# TREASURY WORKING PAPER

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# School Leaving, Labour Supply and Tertiary Education Choices of Young Adults: An Economic Analysis Utilising the 1977-1995 Christchurch Health and Development Surveys

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***Contract to the Treasury***

**ABSTRACT**

Utilising evidence from a longitudinal data set of young adults in New Zealand, this study examines the determinants of school leaving and labour supply behaviour of young adults at ages 16 and 18. The data set employed (the Christchurch Health and Development Survey) includes a number of variables, from birth to age 18, not commonly available in economic data sets. The analysis uses binary choice models to examine the effect of ability factors and household economic constraints on the choice to remain at secondary school beyond post-compulsory levels at age 16. The study further uses binary and multinomial choice models to examine the determinants of participation in tertiary education, as opposed to engaging in labour supply, or unemployment at age 18. The study finally examines the determinants of the type of tertiary institution attended. The results show that participation in tertiary education depends on a combination of family resources, ability and prior achievement. Interestingly the results show girls' (but not boys) school leaving at age 16 is positively and significantly associated with the proportion of family income received from benefits, and with the mother's educational qualifications.

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## INTRODUCTION*

Structural changes in the New Zealand economy over the last decade have increased the demand for educated labour, which has resulted in significant increases in participation in post-compulsory education. This has highlighted the question of the determinants of participation in post compulsory education and their relative significance.

Previous research in this area has included the review of the empirical literature of the determinants of participation in post-compulsory education and training for OECD countries (Maani, 1994): *Participation in Post-compulsory Education and Training: a Review of the Empirical Literature*.[1] This report provided an evaluation of issues, modelling methods and results. This was developed in a further report for the Treasury completed in March 1996 (Maani, 1996b): *A Research Agenda, Methodologies, Models and Data Requirements for Estimating Participation in Post-compulsory Education in New Zealand,* which provided the theoretical framework and the modelling approaches of relevance for New Zealand.[2]

This report extends previous work in this area by providing empirical research on participation in post-compulsory education in New Zealand. The study uses cross-section econometric models and longitudinal individual level data and provides evidence on the determinants of *post-compulsory secondary and tertiary* education (as opposed to *leaving school* beyond the compulsory level at age 16), and the determinants of participation in *tertiary* education. The study further analyses the determinants of post-compulsory schooling in relation to other labour market choices and outcomes of *employment*, and *unemployment* or an *out of the labour force* status. The effect of individual and household characteristics such as parental income, socio-economic background, ability, and prior academic performance are of special interest. The study further examines the determinants of the *type of tertiary institution* attended.

The study focuses on economic modelling and econometric analysis. Individual level data from the longitudinal Christchurch Health and Development Study (CHDS) has been employed in the study.[3] CHDS survey data provides information on a cohort born in Christchurch in 1977 as they leave school and make their transition to further education, training, and work. For the purposes of this study, CHDS provides data

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1 Parts of the material from this report have subsequently been published in Maani (1996a), and in Sholeh A Maani, *Investing in Minds: The Economics of Higher Education in New Zealand*, Institute of Policy Studies, Wellington, 1997.

2 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 in recent years due to policy changes (e.g. Anderson and Vervoon, 1983; Williams, 1987; *The Wran Report* , 1988; Hope and Miller, 1988; Chapman and Chia, 1993.

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).

on 694 in their 18th year in 1995, and corresponding information from earlier surveys at age 8, ages 11-14, and in their 16th year in 1993.[4] This data set is particularly advantageous because of the extensive amount of information on the youths' academic and home environments, academic performance and ability, earlier expressions of interest in higher education, and socio-economic background. In addition, the longitudinal nature of the data allows the possibility of follow-up extensions on completion of tertiary education and transition to work.

The data set has another major advantage in that the supplementary questions for age 18 closely address the questions of labour market options and financial means for study, incorporated in the econometric analysis of participation in education while controlling for a number of relevant economic and personal characteristics.

Four cross-section models are examined in the study. Two are reduced-form binomial qualitative choice models, and two are multinomial models. Model 1 utilises probit analysis to examine the determinants of school leaving, as opposed to post-compulsory study at age 16. Models 2-4, in turn, consider the cohort at age 18. These models examine the determinants of the choice to study at age 18, as opposed to the alternatives of paid work, and unemployment or no economic activity. The analysis further examines the determinants of participation in tertiary study and the type of tertiary institution attended.

Sensitivity analyses based on the econometric models provide further predicted probabilities of engaging in education and labour supply for given sets of personal and household characteristics. These analyses are useful in highlighting the determinants of the demand for higher education.

The plan of this report is as follows. The analytical framework for the study is presented in Section II. A discussion of the data set and the characteristics of the sample is provided in Section III. The models and results are presented in Section IV, followed by concluding remarks in Section V.

## Analytical Framework

The theoretical modelling 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).[5]

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, the family socio-economic background can affect the

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[4] The sample size for the cohort was 1265 at birth. Some observations are lost due to information on all relevant variables such as IQ and test scores, and due to attrition over the 18 year period of the study.

[5] A detailed discussion of the theoretical human capital framework for the study of participation in higher education is provided in Maani, 1996b and Maani, 1997.

demand for post-compulsory and higher education through tastes, and the costs of obtaining information.[6]

Therefore, *ceteris paribus* those individuals who have higher academic ability and a stronger taste for earned income as opposed to leisure over their life-time are more likely to invest in higher education. In addition, keeping ability constant, a greater potential to finance education will lead to greater participation. The model is further extended to control for other personal characteristics such as age and gender.

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, choosing a level of education depends on the expected value of lifetime earnings at that education level, and also background characteristics which determine the individual's tastes, expectations, and the financial constraints facing the household. Individuals select different levels of education on the basis of financial resources, tastes, perceptions and natural ability. Therefore, individuals are sorted into education classes according to the interaction of a selection criterion such as maximum present value of net returns and underlying joint distribution of tastes, talents, expectations, and parental wealth. These characteristics are assumed to be randomly and independently distributed across individuals. While Willis and Rosen's analysis utilised structural models and emphasised self-selection, Rice's application utilises reduced form models of participation and emphasises the effect of financial constraints on school leaving choices of males and females.[7] Neither study had observable variables on academic ability such as IQ or academic test scores.

In this framework, if $Y_{io}$ represents the stream of potential lifetime 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 lifetime earnings if the individual undertakes a period of further education:

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

then potential lifetime earnings at each level of educational attainment (j) are expected to depend on 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

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

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[6] For a detailed review of the empirical literature on participation in post-compulsory and higher education the reader may refer to Maani (1996a).

[7] 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.

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 personal and environmental characteristics which determine the individual's tastes, expectations and the financial constraints facing the household, and $u_i$ are the unobservables. The individual invests in additional education beyond the compulsory level if the expected net benefits are positive ($V_{i1} - V_{i0} = G(S_i, X_i, u_i) > 0$ ).

Empirical estimation of the probability of enrolment at post-compulsory or university education (Pr A) is based on equation (3) below:

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

where vectors of observables $S_i$ and $X_i$ would result in observation of participation if $V_{i1} - V_{i0}$ is positive, and $u_i$ are unobservable characteristics. 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, such that

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

with $\beta, \gamma$ and $\sigma^2$ constant across the population (e.g. Willis and Rosen, 1978; Rice, 1987). One of the advantages of the current study compared to earlier studies is that it includes information on $S_i$ such as IQ and other test scores not available in earlier studies (e.g. Rice 1987).

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. This approach is consistent with a number of theoretical and empirical studies in the 1980s and the 1990s in which the human capital model is adopted, focusing on the relative costs and returns to engagement in higher education. This reduced-form modelling approach is emphasised throughout the study.

The study further extends the Rice (1987) modelling approach by modelling the inter-relationship between the decision to participate in higher *education* in relation to other *labour market* choices.

**Characteristics of the Sample**

The Christchurch Health and Development longitudinal Study (CHDS) survey includes extensive economic and academic information on a cohort born in Christchurch in 1977, throughout their childhood and adolescence, followed by their

transition from school to further education, training, and work. Among the advantages of this data set is the extensive amount of information on the youths' academic and home environments, academic performance and ability, earlier expressions of interest in higher education, and socio-economic background. In addition, the longitudinal nature of the data allows the possibility of follow-up extensions on completion of tertiary education and transition to work.

The sample utilised in the study consists of 694 observations from the 1977- 1995 surveys for which data on all variables of interest was available. In 1995 the cohort was in its 18th - 19th year.[8] The characteristics of the sample are summarised in Table 1 and Figure 1 below.

As Table 1 shows, about half of the sample (51.3%) were females. The characteristics of the sample on academic performance and economic conditions are reassuring in relation to expected national averages, such as the average IQ of 102.8 and the average school certificate mark of 1.07 or a C. Home ownership by parents was 89.0%, and average proportion of family income from benefits was 13.6%. In the sample, 7.2% were Maori and 2.6% were Pacific Islanders.[9]

These mean characteristics also reflect the nation-wide trends of increased participation in study by young adults in comparison to the previous generation. For example, in comparison, 48.7% of the mothers and 47.0% of the fathers of the respondents had no school qualifications, and 20.9% of mothers and 19.9% of fathers had tertiary qualifications.

