see for example, Case and Katz, 1991, and Card and Krueger, 1992), and expectations and the financial constraints facing the household, and u_i are the unobservables. The individual invests in additional education if the expected net benefits are positive.

While Willis and Rosen's analysis utilized structural models and emphasized self-selection, Rice's application utilizes reduced form models of participation and emphasizes the effect of financial constraints on school leaving choices.[6] Neither study had observable variables on academic ability such as IQ or academic test scores.

Empirical estimation of the probability of enrolment in tertiary education (Pr A) is based on equation (3) below:

$$\text{Pr A observed} = \Pr [(V_{i1} - V_{i0} = G(S_i, X_i, u_i) > 0] \quad (3)$$

Given the assumption that the distribution of net benefits conditional on S_i and X_i and their underlying characteristics are normally distributed, Pr A would follow the standard normal c.d.f. and equation (3) can be estimated via Probit analysis:

$$V_{i1} - V_{i0} \sim N (S_i'\beta + X_i'\gamma , \sigma^2) \quad (4)$$

with β, γ and σ^2 constant across the population. [7]

It is useful in modelling educational choices at age 18, to also consider that these choices are a part of a wider set of higher education institution type, and labour market options available. This allows us to examine the effect of family resources on the broader set of choices made at age 18, including or Employment as opposed to Economic Inactivity or Unemployment. In addition, it makes it possible to make a distinction between University education chosen at age 18, as opposed to Polytechnic education. In our modelling, we therefore, extend the modelling approach by Willis and Rosen (1978) and Rice (1987), by incorporating the decisions to participate in higher education in relation to other labour market choices. We consider the four options of participation at university, polytechnic, employment, or economic inactivity. These set of options take the following form:

$$\Pr \ l = G(S_i, X_i, u_i), \quad l = 1,2,3,4. \quad (5)$$

where l=1 represents participation in university education; 2, participation in polytechnic education (equivalent to North American Community Colleges); 3, employment; and 4, unemployment or economic inactivity. S_i , as before, represents personal characteristics such as academic ability and performance for individual *i*, and X_i represents family resources and environmental factors.

IV. Characteristics of the Sample

The characteristics of the sample are summarized in Tables 1 - 3. Table 1, shows marked differences in University and Polytechnic participation rates by eighteen year olds from different income quintiles. This summary statistic highlights that the probability of attending university by the highest income quintile is about 7 times higher than the lowest income quintile. In addition, the 18 year olds from the highest income quintile are about 6 times more likely to attend universities as opposed to polytechnics.

Table 2, in turn, provides group means of income deciles of the youth who chose each of the four choices of participation in University, Polytechnic, Employment and Unemployment or No economic activity. This is useful in highlighting that the eighteen year olds from the higher income deciles are significantly more represented among those participating at University education. By comparison, those who chose Polytechnic were on average from income decile 5 in their adolescent years, and those who participated at University were from income levels close to decile 7 (a mean income decile of 6.9) .

Table 3, in turn, shows general sample means for selected variables. For example, about half of the sample (52.7%) was female. The characteristics of the sample represent the national averages, such as the average IQ of 105.1 and the average School Certificate grade of 1.23 or a C. Home ownership by parents was 92.8.0%, and average proportion of family income from benefits was 9.4%. In addition, 43.83% of the mothers and 42.3% of the fathers of the respondents had no school qualifications, and 24.2% of mothers and 22.8% of fathers had tertiary (university or other higher) qualifications. The definition of all is available in Table A1 in the Appendix.

V. Estimations and Results

The two models of participation in tertiary education participation estimated are discussed below. The first model examines the determinants of participation in tertiary education via Probit analysis, where tertiary education includes participation at university, polytechnic and other higher learning institutions. Model 2 extends this model to examine the determinants of the *type* of tertiary institution attended in relation to other labour market choices of employment and unemployment.

Model 1: Participation in Tertiary Education at age 18

$$\Phi^{-1}(P_i) = \alpha + S_i'\delta + X_i'\varphi \qquad (6)$$

Φ^{-1} =The inverse of the standard normal cumulative distribution function.

P_i =TERTIARY: The probability that the respondent had entered or was entering tertiary education at age 18.

Where S_i represents a rich set of personal academic ability, and expectations variables for individual *i*, reducing usually unobserved heterogeneity, and X_i represents personal economic and environmental constraints such as parental income, home ownership, Proportion of Household Income from Government Benefits, number of siblings, etc. We also control for Peer Effects.

The explanatory variables in the model are as follows:

Family Resources:

Income Decile (adolescent years)
Household home owner
Proportion of household's gross income from government benefits
Number of siblings
Parental financial assistance in previous year (in dollars)
Transport Owner
Education of mother less than School Certificate (10th Grade)
Education of father less than School Certificate (10th Grade)
Private School

Personal Characteristics:

Female (binary variable)
Ethnic Background (Maori, Pacific Islands)
Child's IQ score at age 8
Expressed intention at age 16 to attend either University or Polytechnic

Academic Performance:

Age 15 Tested Performance (Average 10th Grade 'School Certificate' grade for 5 subjects)
Passed 11th Grade

Foregone Earnings:

Local youth unemployment rate

School and Peer Effects:

Proportion of 10th Grade (Fifth Form) class at secondary school continuing to 11th Grade (Sixth Form) or beyond.
Deviant Peer Association at Age 15
Rural School

The set of variables in this study on family resources, and personal academic ability and performance are noticeably favourable in covering a wide range of factors and over am extended period of time from childhood and throughout adolescent years.

It may be noted that for most of the variables included in the model, CHDS includes information for more than one year. In addition, for a number of financial or peer group variables information is available for either age 14, 15 or 16. Our focus in this study is on family economic and other resources through time, in particular, during the more-recent adolescent years. Therefore, the variables included reflect either availability and/or suitability to the objectives of the study. For example, for IQ, the earliest measure available at age 8 was chosen, as an early measure of individual ability heterogeneity. In the case of family resources and income, measures of adolescent years were included, providing measures that were recent but clearly prior to the higher education choices.