Table 1 further shows that 15.3% of the 16 year olds had dropped out of school, and that males were more likely to drop out than females (17.8% of males and 12.9% of females).

At age 18, fewer individuals were engaged in formal study. Of the full sample of 694 individuals, 60.8% (422 individuals) were engaged in study (secondary or tertiary) at age 18, 30.7% (213 individuals) were employed, and 8.5% (59 persons) were unemployed or out of the labour force.

In addition, at age 18, 317 individuals (or 54.2% of the sample of 585 persons who had continued to post-compulsory levels) were either enrolled in tertiary education or were completing Bursary and intending to participate in tertiary study. In this group, 194 individuals or 33.2% were intending to enrol at university and 123 individuals or 21.0% at the polytechnic). The remaining 20.5% of the sample was employed or

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[8] Appendix B provides information on the sample characteristics in relation to omitted observations due to missing variables. Observations have been lost by age 18 compared to the initial 1265 individuals in the survey partly due to attrition over time, and partly due to missing values on variables of importance to this study, such as IQ, parental income, and school factors. For example, the analysis in Appendix B indicates that the sample considered due to information on all variables of interest is slightly less likely to drop out of secondary school (with a probability 0.0034 smaller than the full sample). There is also a small but recognisable bias in favour of higher socio-economic status for the included group.

[9] It may be noted that since the data set is regional in nature, the ethnic composition of the sample differs from New Zealand as a whole. This means that estimates for prediction may not be fully generalised to the population at the national level. However, it is possible to deal with this disadvantage through weights so that a regional sample closely represents the national averages.

had employment arranged, and 25.3% was unemployed or did not have tertiary study or employment plans.

In addition to Table 1 which shows the mean characteristics of the overall sample, the statistical summary in Figure 1 identifies some key mean characteristics of individuals with certain school leaving and higher education and employment choices (e.g. school leavers at age 16, compared to the group pursuing post-compulsory secondary and tertiary education). These characteristics include the individual's IQ at age 8, the average School Certificate grade obtained (reflecting academic factors), and the household income decile during ages 11-14. Figure 1 further provides comparisons of average school, neighbourhood and peer factors: measuring the proportion of the student's class continuing to post-compulsory levels (at age 16), and association with peer groups with deviant behaviour (a 1-10 scale reflecting problems with the law, substance abuse, etc.).

Figure 1 shows that those who participated in post-compulsory secondary schooling at age 16, and in tertiary education at age 18, had mean characteristics different from the school leavers. These included a higher average IQ at age 8, higher average School Certificate marks, they belonged to a higher family income decile, and they went to a school with a higher proportion of the class continuing to the Sixth Form. These characteristics are consistent with the hypothesis that individuals sort themselves into different choices based on their academic ability and the expected returns on their choice, family income constraints, and as influenced by their school and peer environment. These characteristics are further consistent with the observation that the youth from the lower income deciles are less likely to participate in tertiary studies.

The econometric models in the next section provide estimates of schooling choices, and their determining factors.

# IV. Econometric Models and Results

In the analysis of the determinants of participation in higher education it is useful to recognise that the decision reflects a series of conditions faced, and choices made, by young adults over time. For example, the decision to pursue tertiary education at age 18 is influenced by economic resources and constraints, and academic ability at that age. However, the decision is also expected to reflect long term investment choices, in particular, academic performance in secondary school, and eligibility for tertiary study through an earlier choice to pursue post-compulsory schooling at age 16.

To examine the determinants of education and labour market choices of young adults four cross-section models, utilising current and longitudinal information, are estimated. The reference years are 1993 and 1995 when the respondents were ages 16 and 18, respectively. The 1993 data are used in a binary choice model of school leaving behaviour beyond the compulsory age of 16. Three further models are estimated using the 1995 data: a multinomial choice model of study (secondary or tertiary at the time of the interview), work or unemployment; a binary choice model of participation in tertiary education; and a multinomial choice model of enrollment at university, polytechnic, work or unemployment.

More specifically, Model 1 focuses on *school leaving behaviour at age 16*, and it employs data from year 1993 of CHDS when the respondents were 16 years old. Model 2 examines the determinants of *continuing with study at age 18*, as opposed to engaging mainly in employment, or alternatively unemployment or economic inactivity. Model 2 utilises data from the year 1995 phase of the survey when respondents were 18-19 years old. Models 1 and 2 utilise the full sample, including those who had dropped out at the age of 16.

Model 3, in turn, focuses on *participation in tertiary study*, and Model 4 provides a multinomial choice extension of Model 3 in which the *type of tertiary institution chosen, as opposed to employment or unemployment* is modelled. Models 3 and 4, which focus on tertiary education, utilise data from the year 1995 phase of the survey when respondents were 18-19 years old. Models 3 and 4 utilise the sub sample of respondents who had continued with post-compulsory education at age 16, and were therefore eligible for tertiary study.

It should be noted in interpreting the results of Models 3 and 4 that tertiary education choices are realised through first entry into tertiary education over a range of ages. Therefore, while entry during the ages 18 to 22 is most common, choices at 18 are not to be considered as complete lifetime choices. In addition, it is useful to note in relation to models 2 and 4 that in categorising employment and study choices, there are obviously also possible overlaps in these choices through i.e. full-time 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', 'study', or 'unemployment or economic activity'.

The four models estimated and their results are presented below. The definition of all variables in Models 1-4 is provided in Tables A1 and A2 in Appendix A. The extensive information available in this data set allows careful hypothesis testing and extensions to test other labour market choices. The longitudinal nature of the data set provides information on ability and academic performance at an earlier time.

## School Leaving

### Model 1: School Leaving at Age 16

The objective of this model is to examine the effect of relative expected returns to education through personal cognitive ability, academic performance, school characteristics and peer effects, and taste as reflected by socio-economic background, as well as the effect of parental economic constraints on post-compulsory secondary school retention. [10]

Taking the form of a probit model, the dependent variable in Model 1 is binary as to whether or not the respondent had left school beyond the post-compulsory age of 16, as opposed to enrolment beyond the School Certificate in the sixth form:

$$\Phi^{-1}(P_i) = \alpha + S_i'\beta + X_i'\gamma$$

[10] See Rice, P G (1987) "The Demand for Post-compulsory Education in the UK and the Effects of Educational Maintenance Allowances", *Economica*, 54, 465-475 for the general modelling approach.

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

$P_i$ = The probability that the respondent had left school at age 16.

where $S_i$ represents personal academic ability for individual *i,* and $X_i$ represents personal characteristics such as gender, and socio-economic and cultural background, and household and environmental constraints such as Household assets, Proportion of Household Income from Government Benefits, School Effects, and Neighbourhood and Peer Effects, as follows:

**EXPLANATORY VARIABLES:**

**Ability:**

Child's IQ score at the age of 8

**Academic Performance:**

Age 15 Tested Performance (Whether or not the student has passed School Certificate, Average School Certificate mark for 5 subjects).

**School and Peer Effects:**

Proportion of Fifth Form class at secondary school continuing to the Sixth Form or beyond.

Deviant Peer Association at Age 15

Rural School

**Personal Characteristics:**

Female (binary variable)

Ethnic Background (Maori, Pacific Islands)

**Foregone Earnings:**

Local unemployment rate by gender

**Socio-economic Factors:**

Education of mother less than school certificate

Education of father less than school certificate

Number of siblings

Household home owner

Proportion of household gross income from government benefits (at age 16).

Income Decile (Ages 11-14)

The proportion of the Fifth Form class continuing to the Sixth Form is expected to reflect school effects, as well as measures of neighbourhood and peer effects. The effect of private versus public primary and secondary schooling was also estimated and later eliminated due to consistent insignificance.

The proportion of income from benefits was calculated based on data on all sources of parental welfare benefit income and other sources of income. The variable reflects the relative significance of benefit income compared to the young person's family income. The variable also reflects beneficiary status and relative disadvantage such as the household's wealth and assets.

The use of various potential benefits received by the young persons themselves did not prove useful since all respondents were potentially eligible for the unemployment benefit, or a training benefit. For example, the receipt of the unemployment benefit by 6.5% of the total sample was itself a result of unemployment choices, and therefore not a relevant independent predictor. The same is true of the Training Benefit, which was received by 5.2% of the sample who had taken part in training. The Independent Youth benefit can in turn be received independently of education or employment choices and was potentially relevant. This benefit was received by 1 percent of the sample and it was not statistically significant.

Table 2 provides a summary of the coefficients, t-statistics and the mean marginal probability of leaving school at age 16, in relation to a one-unit change in each explanatory variable. These results are compatible with a-priori expectations, and the model performs well on the basis of the explanatory variables. For example, the model results in 90.8% correct predictions in Table 2 for the overall sample. The results in Table 2 further support the hypothesis that those with a higher IQ at age 8, a higher average School Certificate mark, and those from schools with a higher proportion of their class continuing to the Sixth Form were significantly less likely to leave school at age 16.