The income decile variable is useful in providing a measure of relative income during an extended period of ages 11 to 14, and previous to age 18.[8] The variable on the proportion of family income from welfare benefits further reflects potential lack of family resources through beneficiary status (at age 14). Home ownership reflects family assets, and the number of siblings reflects family size demands on family resources. There is also a variable included on the value of financial assistance received from parents and relatives during the previous year. It is useful that family resource variables provide information over an extended time period from rather than only at age 18, and especially earlier time periods.

The variable on the proportion of the young person's 10^{th} Grade class continuing to the post-compulsory 11^{th} Grade is further expected to reflect school effects, as well as measures of peer effects. [9]

Education is compulsory in New Zealand up to the age of 16. In these models we estimate the probability of tertiary education choices made for the sample of the youth who were at school at age 16, and were therefore eligible for further study. The results can, therefore, be interpreted as the probability of choosing tertiary education, conditional on not having left school at age 16. 84.7% of the sample had continued at age 16. We have explored the determinants of school leaving choices at age 16 in detail, elsewhere, (Maani and Kalb,

forthcoming) using the same data set. This analysis shows that school leaving, when it ceases to be compulsory, at age 16 is also affected by childhood and adolescent parental income, as well as by prior academic performance.

Two sets of variables above on academic performance (Tested performance at age 15, and Passing 11th Grade), and intentions to participate in either university or polytechnic, at age 16) provide important information on personal tastes, motivation, talents and abilities. This information is expected to significantly reduce usually unobservable heterogenerity in this study. However, academic performance and expectations can also reflect parental investments and environmental resources over time. Therefore, for each model additional sets of results excluding these variables are also presented. These additional estimations allow examining potential indirect links and effects of family resource variables through academic performance and expectations.

The definition of tertiary education here is based on enrolment in university or polytechnic at the time of the survey, or otherwise an intention to do so and qualifying to do so if the respondent was still at school and completing secondary school. In their 18th year, some respondents were still in secondary school, and in estimating the models of participation in tertiary education two options were considered. The first was to eliminate the sub sample of 268 individuals who were still at secondary school, but the main disadvantage of the approach was that it included in the sample those who had been working or were unemployed, but excluded a major part of the sample who were completing 12th Grade and were planning to participate in tertiary education in a few months. The alternative approach pursued was to consider the full sample, which included those respondents who were still in secondary school, but to also incorporate their plans for the coming year, and the information on having fulfilled the academic requirements to participate in university or polytechnic.[10] Therefore, the analysis gives estimates of where the young persons were at or by all indications headed.

Employment was also defined if the person was no longer studying and was currently employed, or alternatively, if the person was completing school and had organised employment, rather than an intention to study. [11]

A-priori, it was uncertain whether specifying the tertiary education category at age 18 would result in an over- or under- estimation of tertiary participation levels that may materialise at later ages. For example, for the group in the last year of high school, some tertiary

participation expectations may not be materialised, resulting in overestimations. Alternatively, an underestimation may result due to a small number of students who may subsequently meet secondary school academic requirements, and choose higher education.

To examine this, the age 18 tertiary specification used in this study was checked against additional information which became available from the cohort's age 21. This comparison is reassuring in that the age 18 tertiary education measure closely resembles the educational choices that materialised later on. For example, 54.2% of the sample were categorised as participating in tertiary education when aged 18. By age 21, 55.5% of this sample had obtained or was enrolled in a tertiary degree. Therefore, only a small sample of about 1.3% more than those categorised for tertiary education at age 18 had chosen the higher qualifications by age 21. This indicates that our specification only marginally underestimates higher education choices reached by age 21.[12] In addition, and favourably, a comparison of the mean characteristics of those with tertiary education specified at age 21 and at age 18 indicates that the two groups are not distinguishably different.

For comparison purposes, Models 1 and 2 were also estimated for the sub sample of the 317 individuals who were no longer in secondary school at age 18. The results of the model based on the two samples have different interpretations, with the results in the body of the paper placing more emphasis on where all students were headed. These additional results (available from the author) show that the results and conclusions of the full sample presented are robust. In addition, the results on the sample of 586 predict higher initial unemployment rates for those who have not had firm employment plans at secondary school.

Model 1 results are reported in Table 4, and both the estimated coefficients and marginal effects are presented. These results highlight that conditional on having continued with schooling at age 16, continuation to tertiary education can be mainly explained by earlier academic performance, peer effects, and intentions expressed two years earlier to attend university or polytechnic. In other words, the strong relationship that can be observed between parental income decile and tertiary education (as reported in tables 1 and 2), is no longer statistically significant when important academic performance, prior educational choices and tastes and expectations are controlled for. This result is consistent with a number of hypotheses regarding links between academic performance and family resources in childhood and adolescent years. The results are also consistent with models in which family resources such as income and information form tastes and expectations for self selection.

In addition, it is interesting to note that the coefficients for gender and ethnicity in these models, which estimate participation in tertiary education from secondary school, and controlling for academic performance are not statistically significant.[13] This result is, in particular, of interest in relation to higher education demand by ethnic minorities.

On the effect of academic performance on tertiary education, the mean of the marginal effect of a one-grade increase in the average School Certificate mark (for example from an average of C to an average of B) was a 12.7 percentage points increase in the probability of participation in tertiary education. Likewise, the additional effect of having passed Year 11 (Sixth Form) was an increased probability by 15.4 percentage points. An intention at age 16 to attend either university or polytechnic increased the probability of participating in tertiary education by another 23.6 percentage points. However, the results show consistently across these estimations that private schooling does not have a statistically significant effect on tertiary education choices.

Two sets of additional estimates of Model 1, excluding intentions to attend university or polytechnic (INTEND_16_UNI AND INTEND_16_POLY), and two additional academic performance variables (AVE_GRADE, and PASS_11th Grade) are further presented in Table 5. These results show a significant increase in the magnitude and significance of variables on the impact of family and environmental resources (Income Decile, Welfare Benefits, Parental Assistance, IQ8), and peer effects. In particular, the family resource variables become more significant when AVE_GRADE, and most significantly, when PASS_11th Grade are excluded from the model. These results support the indirect links between family resources and tertiary education choices through the offspring's academic performance and educational expectations.