Keeping other factors constant, the probability of leaving school for females at age 16 was lower by 6.9 percentage points. The peer effect was also significant. For each 10% increase in the drop out rate in a student's class at school, his or her probability of leaving school at 16 increases by 2.46 percentage points.

Income Beneficiary status of the family was further associated with greater probabilities of school leaving. The marginal effect of a household's full income resulting from benefits, compared to no benefit income (a one unit change in the explanatory variable) increases the mean school leaving probability by 7.3%. This variable which measures the extent of beneficiary status is expected to reflect relative disadvantage in terms of parental assets, relative income, and other disadvantage in terms of information or social networks. It is also interesting to note that once personal, socio-economic and environmental characteristics are controlled for, Maori youth did not have a statistically significantly higher probability of dropping out of school. It is also interesting to note that once personal, socio-economic and environmental characteristics are controlled for, Maori youth did not have a statistically significantly higher probability of dropping out of school.

It may be noted that relatively few variables are significant in the model, as for example, the variables for ethnic background, parental education, and the local unemployment rate are insignificant.[11] Excluding these variables from the model did not significantly change the results for the other coefficients, and they were therefore included for the formal test of their effects.[12]

Table 3, in turn, provides a summary of probit results for the separate samples of males and females.[13] The results in Table 3 for the sub samples of males and females are consistent with those for the overall sample, but some estimated results are different for males and females. Most significantly, female participation in post-compulsory education is more sensitive to household income constraints and socio-economic background. For example, welfare beneficiary status had a statistically

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[11] It is quite possible that the insignificance of the coefficient for 'the local unemployment rate' results from the regional nature of the data set and the lack of sufficient variation in the variable, despite the fact that some respondents had moved from Christchurch over time. In this data set the variance of the local youth unemployment variable is 0.422, with a mean of 10.56.

[12] Multicollinearity among the explanatory variables was also considered and other variations of the model were tested. However, these variations did not significantly change the results on the significant coefficients on ability and academic performance or peer effects.

[13] The formal test of the 'restricted' version of model 1 in Table 2 against the 'unrestricted' model allowing coefficients to vary by gender in Table 3 shows that the restriction of equal coefficients can be rejected at the 5 percent level of significance. The restricted log-likelihood is –154.3, the unrestricted log-likelihood –138.7, with a likelihood ratio statistic of 31.158 and 17 degrees of freedom.

significant effect on the school leaving behaviour of females, but not for males. This result is consistent with the results of Rice (1987) utilising UK data in which household financial constraints were found to have a significant effect on the school leaving behaviour of females but not males at age 16.[14] Likewise, mother's lack of school qualifications significantly increases the probability of school leaving of females but not of males.

Model 1 results in Tables 2 and 3 are further utilised in providing further analyses of the probability of school leaving at age 16, based on a set of respondent personal and family and peer characteristics. These predicted probabilities are summarised in Table 4. The first row of Table 4 reproduces the average school leaving probability of 15.4% for the overall sample, and higher probabilities for males than for females as reflected by the data (of 18.0% for males and 12.9% for females), as predicted based on Model 1.

With the other characteristics at the mean, the probability of school leaving decreases to 12.6% for an IQ of one standard deviation above the sample mean, and 2 standard deviations above average decreases the probability to 10.2% for the overall sample.[15]

The results further indicate that the probability of school leaving in response to IQ is far greater for males than it is for females. For example, the probability of school leaving for females varies within the narrow range of only 12.4% to 13.4% for variations in IQ as large as two standard deviations above and below the mean of the sample. In comparison, for the sample of males the probability of school leaving has the range of 35.1% to 7.5% for a similar IQ range. This significant difference is likely to reflect differences in study styles of males and females, and a greater range of occupations available for men involving manual or trade related skills.

Table 4 further highlights the importance of academic performance on school leaving behaviour. For example, while a failing School Certificate average mark is associated with a probability of school leaving of 26.5%, an average mark of B decreases the probability significantly to 2.2%, or a decrease by more than tenfold. Moreover, with an average School Certificate mark of A, school leaving at age 16 is virtually not expected (a probability of 0.0004).

Female probability of school leaving, in turn, diminishes much more significantly with higher academic performance. For example, although school leaving probabilities are similar for a failing School Certificate mark, the probability of leaving school at age 16 with an average mark of B diminishes to 4.7% for males, and to 0.6% for females.

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[14] Rice (1987) used a 'current income' variable in addition to the 'benefit ratio' (the ratio of current benefit to current household income). In this study the definition of the income and benefit variables has subtle differences from the Rice study in that income is measured as family income decile during the ages of 11 to 14. Since the benefit ratio in this study is the only measure of current income, it would explain why benefit ratio has a negative effect on school retention partly reflecting the effect of economic disadvantage.

[15] For these calculations, individual predictions are calculated for each category and the averages of those predictions are computed.

An extended analysis of multiple effects of determining factors in Table 5 is useful in highlighting the significance of the *combined effects* leading to significant differences in the probability of leaving school early.[16]

These estimates further provide strong support for the hypothesis that school leaving is influenced by both personal ability and economic factors. Some of these factors such as ability and economic conditions can influence schooling decisions at age 16 not only directly, but through school and peer effects, and academic performance. The analysis in Table 5 further shows how with certain personal, economic and environmental characteristics the probability of dropping out of school is practically unexpected (with probabilities below 1 per 100,000), or alternatively close to certainty (with probabilities of over 99%) for others. The analysis of combined effects is further useful in providing a realistic picture of school leaving behaviour as consistent with the combined characteristics of school leavers in Figure 1. [17]

In the next model, participation in education at age 18 is examined in a multinomial choice model in which the decision to study is considered in relation to other choices of work and unemployment.

## Study, Work, and Unemployment

*Model 2: Multinomial Logit Model of Work, Study or Unemployment at Age 18*

An extension of the school retention model above is a multinomial logit model tested for the respondents at age 18, in which the probability of participation in higher education is estimated along with the probability of participation in *work* (full-time or part-time), or *unemployment or economic inactivity.* In this two-equation multinomial logit model the three choice categories at age 18 are (1) Study; (2) Employment; and (3) Unemployed or OLF, as follows:

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

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

Where, $P_s$ = STUDY: The probability that the respondent remained in study

$P_e$ = EMPLOY: The probability that the respondent was mainly employed

$P_u$ = UN or OLF: The probability that the respondent was unemployed or out of the labour force

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[16] Appendix C provides information from the survey of the respondents at age 16 with the reasons that respondents themselves gave for dropping out of school. Among prominent reasons given were a lack of interest, and a wish to earn one's own living.

[17] Models 1 and 3 have also been estimated with linear probability models. The results summarised in Appendix G show that the estimated probabilities based on the two methods are quite compatible, especially for values of explanatory variables close to the mean.

where $S_i$ represents personal ability of individual *i,* and $X_i$ represents personal characteristics such as gender, and Socio-economic and Cultural Background, and household and environmental constraints such as Household assets, Proportion of Household Income from Government Benefits, School Effects, and Neighbourhood and Peer Effects.

Given the emphasis of this model on study, work, and unemployment choices, Model 2 is estimated over the sample of the 694 individuals which also includes those who had left secondary school at age 16. The dependent variable in this model is based on the year 1995 survey interviews at which time the respondents were 18 to 19 years old. The variable is based on the main activity of the respondent during the year, where 'study' includes formal study in secondary or tertiary education, including polytechnics, universities and colleges of education. The 'study' category, however, does not include on-the-job-training or apprenticeships if employment was the main activity during the year.[18]

The multinomial logit coefficients and the mean marginal probabilities of Model 2 reported in Tables 6-8 are in relation to the base category of unemployed or out of the labour force. The estimations in Table 6 are based on the overall sample, and those in Tables 7 and 8 are based on separate male and female samples. The results of this model are consistent with those of Model 1, and they extend the analysis by identifying the relative contribution of determining factors to study and work decisions.[19]

The results indicate that academic performance at age 15, school effects, and ability (IQ at age 8) are the main mechanisms in sorting students into the choice of study compared to unemployment or OLF status at age 18. Academic performance and average grades had a great association with study at age 18 as opposed to work or unemployment. Furthermore, males had a significantly higher probability of choosing work over study or unemployment. To put the magnitude of these effects in perspective, as 90 indicates, keeping other factors constant, males had a 6.1% higher probability of choosing employment over unemployment or economic inactivity.

In comparison, an increase of one grade in School Certificate marks (e.g. a move from a C average to a B average) increased the marginal probability of choosing study by 20.7 percentage points.

It is interesting to note that a higher average grade was also associated with a lower probability of employment, which may reflect other aptitude and interests such as those required in manual and trade skills.

Those with a higher IQ also had a significantly higher probability of employment compared to unemployment. School and peer effects were further important in choosing 'study' at age 18. For example, the estimates indicate that those who were

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[18] In general, the data set is not suitable for analysing short-term or on-the-job training. The focus of this study is also on formal secondary and tertiary education.

[19] With a likelihood ratio statistic of 30.704 with 17 degrees of Freedom, based on the restricted and unrestricted tests of Model 2 in Tables 6, and 7-8, the restriction of equal coefficients can ve rejected at the 1% level.

in schools at age 15 in which the rest of the class did not drop out at the post-compulsory level, had a probability of involvement in study at age 18 that was 18.0 percentage points greater (As Tables 7 and 8 indicate, this effect was significant for males but not females). A larger number of siblings was also associated with a higher probability of both work and study relative to unemployment, possibly reflecting lower parental economic assistance available.

The results in Table 8 for the female sub sample further showed that household's home ownership (reflecting household economic constraints) had a significant effect on female (but not male) participation in study at age 18. A greater number of siblings was also associated with a greater probability of employment by females, at an estimated probability of involvement in employment as the main activity that was 6.6 percentage points greater than the probability of the base category.

Finally, as academic performance at age 15 is a very significant variable in both Models 1 and 2 in relation to post-compulsory study, this result is worthy of examination in greater detail in future studies, in relation to its determinants. For example, a hypothesis that is compatible with Figure 1 sample characteristics, and is worthy of further examination is that young persons from lower socio-economic backgrounds are influenced through their schooling years by neighbourhood, school and peer effects such that by age 16 their academic performance, tastes and information about alternative opportunities are more likely to sort them into school leaving choices.

## Tertiary Education

### Model 3: Participation in Tertiary Education

This reduced-form model examines the choices made by eighteen-year olds in relation to participation in tertiary education. Models 3 and 4 focus on the tertiary education choices of young adults at age 18. Model 3 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 4 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 3 has the following specification:

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

$\Phi^{-1}$ =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 personal academic ability for individual *i,* and tertiary education intentions at age 16, and $X_i$ represents personal characteristics such as gender, and Socio-economic and Cultural Background, and household and environmental

constraints such as Household assets, Proportion of Household Income from Government Benefits, School Effects, and Neighbourhood and Peer Effects.

Additional variables in Models 3 and 4 compared to the earlier models are as follows:

Expressed intention at age 16 to attend university

Expressed intention at age 16 to attend polytechnic

Parental financial assistance at age 18 (in dollars)

Own transportation at age 18

The definition of all variables in the above models is provided in Tables A1 and A2 in Appendix A. Model 3 is estimated for the sub-sample consisting of those who were eligible for participation at university (585 individuals at age 18) by remaining at school beyond the compulsory schooling age of 16.

Among financial factors the receipt of the tertiary 'student allowance' is not included in the model since it is itself dependent and conditional on tertiary enrolment and income conditions, and not an independent explanatory variable. The proportion of the full sample receiving the student allowance was 6.5%. It may also be noted that tertiary fees are not included in models 3 and 4 since those in the sample were subjected to generally similar tertiary price effects. For a study of the effect of fees on participation in tertiary education, variation in fees over time or in various regions of the country would be useful for such estimations.[20]

It may be noted that the definition of Tertiary enrolment and Employment in Models 3 and 4 is different from Study and Work in Model 2 which identifies the main activity of the respondent in 1995 in their 18th year. The definition of tertiary education in Models 3 and 4 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. This is since the focus of these models is on participation in formal tertiary education. 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. 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.

A characteristic of the sample that needed to be dealt with was that in 1995 and in their 18th year, 268 individuals in the sample of 585 were still in secondary school. Therefore, in estimating the model of participation in tertiary education two options were considered. The first option was to eliminate the sub sample of 268 individuals who were still at secondary school. The main advantage of this approach was that it increases accuracy in relation to the respondents' actual choices, such as who was actually at university or the polytechnic at that time. The main disadvantage of the approach, however, 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 the 7th form and were more likely to participate in tertiary education. The alternative

[20] For details of the requirements of such modelling the reader may refer to Maani (1996b).

approach pursued was to consider the sample of 585 individuals, which included those respondents who were still in secondary school, but to also incorporate the information on their intentions to participate in university or polytechnic, or employment. However, for comparison purposes Models 3 and 4 were also tested for the sub sample of the 317 individuals who were no longer in secondary school and the results have been included in Appendix E.

A comparison of the mean characteristics of the above samples in Table 1 indicates that while including those at secondary school a larger percentage of the sample (25.3%) did not have firm tertiary study or employment plans, in the sub sample that had already completed or left school, a smaller proportion (12.6%) was unemployed. In addition, while 33.2% of the larger sample had university study plans, among those who had actually completed or left secondary school 26.2% had immediately enrolled at the university, possibly reflecting the deferral of university enrolment.

The test of the model based on the sub sample of 317 in Appendix E shows that the results are robust. Of course, the results of the model based on the two samples have somewhat different interpretations, with the results in the body of the paper placing more emphasis on intended tertiary participation. In addition, as expected, the results on the sample of 585 predict higher initial unemployment rates for those who have not had firm employment plans at secondary school.

Model 3 results reported in Table 9 are consistent with the earlier models in their finding that tertiary education is mainly influenced through academic performance, school effects, and also intentions expressed two years earlier to attend university or polytechnic.

In addition, in Model 3 results a statistically significant difference in participation in tertiary education by gender is not found. The likelihood ratio test of results of Model 3 in Table 9 for the overall sample, and for the two separate samples of males and females in Table F1 in Appendix F, confirms that the restriction that coefficients are constant across gender cannot be rejected. Therefore, in this part of the study the overall sample results are emphasised.[21]

On the effect of academic performance on continued 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 the Sixth Form Certificate was an increased probability by 15.6 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.

The results of Model 3 are further consistent with the results of Models 1 and 2 in indicating that the decision to attend tertiary education is influenced by a host of personal choice and household characteristics which operate significantly through academic performance by age 18. These factors are expected to influence tertiary

[21] Table F1 in Appendix F contains the results of Model 3 for the sub samples of males and females. It may be noted that being male and Maori is significantly negatively associated with choosing tertiary education, and the coefficient is relatively large in magnitude.

education decisions through the expected returns to such investments relative to employment and unemployment.

## Type of Tertiary Institution Attended

### Model 4: Multinomial Logit Model of Work, Polytechnic or University Participation compared to Unemployment at Age 18

This three-equation multinomial logit model is an extension of Model 3 to examine the effect of socio-economic factors, cognitive ability and earlier academic performance, economic constraints and earlier intentions to take part in either university or polytechnic and other non-university tertiary institutions, on the choices made at age 18. The choices modelled in Model 4 are: (1) University; (2) Polytechnic and other non-university tertiary Studies; (3) Employment as the main activity during the year; and (4) Unemployed or an Out of the Labour Force status as the main activity during the year. Similar to Model 3, Model 4 is estimated for the more relevant sub-sample of the 585 individuals who had continued with post-compulsory education at age 16. Model 4 below, therefore, estimates the probability of the above choices made, given that the individual was eligible for further study by not having left school at age 16.

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

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

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

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

and where $S_i$ represents personal characteristics for individual *i,* such as ability, gender, tertiary education intentions at age 16, and Socio-economic and Cultural Background, and $X_i$ represents household and environmental constraints such as Household assets, Proportion of Household Income from Government Benefits, parental financial assistance, School Effects, and Neighbourhood and Peer Effects.

Additional variables in Model 4, compared to Models 1 and 2, are as follows:

Expressed intention at age 16 to attend university

Expressed intention at age 16 to attend polytechnic
Parental financial assistance at age 18 (in dollars)
Own transportation at age 18

As before, the definition of all variables in the above models is provided in Tables A1 and A2 in Appendix A.

The results of Model 4 are presented in Table 10. 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. Sensitivity analyses of estimated probabilities of each of the four options are further provided in Tables 11 and 12. For a description of the estimation methods used for predicting probabilities based on multinomial logit estimations as in Tables 11 and 12 the reader may refer to Appendix D, and for further details to Davidson and MacKinnon (1993).

Model 4 results show a number of significant statistical results. These results indicate that participation at university, as opposed to work, unemployment, or attendance at the polytechnic, is influenced by IQ, academic performance, earlier intentions to attend university, and parental income decile during ages 11 to 14.

First, participation in university is influenced significantly through academic performance as measured by School Certificate marks and a pass in the Sixth Form Certificate exams. A significant statistical relationship is, in turn, not established between academic performance and attendance in the polytechnic. 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.

Model 4 results further show that parental income also exerts a direct effect on university attendance, as opposed to the other three options.

The young person's intention at age 16 to attend university is closely associated with university attendance at 18. Likewise, the intention at age 16 to attend a polytechnic is closely associated with attendance at the polytechnic.

IQ is also statistically significant in determining the options of university, employment and polytechnic attendance compared to the base option of unemployment or OLF status, with stronger estimated links between a higher IQ and either university or employment options.

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 is also likely to reflect less parental financial assistance available, is positively associated with a greater probability of employment as opposed to tertiary study or unemployment at age 18. Owning transport is further associated with a greater probability of employment rather than unemployment.

The sensitivity analyses in Table 11 provide estimates of the probability levels for each of the choices in Model 4, while holding all other explanatory variables at their

mean values. The first row provides the mean estimated probabilities of the four outcomes.

As Table 11 indicates, 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 D, the estimated probability of attending the university is 7.5% and of the polytechnic is 31.7%. With an average grade of C, the probability of attending the polytechnic is slightly higher at 25.7%, 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 8.8% compared to the probability of attending university of 66.8%. 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.