Overall, the results of Model 1 indicate that the decision to attend tertiary education is influenced by a host of personal choice and household characteristics, which operate significantly through academic performance and expectations by age 18.

Model 2: Type of Tertiary Education and Employment Choices at Age 18

This three-equation multinomial logit model examine the effect of parental resources and economic constraints on the choices made at age 18.

$$\ln\left[\frac{P_{uni}}{P_u}\right] = f(S_i, X_i) \quad (7)$$

$$\ln\left[\frac{P_{poly}}{P_u}\right] = f(S_i, X_i) \quad (8)$$

$$\ln\left[\frac{P_e}{P_u}\right] = f(S_i, X_i) \quad (9)$$

Where P_{uni} = The probability that the respondent attends university

P_{poly} = The probability that the respondent attends a polytechnic or other non-university tertiary institution

P_e = The probability that the respondent is employed or has a job arranged

P_u = The probability that the respondent was unemployed or out of the labour force

The results are presented in Table 6.[14] In this three-equation model, the estimated coefficients and the marginal mean probability effects are in relation to the base category of unemployment or OLF status at age 18. Both coefficients and marginal effects are presented.[15]

A significant result is that adolescent parental income decile exerts a direct effect on the type of tertiary institution attended, showing a significantly higher probability of university attendance, as opposed to the other three options. This result is robust although we control for a large set of other academic and personal and environmental characteristics.

The probability of choosing employment rather than tertiary study or unemployment at age 18 is negatively associated with parental financial assistance.

A larger number of siblings, which reflects potentially less parental financial assistance available, is positively associated with a greater probability of employment as opposed to tertiary study or unemployment at age 18.

In addition to the significant effect of parental income decile during adolescent years, these results indicate that participation at university, as opposed to work, unemployment, or attendance at the polytechnic, is influenced by few other important variables.

Finally, participation in university is influenced significantly through academic performance as measured by (10th Grade) School Certificate marks and a pass in (11^{th} Grade) Sixth Form Certificate exams. A significant statistical relationship is, in turn, not established between academic performance and attendance in the polytechnic. IQ is also statistically significant in determining the extended choices at age 18, controlling for usually unobserved personal and early academic performance. This is consistent with the hypothesis that students are sorted into university and polytechnics based on their academic performance and tastes, while these factors are expected to reflect other interests, and the effect of unobservable family background factors over the years of growing up. While in addition to these effects, parental income has an additional effect on sorting students to university or polytechnic.

Estimates of an additional specification of Model 2 excluding intentions to attend university or polytechnic (INTEND_16_UNI AND INTEND_16_POLY), and academic performance variables (AVE_GRADE, and PASS_11^{th} Grade) is also provided in Table A2 in the Appendix. Similar to the findings for Model 1, when these variables are excluded from the model, the impact of family and environmental resources, and peer variables becomes more significant in explaining university participation. Most significantly, the marginal effect of income decile doubles (from 2.1% to 4.1% for each decile). In addition, as earlier, the effects of IQ, financial assistance through benefits, and peer effects become more pronounced and significant.

Estimated Probabilities of Alternative Scenarios

Additional analyses of selected estimated probabilities of each of the four outcome categories are further provided in Tables 7 and 8. The estimated probability levels are for specific choices in Model 2, while placing all other explanatory variables at their mean values. A description of the estimation methods used for predicting probabilities based on multinomial logit estimations is available in footnote 16 (and further details, are available in e.g. Davidson and MacKinnon (1993)). The first row of Table 7 provides the mean estimated probabilities of the four outcomes. [16]

Table 7 shows that the estimated probability of attending university increases significantly with parental income decile, even when keeping academic performance and other variables constant at their mean values. In contrast, the probability of attending the polytechnic decreases significantly as income decile increases.

In addition, Table 7 highlights that academic performance is a key factor in participation in tertiary education and in the type of tertiary institution attended. For example, with an average School Certificate grade of C, the probability of attending the polytechnic is slightly higher at 25.6%, compared to 21.9% for attending the university. In comparison, with an average School Certificate grade of A, the estimated probability of attending the polytechnic is as low as 9.9% compared to the probability of attending university of 77.2%. The probability of being mainly employed or unemployed at age 18 also diminishes significantly with higher academic performance, reflecting the choice of participation in university studies.

Predicted probabilities of 'multiple effects' provided in Table 8 are also useful in highlighting the effect of combined characteristics in predicting significantly different probabilities of enrolment in university. For these multiple effects, parental income is kept at mean values to give examples of choice outcomes, which can resemble reality closely by combining the effects of certain personal, other family resource, and peer characteristics. Scenarios 1 and 2 in Table 8 highlight the effect of family resources (proportion of family income from beneficiary status) and peer effects on type of institution attended and/or employment choices.

Scenarios 3 and 4, highlight the role of self and peer academic performance. These scenarios highlight that academic performance results alone are capable of predicting major differences in outcomes (with a high probability of university participation of 839 per thousand, as compared to an unfavourable outcome of 2 per 1000, based only on self academic performance in the 10^{th} and 11^{th} grades and peer educational choices at age 16). These have important implications for assisting groups that have low representation at the tertiary level, such as the youth from the lower income deciles, as the study highlights, that the process of improving educational opportunities should also encompass the earlier stages of the educational process and academic performance for eligibility and interest in higher education.

The last scenario with a combination of academic performance, economic resources and peer effects predicts a very high (84%) probability of university participation and a low (2%)

probability of unemployment or economic inactivity at age 18.

The above results are consistent with a-priori expectations, in showing the effect of parental income and academic performance on the type of tertiary institution attended. The results are further consistent with educational choice models presented in highlighting a constrained self-selection and sorting process in which economic factors and academic ability, schooling and academic performance play important roles.