Table 11 further shows that the estimated probability of attending university increases significantly with parental income decile, even when keeping IQ and academic performance constant at their mean values. In contrast, the probability of attending the polytechnic decreases significantly as income decile increases. This is consistent with the effect of income and socio-economic background on the level of information available to the young person or the tastes developed for the type of training and occupations pursued.

Predicted probabilities of multiple effects in Table 12 are also useful in highlighting the effect of combined characteristics in predicting significantly different probabilities of enrolment in university, polytechnic, employment and unemployment. For example, the two last scenarios in Table 12 show two contrasting predicted probabilities of 85%, and 1 per thousand for university attendance predicted based on Model 4 and for a set of personal, economic and environmental characteristics. These two scenarios further predict respective probabilities of 2.2% and 88.6% for unemployment based on the same set of characteristics. This analysis is useful in highlighting how certain personal characteristics, economic conditions, school and peer effects, and earlier academic performance result in the sorting of young individuals into tertiary study or unemployment. An implication of this result is that the choices at age 18 are somewhat predetermined by family and environmental conditions and earlier results such as academic performance.

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

# V. Conclusion

This study has provided empirical tests of the determinants of school leaving at age 16, transition to work or tertiary study at age 18, and the determinants of the type of tertiary institution attended.

The individual level and longitudinal nature of the Christchurch Health and Development data sets employed have allowed modelling and hypothesis testing of a number of relevant factors. In particular, the analysis incorporated the test of the effect of academic ability and academic performance as well as household economic conditions, and school and peer effects. The study has provided the first economic test of the above factors in the New Zealand Context, and in relation to alternative labour market choices.

The analysis of school leaving choice at age 16 indicates that this decision is influenced by factors that are at work for a long period of time. Both personal ability and household income constraints and socio-economic background are influential in school retention choices, and exert an influence through factors such as academic performance and school effects.

The results on school leaving at age 16 showed a statistically significant response by females but not males to parental income constraints, a result that is consistent with Rice's (1987) findings on school leaving at age 16 with UK data. Likewise, female but not male school leaving behaviour was significantly affected by mother's lack of school qualifications. In addition, while males had a generally higher probability of leaving school at age 16, conditional on continuing school, a statistically significant difference in participation in tertiary education of males and females was not found.

The study further 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 is an important channel through which personal ability and economic factors exert their influence.

Finally, the analysis provides strong support for the hypothesis that personal ability, socio-economic background, and household's income continue to exert an influence on the decisions of the type of institution attended, while the choices are significantly influenced though the academic performance of the young adult.

## Table 1: Characteristics of the Samples

Means (Standard deviations)

| Characteristics | Overall | Males | Females |
|---|---|---|---|
| **Full Sample (694 Individuals)** | | | |
| Percentage Male/Female | 100.0% | 48.7% | 51.3% |
| Percentage Maori | 7.2% | 6.2% | 8.1% |
| Percentage Pacific Islander | 2.6% | 3.6% | 1.7% |
| Average IQ (tested at 8 years of age) | 102.8 | 103.0 | 102.6 |
| | (15.44) | (15.33) | (15.56) |
| **Education** | | | |
| Average School Certificate Mark | 1.07 | 0.98 | 1.15 |
| (where E=0, D=0, C=1, B=2, A=3) | (0.85) | (0.83) | (0.87) |
| Mother with No Qualifications | 48.7% | 46.2% | 51.1% |
| Mother with a Tertiary Qualification | 20.9% | 19.8% | 21.9% |
| Father with No Qualifications | 47.0% | 45.3% | 48.6% |
| Father with a Tertiary Qualification | 19.9% | 18.9% | 20.8% |
| Drop Out Percentage from School at Age 16 | 15.3% | 17.8% | 12.9% |
| Unemployed or OLF at Age 18 | 8.5% | 6.2% | 10.7% |
| Employed at Age 18 | 30.7% | 35.2% | 26.4% |
| In Secondary or Tertiary Study at Age 18 | 60.8% | 58.6% | 62.9% |
| **Family and Social Environment** | | | |
| Average Number of Siblings | 1.49 | 1.47 | 1.51 |
| | (0.92) | (0.89) | (0.94) |
| Average Proportion of Class Continuing to Form Six | 83.7% | 83.6% | 83.8% |
| | (0.16) | (0.16) | (0.16) |
| Percentage of Parents who have their Own Home | 89.0% | 90.5% | 87.6% |
| Rural Location at Age 15 | 16.6% | 16.0% | 17.1% |
| Average Proportion of Family Income from Benefits | 13.6% | 12.5% | 14.6% |
| Average Regional Unemployment Rate by Gender | 10.6% | 10.4% | 10.7% |
| Average Income Decile (10 is most affluent) | 5.56 | 5.55 | 5.57 |
| | (2.56) | (2.52) | (2.60) |
| Average Association with Deviant Peers | 2.27 | 2.12 | 2.43 |
| (10 is the highest association) | (2.44) | (2.43) | (2.44) |

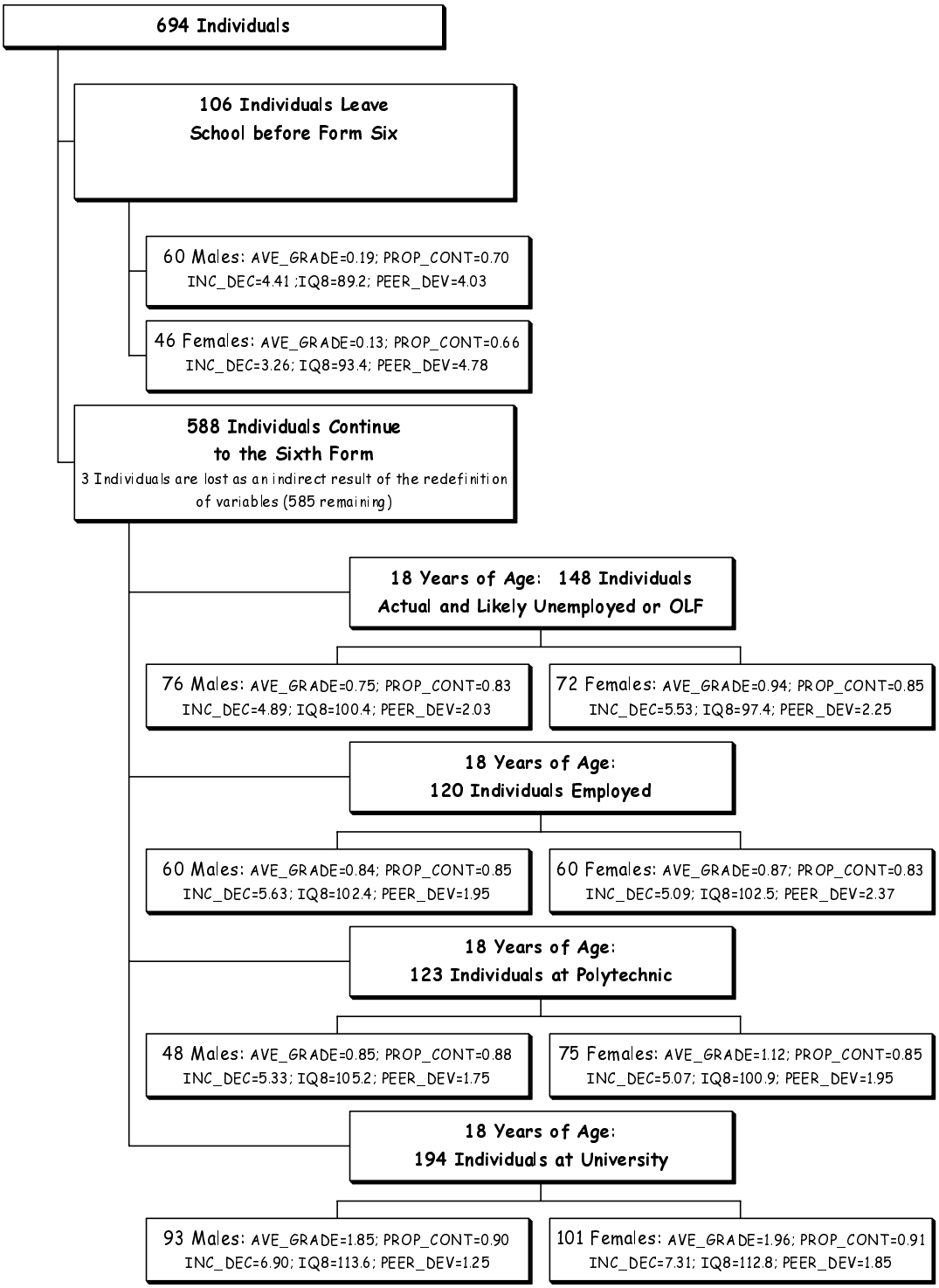
## Table 1 Continued : Characteristics of the Samples