VI. Conclusion

This study has provided empirical evidence on the effect of family resources on the choice of tertiary study or employment, and the type of tertiary institution attended at age 18. The favourable set of variables included, and the longitudinal nature of the Christchurch Health and Development data sets employed allowed controlling for a number of relevant factors, expected to reduce usual unobserved heterogeneity, in this study relative to many other studies. In particular, the analysis incorporated variables on academic ability and nationally comparable academic performance as well as household economic conditions, and school and peer effects.

The study supports the hypothesis that students sort themselves into tertiary study or labour market choices based on the expected returns of these choices, their tastes, and information available to them through their family, school and peer networks. In this transition from school to further study, work or unemployment, the student's academic performance, expectations of further study, peer effects and parental resources are important factors.

Finally, the results provide strong support for the hypothesis that family income is associated with the type of tertiary education attended, where the probability of university attendance increases significantly with parental income, even when controlling for personal academic ability and performance. In addition, the choice of the type of tertiary institution attended is significantly influenced by the prior academic performance of the young adult, his or her expectations.

The results are further consistent with recent findings of a growing body of literature in providing evidence on the link between parental resources and the academic performance of children and adolescents. This study extends that international literature by providing

evidence on the type of tertiary education, within a wider range of options at age 18. Examples are Maani and Kalb (forthcoming) with the CHDS data for New Zealand, Feinstein and Symons (1999); and Ermisch and Francesconi (2001), for the UK; and Blau (1999), and Gregg and Machins (1998), for the US., regarding the importance of resources throughout childhood in determining children's academic performance. An implication of this link is that academic performance effects reported are also expected to partly reflect the long-term effects of family resources on higher education choices at age 18.

Table 1

Participation in Higher Education and Income Deciles

Percentage Participation	Income Quintile				
	1	2	3	4	5
Age 18:					
Participation in University	10 %	18 %	20 %	40 %	69 %
Participation in Polytechnic	17 %	21 %	27 %	18 %	11 %

Source: Christchurch Health and Development Surveys. Average Adolescent family income deciles (ages 11-14).

Table 2
Participation in Higher Education and Income Deciles

Choice at Age 18:	**University**	**Poly-technic**	**Employment**	**Unemployment**
Mean Parental Income Decile Adolescent Years	7.1	5.2	5.4	5.2

Source: Christchurch Health and Development Surveys. Average Adolescent family income deciles (ages 11-14), and participation choices at age 18.

Table 3
Characteristics of the Sample

Characteristics	Means (Standard deviations)
Personal Characteristics	
Female (%)	52.7%
Maori Ethnicity (%)	5.6%
Pacific Island Ethnicity (%)	2.2%
IQ (tested at age 8)	105.1 (14.3)
Education	
Average School Certificate Grade (where E=0, D=0, C=1, B=2, A=3)	1.23 (0.80)
Passed 11th Grade (%)	77.6%
Intended University Participation at Age 16 (%)	36.5%
Intended Polytechnic Participation at Age 16 (%)	21.5%
Mother with No Qualifications	43.8%
Mother with a Tertiary Qualification	24.2%
Father with No Qualifications	42.3%
Father with a Tertiary Qualification	22.82%
Family Resources and Social Environment	
Average Income Decile (10 is most affluent)	5.86 (2.50)
Number of Siblings	1.48 (0.89)
Percentage of Parents who have their Own Home	92.8%
Proportion of Family Income from Benefits	9.4%
Rural Location at Age 15	15.70%
Regional Unemployment Rate by Gender	10.6%
Private Schooling (percentage of school years)	1.84 (8.04)
Proportion of Class Continuing at age 16	86.0% (11.0)
Average Association with Deviant Peers at age 15 (10 is the highest association)	1.89 (2.12)
Outcome Categories (at Age 18)	
University (n=194)	33.1%
Polytechnic (n=124)	21.2%
Employed (n=120)	20.5%
Unemployed or Out of the Labour Force (n=148)	25.2%
Sample size: 586	

Table 4: Participation in Tertiary Education

Estimates (t-statistics)

Probit Estimates: (Dependent Variable TERT18: 1= Tertiary Education (all types); 0=Otherwise)

Explanatory variables	**Coefficients**	**Marginal Effects: Mean of dP/dX**
CONSTANT	- 4.647 (1.720)	
FEMALE	0.053 (0.368)	0.062
MAORI	-0.160 (0.636)	-0.049
P_ISLAND	0.087 (0.221)	0.027
IQ8	0.007 (1.310)	0.002
AVE_GRADE	0.416 * (3.817)	0.127 *
PASS_11TH GRADE	0.502 * (3.042)	0.154 *
Family Resources:		
INCOME_DECILE	0.020 (0.649)	0.006
OWN_HOME	0.286 (1.135)	0.087
BENEFIT_PROP	0.329 (1.302)	0.101
NUM_SIBLINGS	-0.016 (0.238)	-0.005
MOTHER_NO_Q	-0.043 (0.306)	- 0.013
MOTHER_TERT_Q	0.133 (0.799)	0.040
FATHER_NO_Q	-0.070 (0.514)	-0.022
FATHER_TERT_Q	-0.016 (0.095)	-0.005
PARENTAL_ASSISTANCE	0.007 (1.502)	0.002
OWN_TRANSPORTATION	-0.014 (0.110)	0.004
PRIVATE_SCHOOL	- 0.007 (1.014)	- 0.002
*******		
INTEND_16_UNI	0.416 * (3.063)	0.128 *
INTEND_16_POLY	0.352 * (2.344)	0.108 *
LOCAL_UNEM	0.143 (0.602)	0.044
PEERS_CONTINUE	1.171 * (2.146)	0.359 *
PEER_DEVIANT	-0.043 (1.511)	-0.013
RURAL	0.382 (1.521)	0.117
Sample Size: 586		
Log Likelihood=: - 315.771	R-Squared = 0.279	

* Estimates significant at 0.05. (TERT18=1)= 54.3% of sample.

Table 5: Participation in Tertiary Education (Alternative Specifications)

Estimates (t-statistics)

Probit Estimates: (Dependent Variable TERT18: 1= Tertiary Education (all types); 0=Otherwise)

Explanatory variables	**Coefficients (1)**	**Marginal Effects: Mean of dP/dX**	**Coefficients (2)**	**Marginal Effects: Mean of dP/dX**
CONSTANT	- 4.383 (1.639)		- 6.473 * (2.543)	
FEMALE	0.057 (0.403)	0.018	0.192 (1.413)	0.064
MAORI	- 0.109 (0.436)	- 0.034	- 0.075 (0.306)	- 0.025
P_ISLAND	0.124 (0.318)	0.038	0.125 (0.335)	0.042
IQ8	0.007 (1.343)	0.002	0.023 * (5.404)	0.008 *
AVE_GRADE	0.458 * (4.309)	0.143 *	----------	---------
PASS_11TH GRADE	0.536 * (3.268)	0.167 *	----------	----------
Family Resources:				
INCOME_DECILE	0.021 (0.694)	0.007	0.061 * (2.056)	0.020 *
OWN_HOME	0.273 (1.095)	0.085	0.239 (0.993)	0.086
BENEFIT_PROP	0.375 (1.487)	0.117	0.528 * (2.150)	0.177 *
NUM_SIBLINGS	0.007 (0.115)	0.002	0.019 (0.315)	0.007
MOTHER_NO_Q	- 0.053 (0.382)	- 0.016	- 0.0881 (0.652)	- 0.029
MOTHER_TERT_Q	0.103 (0.626)	0.032	0.205 (1.289)	0.069
FATHER_NO_Q	- 0.101 (0.752)	- 0.032	- 0.141 (1.076)	- 0.047
FATHER_TERT_Q	- 0.002 (0.012)	- 0.0006	0.066 (0.401)	0.022
PARENTAL_ASSISTANCE	0.006 (1.491)	0.002	0.009 * (2.032)	0.003 *
OWN_TRANSPORTATION	- 0.022 (0.176)	- 0.007	- 0.033 (0.269)	- 0.011
PRIVATE_SCHOOL	-0.007 (0.970)	- 0.002	- 0.007 (1.051)	- 0.002
******				
INTEND_16_UNI	----------	----------	----------	----------
INTEND_16_POLY	----------	----------	----------	----------
LOCAL_UNEM	0.136 (0.576)	0.042	0.212 (0.939)	0.071
PEERS_CONTINUE	1.098 * (2.059)	0.343 *	1.379 * (2.602)	0.464 *
PEER_DEVIANT	- 0.041 (1.489)	- 0.013	- 0.072 * (2.699)	- 0.024 *
RURAL	0.333 (1.338)	0.104	0.448 (1.874)	0.150
Log Likelihood	- 322.825		- 345.767	
R-Squared	0.256		0.186	
Sample Size: 586				

* Estimates significant at 0.05.

Table 6: Type of Tertiary Education and Employment Choices at Age 18

Estimates (t-statistics), and Marginal Effects

Multinomial Logit: (Dependent Variable WORKTERT18: =University participation; Polytechnic/Other tertiary participation; and Employment; compared to Unemployed or OLF

Explanatory variables	$\ln\left(\frac{P(Employed)}{P(Unemployed\ or\ OLF)}\right)$	$\frac{dP}{dX}$	$\ln\left(\frac{P(Polytechnic)}{P(Unemployed\ or\ OLF)}\right)$	$\frac{dP}{dX}$	$\ln\left(\frac{P(University)}{P(Unemployed\ or\ OLF)}\right)$	$\frac{dP}{dX}$
CONSTANT	4.772 (0.655)		- 1.584 (0.272)		- 20.440 * (3.218)	
FEMALE	0.498 (1.357)	0.032	0.819 * (2.492)	0.109 *	- 0.224 (0.662)	-0.078
MAORI	- 0.912 (1.518)	-0.068	- 0.807 - (1.426)	-0.060	- 0.406 (0.651)	0.015
P_ISLAND	0.880 (1.038)	0.071	0.305 (0.369)	-0.036	0.922 (0.831)	0.069
IQ8	0.037 * (3.065)	0.002 *	0.023 * (1.963)	0.00005*	0.038 * (2.975)	0.002 *
AVE_GRADE	0.023 (0.087)	-0.040	0.025 (0.098)	-0.063	1.466 * (5.208)	0.172 *
PASS_11th GRADE	- 0.798 * (2.395)	-0.190 *	0.310 (0.909)	-0.032	2.537 * (2.398)	0.309 *
Family Resources:						
INCOME_DECILE	0.037 (0.502)	0.003	- 0.061 (0.864)	-0.018	0.163 * (2.163)	0.021 *
OWN_HOME	- 0.065 (0.131)	-0.041	0.395 (0.763)	0.038	0.515 (0.769)	0.045
BENEFIT_PROP	0.115 (0.200)	-0.026	0.337 (0.623)	0.004	0.896 (1.362)	0.087
NUM_SIBLINGS	0.440 * (2.893)	0.045 *	0.202 (1.350)	0.007	0.061 (0.349)	-0.015
MOTHER_NO_Q	0.0819 (0.253)	0.016	- 0.200 (0.647)	-0.039	0.122 (0.345)	0.021
MOTHER_TERT_Q	- 0.358 (- 0.798)	-0.046	- 0.169 (0.425)	-0.022	0.296 (0.775)	0.053
FATHER_NO_Q	0.005 (0.016)	0.006	0.094 (0.312)	0.030	- 0.357 (1.047)	-0.046
FATHER_TERT_Q	- 0.275 (0.602)	-0.027	0.223 (0.545)	0.074	- 0.631 (1.545)	-0.077
PARENTAL_ ASSISTANCE	- 0.081 * (3.828)	-0.010 *	- 0.001 (0.168)	0.003	- 0.0009 (0.121)	0.002
OWN_ TRANSPORT	1.143 * (3.761)	0.105 *	0.802 * (2.707)	0.060 *	0.158 (0.477)	-0.051
PRIVATE-SCHOOL *****	0.016 (0.845)	0.002	- 0.006 (0.324)	- 0.001	- 0.003 (0.160)	- 0.0005
INTEND_16_UNI	- 0.096 (0.276)	-0.049	0.261 (0.825)	0.0003	0.888 * (2.860)	0.097 *
INTEND_16_POLY	0.072 (0.217)	-0.029	0.863 * (2.783)	0.125 *	- 0.012 (0.030)	-0.042
LOCAL_UNEM	- 0.006 (0.009)	-0.006	- 0.357 (0.699)	-0.087	0.762 (1.399)	0.106
PEERS_CONTINUE	0.347 (0.298)	-0.110	1.697 (1.466)	0.113	2.705 * (1.969)	0.233 *
PEER_DEVIANT	- 0.026 (0.415)	0.002	- 0.073 (1.150)	-0.006	- 0.079 (1.117)	-0.005
RURAL	- 0.704 (1.007)	-0.109	- 0.095 (0.1777)	-0.020	0.829 (1.468)	0.122