Means (Standard deviations)

| Characteristics | Overall | Males | Females |
|---|---|---|---|
| ***Percentage of Sub-sample who progressed to*** | | | |
| **post-compulsory education at Age 16** | | | |
| **(585 Individuals: 277 males and 308 females)** | | | |
| Unemployed, OLF, or at secondary school without tertiary study or employment plans (Age 18) | 25.3% | 27.4% | 23.4% |
| Employed or at secondary school and has a Job Arranged (Age 18) | 26.5% | 21.7% | 19.5% |
| Enrolled or at secondary school and intending Polytechnic Attendance (Age 18) | 21.0% | 17.3% | 24.3% |
| Enrolled at university, or at 7th form, and intending University Attendance (Age 18) | 33.2% | 33.6% | 32.8% |
| **Percentage of Sub-sample excluding secondary pupils** | | | |
| **(317 individuals: 137 males and 180 females)** | | | |
| Unemployed, or OLF (Age 18) | 12.6% | 11.7% | 13.3% |
| Employed or has a Job Arranged (Age 18) | 37.2% | 43.8% | 32.2% |
| Enrolled at Polytechnic (Age 18) | 24.0% | 21.1% | 26.11% |
| Enrolled at University (Age 18) | 26.2% | 23.4% | 28.3% |

## Figure 1: Characteristics of the Samples

Statistics are at average values



## Table 2: Probit and Logit Models of School Leaving at Age 16

Estimates (t-statistics)

Model 1: (Dependent Variable DROPOUT: 1=Left School at Age 16; 0=Enrolled in School at Age 16)

| Explanatory variables | Probit (90.8% correct predictions) | Mean of $\frac{dP}{dX}$ | Logit (91.2% correct predictions) | Mean of $\frac{dP}{dX}$ |
|---|---|---|---|---|
| CONSTANT | -2.144<br>(0.578) | | -3.489<br>(0.516) | |
| AVE_GRADE | -1.040*<br>(6.065) | -0.131 | -2.351*<br>(5.724) | -0.157 |
| PROP_CONT | -1.956*<br>(3.798) | -0.246 | -3.489*<br>(3.656) | -0.234 |
| FEMALE | -0.550*<br>(2.687) | -0.069 | -0.816*<br>(2.170) | -0.055 |
| MAORI | 0.247<br>(0.927) | 0.031 | 0.576<br>(1.217) | 0.039 |
| P_ISLAND | -0.154<br>(0.377) | -0.019 | -0.068<br>(0.097) | -0.0045 |
| MOTHER_NO_Q | 0.189<br>(0.970) | 0.024 | 0.328<br>(0.913) | 0.022 |
| MOTHER_TERT_Q | -0.263<br>(0.727) | -0.033 | -0.729<br>(0.958) | -0.049 |
| FATHER_NO_Q | 0.221<br>(1.160) | 0.028 | 0.396<br>(1.113) | 0.027 |
| FATHER_TERT_Q | 0.120<br>(0.331) | 0.015 | 0.403<br>(0.557) | 0.027 |
| NUM_SIB | 0.00097<br>(0.011) | 0.00012 | -0.014<br>(0.087) | -0.0009 |
| OWN_HOME | -0.413<br>(1.753) | -0.052 | -0.692<br>(1.643) | -0.046 |
| RURAL | 0.631<br>(1.806) | 0.079 | 1.236*<br>(1.971) | 0.082 |
| BEN_PROP | 0.577*<br>(2.193) | 0.073 | 0.955*<br>(2.039) | 0.064 |
| LOCAL_UNEM | 0.392<br>(1.160) | 0.049 | 0.654<br>(1.062) | 0.044 |
| INC_DEC | 0.067<br>(1.392) | 0.0084 | 0.125<br>(1.425) | 0.00084 |
| IQ8 | -0.016*<br>(2.306) | -0.0020 | -0.026*<br>(1.994) | -0.0017 |
| PEER_DEV | 0.171*<br>(5.384) | 0.021 | 0.292*<br>(4.952) | 0.020 |
| Log Likelihood | -154.328 | | -151.161 | |
| Sample Size | 694 | | 694 | |

* Estimates significant at 0.05.

## Table 3: Probit Models of School Leaving at Age 16 for Males and Females

Estimates (t-statistics)

**Model 1:** (Dependent Variable DROPOUT: 1=Left School at Age 16; 0=Enrolled in School at Age 16)

| Explanatory variables | Males (90.2% correct predictions) | Mean of $\frac{dP}{dX}$ | Females (93.3% correct predictions) | Mean of $\frac{dP}{dX}$ |
|---|---|---|---|---|
| CONSTANT | -1.569<br>(0.251) | | 2.078<br>(0.276) | |
| AVE_GRADE | -0.751*<br>(3.498) | -0.114 | -1.893*<br>(4.846) | -0.143 |
| PROP_CONT | -1.883*<br>(2.700) | -0.284 | -3.299*<br>(3.056) | -0.249 |
| MAORI | 0.114<br>(0.281) | 0.017 | 0.668<br>(1.565) | 0.050 |
| P_ISLAND | -0.313<br>(0.609) | -0.047 | 0.782<br>(0.892) | 0.059 |
| MOTHER_NO_Q | -0.060<br>(0.250) | -0.009 | 1.281*<br>(2.295) | 0.097 |
| MOTHER_TERT_Q | -0.623<br>(1.420) | -0.094 | 0.996<br>(1.207) | 0.075 |
| FATHER_NO_Q | 0.466<br>(1.880) | 0.070 | -0.265<br>(0.673) | -0.020 |
| FATHER_TERT_Q | 0.269<br>(0.678) | 0.041 | —[†] | — |
| NUM_SIB | -0.041<br>(0.344) | -0.006 | -0.045<br>(0.301) | -0.003 |
| OWN_HOME | -0.216<br>(0.658) | -0.033 | -0.557<br>(1.376) | -0.042 |
| RURAL | 0.601<br>(0.828) | 0.091 | 0.869<br>(1.707) | 0.066 |
| BEN_PROP | 0.360<br>(0.961) | 0.054 | 0.986*<br>(2.125) | 0.074 |
| LOCAL_UNEM | 0.441<br>(0.778) | 0.067 | -0.127<br>(0.192) | -0.010 |
| INC_DEC | 0.105<br>(1.626) | 0.016 | 0.044<br>(0.479) | 0.003 |
| IQ8 | -0.030*<br>(3.115) | -0.005 | -0.002<br>(0.152) | -0.0002 |
| PEER_DEV | 0.130*<br>(3.073) | 0.020 | 0.244*<br>(4.009) | 0.018 |
| Log Likelihood | -90.431 | | -48.318 | |
| Sample Size | 338 | | 356 | |

* Estimates significant at 0.05.

[†] FATHER_TERT_Q=TRUE (1) perfectly predicts DROPOUT=FALSE (0)

**Table 4: Predicted Probabilities of Dropping Out of Secondary School at Age 16: Overall, Male and Female Samples**

Based on Probit Estimations

| Characteristics | Overall | Males | Females |
|---|---|---|---|
| **Overall Characteristics** | 0.1548 | 0.1806 | 0.1296 |
| Maori | 0.1840 | 0.1966 | 0.1788 |
| Mother with No Qualification | 0.1654 | 0.1852 | 0.1475 |
| Mother with a Tertiary Qualification | 0.1117 | 0.1101 | 0.1243 |
| Father with No Qualification | 0.1640 | 0.2088 | 0.1247 |
| Father with a Tertiary Qualification | 0.1509 | 0.1764 | — |
| **Intelligence Quotient (IQ Score)** | | | |
| Individual IQ's: -2 s.d. | 0.2228 | 0.3511 | 0.1346 |
| -1 s.d. | 0.1869 | 0.2582 | 0.1321 |
| +1 s.d. | 0.1266 | 0.1198 | 0.1272 |
| +2 s.d. | 0.1022 | 0.0751 | 0.1248 |
| **Average School Certificate Mark** | | | |
| Average S.C. Mark: D or E | 0.2656 | 0.2672 | 0.2699 |
| C | 0.0871 | 0.1228 | 0.0527 |
| B | 0.0221 | 0.0478 | 0.0069 |
| A | 0.0046 | 0.0163 | 0.0003 |
| **Proportion of Rest of Class Continuing** | | | |
| Proportion of Rest Continuing: 25% | 0.3382 | 0.3956 | 0.3261 |
| 50% | 0.2429 | 0.2865 | 0.2195 |
| 75% | 0.1633 | 0.1941 | 0.1355 |
| 100% | 0.1019 | 0.1220 | 0.0744 |
| **Proportion of Family Income from Benefits** | | | |
| Benefit Proportion of: 0% | 0.1376 | 0.1703 | 0.1075 |
| 50% | 0.1764 | 0.1985 | 0.1478 |
| 100% | 0.2211 | 0.2293 | 0.1972 |
| **Deviant Peer Effects (0-10)** | | | |
| Deviant Affiliation of: 0 | 0.0908 | 0.1256 | 0.0689 |
| 5 | 0.2061 | 0.2320 | 0.1663 |
| 10 | 0.3740 | 0.3747 | 0.3175 |
| **Sample Size** | 694 | 338 | 356 |

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

**Table 5: Predicted Probabilities of Dropping Out of Secondary School at Age 16:**
**Multiple Effects**

| Characteristics | Overall | Males | Females |
|---|---|---|---|
| **Economic & Environmental Scenarios** | | | |
| No family Income from Benefits and the Rest of the Class Continuing | 0.0852 | 0.1124 | 0.0512 |
| Half Family Income from Benefits and half of the Rest of the Class Continuing | 0.2785 | 0.3143 | 0.2587 |
| All Family Income from Benefits and none of the Rest of the Class Continuing | 0.5624 | 0.5959 | 0.5882 |
| **Academic Performance & School and Peer Scenarios** | | | |
| Deviant Affiliation of 0, all of the Rest of the Class Continuing and an Average School Certificate Mark of A | $3.0\times10^{-5}$ | $9.7\times10^{-4}$ | $4.4\times10^{-10}$ |
| Deviant Affiliation of 5, half of the Rest of the Class Continuing and an Average School Certificate Mark of B | 0.0632 | 0.1373 | 0.0124 |
| Deviant Affiliation of 10, none of the Rest of the Class Continuing and an Average School Certificate Mark of C | 0.8479 | 0.8196 | 0.9270 |
| **Personal Characteristics** | | | |
| European with IQ +1 s.d. | 0.1241 | 0.1200 | 0.1176 |
| Maori with IQ +1 s.d. | 0.1531 | 0.1337 | 0.1734 |
| European with IQ -1 s.d. | 0.1841 | 0.2599 | 0.1224 |
| Maori with IQ -1 s.d. | 0.2211 | 0.2817 | 0.1796 |
| **Low Dropout Rate Scenario** | | | |
| Urban with IQ +2 s.d., Average School Certificate Mark of A, Deviant Peer Affiliation of 0, no Family Income from Benefits and all of the Rest of the Class Continuing | $8.4\times10^{-7}$ | $2.8\times10^{-5}$ | $1.5\times10^{-14}$ |
| **High Dropout Rate Scenario** | | | |
| Rural with IQ -2 s.d., Average School Certificate Mark of D, Deviant Peer Affiliation of 10, all Family Income from Benefits and none of the Rest of the Class Continuing | 0.99983 | 0.99898 | >0.99999 |
| **Sample Size** | 694 | 338 | 356 |

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

## Table 6: Multinomial Logit Model of Work, Study or Unemployment at Age 18℘

Estimates (t-statistics)

**Model 2:** (Dependent Variable STUDWORK: 2=Study; 1=Employed; 0=Unemployed or Out of the Labour Force)

| Explanatory variables | $\ln\left(\frac{\text{P(Employed)}}{\text{P(Unemployed or OLF)}}\right)$ | Mean of $\frac{dP_e}{dX}$ | $\ln\left(\frac{\text{P(In Study)}}{\text{P(Unemployed or OLF)}}\right)$ | Mean of $\frac{dP_s}{dX}$ |
|---|---|---|---|---|
| CONSTANT | 3.740<br>(0.457) | | 0.639<br>(0.077) | |
| AVE_GRADE | 0.833*<br>(2.023) | -0.135 | 2.022*<br>(4.938) | 0.207 |
| PROP_CONT | 1.328<br>(1.655) | -0.085 | 2.278*<br>(2.385) | 0.180 |
| FEMALE | -0.860*<br>(1.984) | -0.061 | -0.634<br>(1.416) | 0.017 |
| MAORI | -0.636<br>(1.297) | -0.028 | -0.588<br>(1.104) | -0.0063 |
| P_ISLAND | -0.562<br>(0.672) | -0.055 | -0.305<br>(0.346) | 0.029 |
| MOTHER_NO_Q | 0.148<br>(0.357) | 0.027 | -0.010<br>(0.024) | -0.022 |
| MOTHER_TERT_Q | -0.364<br>(0.475) | -0.047 | -0.111<br>(0.145) | 0.032 |
| FATHER_NO_Q | 0.189<br>(0.486) | 0.085 | -0.384<br>(0.959) | -0.087 |
| FATHER_TERT_Q | 0.396<br>(0.344) | -0.083 | 1.099<br>(0.970) | 0.120 |
| NUM_SIB | 0.571*<br>(3.159) | 0.035 | 0.459*<br>(2.402) | -0.0055 |
| OWN_HOME | 0.681<br>(1.533) | -0.0095 | 0.921<br>(1.884) | 0.053 |
| RURAL | -0.557<br>(0.789) | -0.098 | 0.018<br>(0.026) | 0.079 |
| BEN_PROP | -0.133<br>(0.026) | -0.034 | 0.267<br>(0.485) | 0.040 |
| LOCAL_UNEM | -0.718<br>(0.940) | -0.061 | -0.455<br>(0.587) | 0.026 |
| INC_DEC | 0.077<br>(0.782) | 0.010 | 0.021<br>(0.207) | -0.0072 |
| IQ8 | 0.033*<br>(2.379) | 0.0016 | 0.029*<br>(2.088) | 0.00012 |
| PEER_DEV | -0.140*<br>(2.251) | 0.017 | -0.302*<br>(4.426) | -0.029 |

*Estimates significant at 0.05 Sample Size=694 Kullback-Leibler $R^2$=0.2702 Log-likelihood=-442.947

℘ For a note on the calculation of the Multinomial Logit probabilities the reader may refer to Appendix D.

## Table 7: Multinomial Logit Model of Work, Study or Unemployment at Age 18: Male Sample

Estimates (t-statistics)

**Model 2:** (Dependent Variable STUDWORK: 2=Study; 1=Employed; 0=Unemployed or Out of the Labour Force)

| Explanatory variables | $\ln\left(\frac{\text{P(Employed)}}{\text{P(Unemployed or OLF)}}\right)$ | Mean of $\frac{dP_e}{dX}$ | $\ln\left(\frac{\text{P(In Study)}}{\text{P(Unemployed or OLF)}}\right)$ | Mean of $\frac{dP_s}{dX}$ |
|---|---|---|---|---|
| CONSTANT | 18.960<br>(0.307) | | 7.653<br>(0.447) | |
| AVE_GRADE | 1.380<br>(1.256) | -0.112 | 2.348*<br>(2.125) | 0.174 |
| PROP_CONT | 3.865*<br>(2.544) | -0.107 | 5.226*<br>(3.013) | 0.267 |
| MAORI | -1.022<br>(1.160) | -0.004 | -1.172<br>(1.158) | -0.036 |
| P_ISLAND | -0.862<br>(0.663) | -0.084 | -0.463<br>(0.344) | 0.056 |
| MOTHER_NO_Q | 0.593<br>(0.911) | 0.013 | 0.612<br>(0.897) | 0.010 |
| MOTHER_TERT_Q | 0.930<br>(0.640) | -0.016 | 1.196<br>(0.812) | 0.054 |
| FATHER_NO_Q | 0.761<br>(1.083) | 0.191 | -0.357<br>(0.495) | -0.175 |
| FATHER_TERT_Q | Variable not used† | — | — | — |
| NUM_SIB | 0.213<br>(0.682) | -0.015 | 0.345<br>(1.058) | 0.024 |
| OWN_HOME | -1.003<br>(1.104) | -0.030 | -0.978<br>(1.010) | -0.007 |
| RURAL | -2.335<br>(1.051) | -0.300 | -0.782<br>(0.390) | 0.229 |
| BEN_PROP | 1.235<br>(1.315) | -0.035 | 1.679<br>(1.667) | 0.087 |
| LOCAL_UNEM | -2.675<br>(1.548) | -0.206 | -1.792<br>(1.133) | 0.116 |
| INC_DEC | 0.477*<br>(2.346) | 0.026 | 0.386<br>(1.845) | -0.010 |
| IQ8 | 0.062*<br>(2.349) | -0.0005 | 0.076*<br>(2.738) | 0.003 |
| PEER_DEV | -0.097<br>(0.881) | 0.028 | -0.294*<br>(2.445) | -0.034 |
| *Estimates significant at 0.05 Sample Size=338 Kullback-Leibler R2=0.2855 Log-likelihood=-206.104 | | | | |

† FATHER_TERT_Q=TRUE (1) perfectly predicts STUDWORK≠0

**Table 8: Multinomial Logit Model of Work, Study or Unemployment at Age 18: Female Sample**

Estimates (t-statistics)