* Estimates significant at 0.05. Sample Size= 586 Log-likelihood= - 585.49 Scaled R^2= 0.575

Table 7: Predicted Probabilities of Unemployment, Employment, Attending a Polytechnic, or University

Alternative Individual Characteristics

Characteristics		Unemployed or OLF	Employed	Polytechnic	University
Overall Characteristics at Mean Values		0.2526	0.20481	0.2116	0.33106
Income Decile of :	1	0.28656	0.1936	0.3107	0.2090
	4	0.2701	0.2058	0.2485	0.2755
	7	0.2473	0.2126	0.1920	0.3479
	10	0.2197	0.2134	0.1435	0.4233
Mother with No Qualification		0.2490	0.2173	0.2022	0.3314
Mother with a Tertiary Qualification		0.2688	0.1537	0.2111	0.3663
Father with No Qualification		0.2521	0.2140	0.2153	0.3184
Father with a Tertiary Qualification		0.2663	0.1852	0.2560	0.2924
<u>Academic Performance Age 15</u>					
Ave. S.C. Mark:	D or E	0.3543	0.3175	0.2608	0.0672
	C	0.2908	0.2331	0.2565	0.2194
	B	0.1829	0.1312	0.1928	0.4930
	A	0.0788	0.0494	0.0996	0.7720

Note: 586 individual predictions are calculated for each category and the average of those predictions is computed.

Table 8: Predicted Probabilities of Unemployment, Employment, Attending a Polytechnic, or University

Multiple Effects

Characteristics	Unemployed or OLF	Employed	Polytechnic	University
Average Parental Income Decile and:				
Economic and Environmental Scenarios				
No family Income from Benefits and the Rest of the age 15 Class Continuing	0.2261	0.1940	0.2281	0.3517
All Family Income from Benefits and none of the Rest of the age 15 Class Continuing	0.4114	0.2545	0.1255	0.2086
Academic Performance & School and Peer Scenarios				
Average School Certificate Mark of A and passed 11th Grade, and all of the Rest of the age 15 Class Continuing	0.0491	0.0410	0.0721	0.8392
Average School Certificate Mark of C and failed 11th Grade, and none of the Rest of the age 15 Class Continuing	0.5440	0.3972	0.0546	0.0024
High Probability of University Participation				
Average School Certificate Mark of A, passed 11th Grade, no Family Income from Benefits, IQ +2 Std. deviations, and all of the Rest of the age 15 Class Continuing	0.0229	0.0604	0.0743	0.8422

Note: 586 individual predictions are calculated for each category and the average of those predictions is computed.

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APPENDIX A
Table A1: Definition of the Variables

Dependent Variables:	
Binomial Tertiary (TERT18)	Binary dependent variable = 1 for attending or about to attend a tertiary institution at 18 years of age.
Multinomial Tertiary (WORKTERT18)	Multinomial dependent variable at age 18 and =0, 1, 2, 3 for attending or about to attend: 3= University 2= Polytechnic or other non-University tertiary institution 1= Employed (or has a job arranged) and is not attending a tertiary institution 0= otherwise
Explanatory Variables:	
Personal Characteristics:	
FEMALE	1 for a female, 0 for a male.
MAORI	1 if Maori; 0 otherwise.
Pacific Islander (P_ISLAND)	1 if a Pacific Islander; 0 otherwise.
Total Intelligence Quotient (IQ8)	The child's measured total IQ score at 8 years of age (revised Wechsler Intelligence Scale for Children).
Intention to go to University (INTEND_16_UNI)	1 for an intention expressed to go to University at age 16; 0 otherwise.
Intention to go to University (INTEND_16_POLY	1 for an intention expressed to go to Polytechnic at age 16; 0 otherwise.
Family Resources:	
Average Income Decile (INCOME_DECILE)	Average income decile of the family when adolescent (aged between 11 and 14 years): 1 is consistently poor; 10 is consistently affluent.
Parents Own their Own Home (OWN_HOME)	1 if parents own their own home and the child is living at home at 15 years of age; 0 otherwise.
Proportion of Family Income from Benefits (BENEFIT_PROPORTION)	The proportion (between 0 and 1) of the family's income derived from social welfare benefits (age 14).
Number of Siblings (NUM_SIBLINGS)	Number of siblings in the home at 15 years.
Mother without Qualifications (MOTHER_NO_Q)	1 if mother does not have formal educational qualifications (School Certificate or higher); 0 otherwise.

Mother with Tertiary Qualifications (MOTHER_TERT_Q)	1 if mother has a tertiary qualification; 0 otherwise.
Father without Qualifications (FATHER_NO_Q)	1 if father does not have formal educational qualifications (School Certificate or higher); 0 otherwise.
Father with Tertiary Qualifications (FATHER_TERT_Q)	1 if father has a tertiary qualification; 0 otherwise.
PARENTAL_ASSISTANCE	Amount of assistance from parents and relatives given to each individual in previous year (average weekly amount in dollars).
OWN_TRANSPORTATION	1 if owns a car or motorcycle ; 0 otherwise.
PRIVATE_SCHOOL	Percentage of school years at private school. (0-100).
Academic Performance:	
Average School Certificate Grade (AVE_GRADE)	The average value of all School Certificate (10th Grade) subjects sat with weightings of 3 for an A, 2 for a B, 1 for a C and 0 for a D or E.
Pass in Sixth Form Certificate (PASS_11th GRADE)	1 for a pass in 11th Grade (Sixth Form, an d the year following School Certificate); 0 otherwise.
Local Labour Market an d Foregone Earnings:	
Registered Unemployment (LOCAL_UNEM)	Regional unemployment rate in which each individual was living at 15 years of age, by gender. (Source: 1991 Census of Population and Dwellings: Regional Summary). There were 8 regions and their corresponding levels of unemployment ranging between 5.9 and 12.1 percent.
School and Peer Effects:	
Proportion of Students Continuing (PEERS_CONTINUE)	Proportion of an individual's Fifth Form class (Year 11) within the data set continuing onto the Sixth Form. The relevant individual is excluded from the calculation.
Affiliation with Deviant Peers (PEER_DEVIANT)	Affiliation with deviant peers at age 15 based upon self-reported friends' use of tobacco, alcohol, illicit drugs, other illegal behaviour, etc: 0-10, with 10 being the most deviant affiliations.
Rural School (RURAL)	1 if was not living in a main urban centre at 15 years of age; 0 otherwise.

APPENDIX A

Table A2: Type of Tertiary Education and Employment Choices at Age 18
Alternative Specification Excluding Academic performance and Intentions

Estimates (t-statistics), and Marginal Effects

Multinomial Logit: (Dependent Variable WORKTERT18: =University participation; Polytechnic/Other tertiary participation; and Employment; compared to Unemployed or OLF

Explanatory variables	$\ln\left(\frac{P(Employed)}{P(Unemployed\ or\ OLF)}\right)$	$\frac{\overline{dP}}{dX}$	$\ln\left(\frac{P(Polytechnic)}{P(Unemployed\ or\ OLF)}\right)$	$\frac{\overline{dP}}{dX}$	$\ln\left(\frac{P(University)}{P(Unemployed\ or\ OLF)}\right)$	$\frac{\overline{dP}}{dX}$
CONSTANT	- 5.676 (0.805)		-1.318 (0.232)		- 24.530 (4.312)	
FEMALE	0.304 (0.901)	- 0.001	0.927 * (2.914)	0.128 *	0.031 (0.101)	- 0.057
MAORI	- 0.899 (1.527)	- 0.082	- 0.632 (1.160)	- 0.040	- 0.315 (0.578)	0.023
P_ISLAND	0.605 (0.754)	0.048	0.377 (0.460)	0.007	0.437 (0.438)	0.020
IQ8	0.288 * (2.725)	-0.0006*	0.0249 * (2.428)	- 0.002 *	0.082 * (7.506)	0.010 *
AVE_GRADE	-------	-------	-------	-------	-------	-------
PASS_11th GRADE	-------	-------	-------	-------	-------	-------
Family Resources:						
INCOME_DECILE	0.035 (0.486)	- 0.004	- 0.046 (0.684)	- 0.023	0.270 * (3.946)	0.041 *
OWN_HOME	- 0.180 (0.372)	- 0.052	0.359 (0.716)	0.049	0.274 (0.462)	0.029
BENEFIT_PROP	- 0.095 (0.169)	- 0.091	0.376 (0.719)	- 0.014	1.455 * (2.442)	0.202 *
NUM_SIBLINGS	0.433 * (2.890)	0.040 *	0.261 (1.784)	0.011	0.177 (1.142)	- 0.005
MOTHER_NO_Q	0.064 (0.204)	0.021	- 0.186 (0.615)	- 0.027	-0.086 (0.273)	- 0.006
MOTHER_TERT_Q	- 0.402 (0.926)	- 0.066	- 0.173 (0.446)	- 0.032	0.447 (1.268)	0.093
FATHER_NO_Q	0.055 (0.181)	0.024	0.053 (0.178)	0.030	- 0.463 (1.512)	- 0.074
FATHER_TERT_Q	- 0.283 (0.640)	- 0.034	0.229 (0.579)	0.067	-0.354 (0.953)	- 0.053
PARENTAL_ ASSISTANCE	- 0.082 * (3.764)	- 0.011 *	- 0.003 (0.312)	0.003	0.004 (0.593)	0.004
OWN_ TRANSPORT	1.143 * (3.903)	0.113 *	0.756 * (2.635)	0.052 *	0.237 (0.783)	- 0.052
PRIVATE-SCHOOL	0.007 (0.364)	0.002	- 0.073 (1.199)	- 0.002	- 0.006 (0.415)	- 0.0006
*****						
INTEND_16_UNI	-------	-------	-------	-------	-------	-------
INTEND_16_POLY	-------	-------	-------	-------	-------	-------
LOCAL_UNEM	0.130 (0.205)	- 0.009	- 0.356 (0.711)	- 0.116	1.045 * (2.136)	0.170 *
PEERS_CONTINUE	0.426 (0.381)	- 0.156	1.658 (1.450)	0.060	3.336 * (2.595)	0.395 *
PEER_DEVIANT	- 0.010 * (0.162)	0.009 *	- 0.073 (1.199)	- 0.001	- 0.184 * (0.415)	- 0.023 *
RURAL	- 0.561 (0.821)	- 0.118	- 0.078 (0.147)	- 0.042	1.055 * (2.051)	0.186 *

* Estimates significant at 0.05. Sample Size= 586 Log-likelihood= - 651.819 Scaled R^2= 0.431

Footnotes:

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[1] For statistical details on participation in tertiary education in New Zealand and relevant policy changes the reader may refer to Maani (1997). Research on participation in higher education has also received significant attention in Australia due to policy changes (e.g. Anderson and Vervoon, 1983; Williams, 1987; *The Wran Report* , 1988; Prior and Beggs, 1989; Hope and Miller, 1988; Chapman and Chia, 1993).

[2] Tables1 and 2 of this paper, for example, can be referred to.

[3] For further information and other research with this data set the reader may refer to Fergusson, et. al. (1989), Fergusson, et. al. (1991), and Fergusson and Lynskey (1993).

[4] The original cohort of individuals in the survey consisted of 1265 individuals. The sample used in this study contains 694 observations, partly due to minor attrition over time, and partly due to missing values on variables of importance to this study, such as academic performance, parental income, and school factors. Analysis indicates that the selected sample is slightly less likely to drop out of secondary school than the full sample (the probability is 0.0034 lower). A study for the New Zealand Treasury (Maloney, 1999) showed that attrition was related to some initial characteristics such as ethnicity and having a single parent. Nevertheless, comparisons with later Census data at both local national levels show that the CHDS is still fairly representative of the population of children born around 1977.

[5] Polytechnics are similar to two-year colleges in North America in some respects, especially for vocational training. However, they are generally not designed to substitute the first two years of university education, as several U.S. two-year or community colleges do.

[6] It is interesting to note that although the Willis and Rosen (1979) model is based on Human Capital theory, it is also consistent with Signalling theories of investment in education, since in both theories schooling is pursued to the point where its marginal (private) internal rate of return equals the rate of interest. Both theories are also consistent with this model in which participation in education is influenced by the capacity to finance education, ability, tastes, perceptions and information, and expectations (some observed and some unobserved) --although in human capital theory investment in education is assumed to increase labour productivity, while in signalling theory education is a positional good to signal information on unobserved ability.

[7] The above model is nested in a model of lifetime utility maximisation, which determines labour supply and education investment decisions. Although it is possible to emphasise empirical models, which are based on joint determination of expected future labour supply and participation in higher education, the education participation model above presents a satisfactory approach by providing a reduced-

form model of participation, which incorporates the effect of tastes and ability. In addition, the life-time supply decisions of young persons have not materialised at the time of participation in education, and they can at best be measured empirically as expressed expectations influenced by the same set of factors which determine the participation in education decisions. Therefore, the reduced-form approach is generally more suitable for the study of participation in higher education.

[8] In addition to the family income decile measure included in the model for 'adolescent' years (averaged for ages 11-14), CHDS includes two other similar measures for 'childhood' (ages 6 -10), and 'early childhood' (ages 1-5). The simple correlation between the included variable and the childhood measure is 0.766 and with the early childhood measure is 0.543. Including either one of these 3 variables in the Tertiary education models by itself results in similar explanatory power (the R-square changes <0.0001). The more recent adolescent income decile, however has greater association with University participation (e.g. the correlation between University participation and the adolescent income decile is 0.34, as opposed to 0.33 for childhood, and 0.26 for the early childhood income decile). In addition, it has greater explanatory power for the multinomial logit models discussed below.

[9] It may be noted that tertiary fees are not included since those in the sample were subjected to generally similar tertiary price effects. For a study of the effect of fees and family resources on participation in tertiary education, variation in fees over time or in various regions of the country would be useful for such estimations (see for example, Maani, 1996).

[10] For students who had not completed secondary school at age 18, three conditions were to be met for inclusion in the university outcome. First, they had to be at school at age 18; second, taking the university entry requirement of 12^{th} Grade examinations at the end of the year (also called Year 13, Bursary exams); and third, a definite intention to attend university at age 18 (maybe was not included). For attending the Polytechnic, the Bursary examination condition is relaxed, since it is possible to attend Polytechnic degrees without the year 13 (Bursary) examination.

[11] Those who did not indicate a plan to attend tertiary study, or did not have employment plans were included with those who were currently unemployed or OLF as expected to be initially unemployed.

[12] Despite this positive feature of the age 21 CHDS data for comparison purposes, several other features of the age 18 data and its comprehensive coverage of outcome categories made it most suitable for the study. Most significantly, the age 18 data distinguishes between University and Polytechnic participation, which is a core part of this study.

[13] Moreover, the likelihood ratio test of results of Model 1 and 2 for the overall sample, and for two separate sub-samples of males and females confirmed that the restriction that coefficients are constant across gender could not be rejected.

[14] In categorising employment and tertiary study choices, there are obviously other possible overlaps in these choices through i.e. full-time tertiary study and part-time work, or part-time study and full-time work, etc., so that it is possible to estimate 6 or 7 activity categories. For simplicity in this study 'the main activity' of the individual was chosen as work, tertiary (university and polytechnic) study, or

unemployment or economic activity.

15 It is noted that the Multinomial logit specification adopted here assumes the usual Independence of Irrelevant Alternatives (IIA) property. This assumes that the four outcome options are independent. In favour of the modelling choice is that in New Zealand many students traditionally prefer to work or experience leisure right after secondary school, and many prefer trades and vocational training over university education. Therefore, our modelling approach (rather than for example, a nested logit) reflects the tradition in New Zealand that tertiary education (and University participation in particular) are not traditionally the first sequential preference for students above Polytechnic or other options. In addition, the inclusion of important explanatory variables (on ability heterogeneity, academic performance, and preferences), which are not available in most studies, is expected to favourably reduce unobservables across outcome equations. Of course, other modelling approaches such as the multinomial probit are possible, and may be useful in providing comparisons by relaxing this assumption in later studies, especially when such a rich data set is not available.

16 In calculating the probabilities for each category, first for each individual (i) and category (l=1,…,J, where J=3), $Xi\beta^l$ is calculated, where Xi is the row vector of observations for individual i and β^l is the column vector of corresponding coefficients for each category. The probabilities for each individual for the base category are:

$$P(y_i = 0) = \frac{1}{1 + \sum_{j=1}^{3} e^{X_i \beta^j}}$$

The probabilities for each individual in categories l=1,…,3 are:

$$P(y_i = j) = \frac{e^{X_i \beta^l}}{1 + \sum_{j=1}^{3} e^{X_i \beta^j}}$$

The reported probabilities for each category in Tables 7 and 8 are calculated by taking the *average* of all the individual probabilities in each category. Having calculated $Xi\beta^l$, for each individual and category, the probability for each option is calculated for each individual (See, for example, Davidson and MacKinnon, 1993).