**Model 2:** (Dependent Variable STUDWORK: 2=Study; 1=Employed; 0=Unemployed or Out of the Labour Force)

| Explanatory variables | $\ln\left(\frac{\text{P(Employed)}}{\text{P(Unemployed or OLF)}}\right)$ | Mean of $\frac{dP_e}{dX}$ | $\ln\left(\frac{\text{P(In Study)}}{\text{P(Unemployed or OLF)}}\right)$ | Mean of $\frac{dP_s}{dX}$ |
|---|---|---|---|---|
| CONSTANT | -4.892<br>(0.432) | | -9.691<br>(0.837) | |
| AVE_GRADE | 0.718<br>(1.400) | -0.149 | 2.208*<br>(4.356) | 0.237 |
| PROP_CONT | 0.057<br>(0.048) | -0.037 | 0.391<br>(0.290) | 0.050 |
| MAORI | -0.888<br>(1.290) | -0.063 | -0.612<br>(0.872) | 0.015 |
| P_ISLAND | -0.580<br>(0.445) | 0.013 | -0.867<br>(0.584) | -0.058 |
| MOTHER_NO_Q | 0.122<br>(0.196) | 0.043 | -0.211<br>(0.342) | -0.045 |
| MOTHER_TERT_Q | -0.803<br>(0.702) | -0.084 | -0.324<br>(0.298) | 0.047 |
| FATHER_NO_Q | 0.161<br>(0.298) | 0.024 | 0.005<br>(0.010) | -0.018 |
| FATHER_TERT_Q | -0.060<br>(0.043) | -0.109 | 0.855<br>(0.642) | 0.131 |
| NUM_SIB | 0.884*<br>(3.224) | 0.066 | 0.578*<br>(2.048) | -0.019 |
| OWN_HOME | 1.577*<br>(2.579) | 0.001 | 2.034*<br>(3.060) | 0.111 |
| RURAL | -0.435<br>(0.576) | -0.072 | 0.055<br>(0.073) | 0.059 |
| BEN_PROP | -0.564<br>(0.801) | -0.058 | -0.239<br>(0.317) | 0.031 |
| LOCAL_UNEM | 0.180<br>(0.176) | -0.057 | 0.719<br>(0.691) | 0.084 |
| INC_DEC | -0.111<br>(0.838) | -0.003 | -0.116<br>(0.872) | -0.004 |
| IQ8 | 0.027<br>(1.305) | 0.003 | 0.010<br>(0.504) | -0.002 |
| PEER_DEV | -0.207*<br>(2.251) | 0.005 | -0.308*<br>(3.161) | -0.021 |
| *Estimates significant at 0.05 Sample Size=356 Kullback-Leibler $R^2$=0.3089 Log-likelihood=-216.991 | | | | |

## Table 9: Probit Model of Participation in Tertiary Education

Estimates (t-statistics)

**Model 3:** (Dependent Variable TERT18: 1=Entered or entering tertiary education; 0=Otherwise)

| Explanatory variables | Probit (76.9% correct predictions) | Mean of $\frac{dP}{dX}$ |
|---|---|---|
| CONSTANT | -4.418<br>(1.647) | |
| AVE_GRADE | 0.413*<br>(3.793) | 0.127 |
| PASS_SIXTH_FORM_CERT | 0.508*<br>(3.075) | 0.156 |
| INTEND_16_UNI | 0.412*<br>(3.039) | 0.127 |
| INTEND_16_POLY | 0.353*<br>(2.350) | 0.109 |
| PROP_CONT | 1.106*<br>(2.046) | 0.341 |
| FEMALE | 0.057<br>(0.394) | 0.017 |
| MAORI | -0.170<br>(0.675) | -0.052 |
| P_ISLAND | 0.092<br>(0.234) | 0.028 |
| MOTHER_NO_Q | -0.044<br>(0.310) | -0.013 |
| MOTHER_TERT_Q | 0.125<br>(0.751) | 0.038 |
| FATHER_NO_Q | -0.065<br>(0.475) | -0.020 |
| FATHER_TERT_Q | -0.024<br>(0.136) | -0.007 |
| NUM_SIB | -0.019<br>(0.288) | -0.006 |
| OWN_HOME | 0.283<br>(1.122) | 0.087 |
| RURAL | 0.374<br>(1.495) | 0.115 |
| BEN_PROP | 0.319<br>(1.261) | 0.098 |
| LOCAL_UNEM | 0.129<br>(0.544) | 0.040 |
| INC_DEC | 0.019<br>(0.618) | 0.006 |
| PARENTAL_ASSISTANCE_18 | 0.007<br>(1.475) | 0.002 |
| OWN_TRANSPORTATION | -0.014<br>(0.105) | 0.004 |
| IQ8 | 0.007<br>(1.280) | 0.002 |
| PEER_DEV | -0.043<br>(1.531) | -0.013 |
| Log Likelihood | -317.196 | |
| Sample Size | 585 | |

* Estimates significant at 0.05.

**Table 10: Multinomial Logit Model of Work, Polytechnic or University Participation compared to Unemployment at Age 18**
Estimates (t-statistics)

**Model 4:** (Dependent Variable WORKTERT18: 3=University participation; 2=Polytechnic/other tertiary participation; 1=Employed or job arranged; 0=Actual and likely unemployed or out of the labour force)

| Explanatory variables | $\ln\left(\frac{P(\text{Employed})}{P(\text{Unemployed or OLF})}\right)$ | Mean of $\frac{dP}{dX}$ | $\ln\left(\frac{P(\text{Polytechnic})}{P(\text{Unemployed or OLF})}\right)$ | Mean of $\frac{dP}{dX}$ | $\ln\left(\frac{P(\text{University})}{P(\text{Unemployed or OLF})}\right)$ | Mean of $\frac{dP}{dX}$ |
|---|---|---|---|---|---|---|
| CONSTANT | -5.220<br>(0.720) | | -1.350<br>(0.234) | | -20.198*<br>(3.198) | |
| AVE_GRADE | 0.042<br>(0.152) | -0.038 | -0.010<br>(0.040) | -0.069 | 1.495*<br>(5.268) | 0.175 |
| PASS_SIXTH_FORM_CERT | -0.801*<br>(2.400) | -0.190 | 0.332<br>(0.973) | -0.026 | 2.519*<br>(2.383) | 0.304 |
| INTEND_16_UNI | -0.093<br>(0.266) | -0.049 | 0.242<br>(0.760) | 0.0003 | 0.897*<br>(2.888) | 0.097 |
| INTEND_16_POLY | 0.077<br>(0.232) | -0.028 | 0.872*<br>(2.815) | 0.127 | -0.039<br>(0.097) | -0.045 |
| PROP_CONT | 0.448<br>(0.387) | -0.094 | 1.651<br>(1.437) | 0.107 | 2.641<br>(1.933) | 0.224 |
| FEMALE | 0.495<br>(1.383) | 0.032 | 0.818*<br>(2.498) | 0.107 | -0.204<br>(0.604) | -0.074 |
| MAORI | -0.916<br>(1.523) | -0.069 | -0.812<br>(1.433) | -0.061 | -0.399<br>(0.636) | 0.016 |
| P_ISLAND | 0.868<br>(1.025) | 0.069 | 0.294<br>(0.356) | -0.038 | 0.963<br>(0.865) | 0.075 |
| MOTHER_NO_Q | 0.100<br>(0.309) | 0.019 | -0.191<br>(0.615) | -0.037 | 0.093<br>(0.262) | 0.016 |
| MOTHER_TERT_Q | -0.298<br>(0.671) | -0.039 | -0.141<br>(0.354) | -0.019 | 0.257<br>(0.675) | 0.045 |

## Table 10 Continued

| Explanatory variables | $\ln\left(\frac{P(Employed)}{P(Unemployed\ or\ OLF)}\right)$ | Mean of $\frac{dP}{dX}$ | $\ln\left(\frac{P(Polytechnic)}{P(Unemployed\ or\ OLF)}\right)$ | Mean of $\frac{dP}{dX}$ | $\ln\left(\frac{P(University)}{P(Unemployed\ or\ OLF)}\right)$ | Mean of $\frac{dP}{dX}$ |
|---|---|---|---|---|---|---|
| FATHER_NO_Q | 0.050<br>(0.016) | 0.005 | 0.098<br>(0.323) | 0.030 | -0.342<br>(1.001) | -0.044 |
| FATHER_TERT_Q | -0.248<br>(0.547) | -0.023 | 0.186<br>(0.452) | 0.065 | -0.597<br>(1.465) | -0.071 |
| NUM_SIB | 0.441*<br>(2.898) | 0.046 | 0.198<br>(1.317) | 0.007 | 0.059<br>(0.338) | -0.015 |
| OWN_HOME | -0.057<br>(0.115) | -0.040 | 0.389<br>(0.751) | 0.037 | 0.521<br>(0.776) | 0.046 |
| RURAL | -0.669<br>(0.960) | -0.104 | -0.103<br>(0.193) | -0.021 | 0.811<br>(1.438) | 0.119 |
| BEN_PROP | 0.126<br>(0.219) | -0.024 | 0.322<br>(0.597) | -0.003 | 0.883<br>(1.341) | 0.086 |
| LOCAL_UNEM | -0.024<br>(0.036) | -0.002 | -0.374<br>(0.738) | -0.089 | 0.773<br>(1.387) | 0.104 |
| INC_DEC | 0.040<br>(0.533) | 0.003 | -0.062<br>(0.880) | -0.018 | 0.160*<br>(2.127) | 0.020 |
| PARENTAL_ASSISTANCE_18 | -0.080*<br>(3.780) | -0.010 | -0.001<br>(0.129) | 0.004 | -0.001<br>(0.171) | 0.002 |
| OWN_TRANSPORTATION | 1.144*<br>(3.766) | 0.105 | 0.818*<br>(2.761) | 0.062 | 0.142<br>(0.428) | -0.053 |
| IQ8 | 0.037*<br>(3.070) | 0.003 | 0.023*<br>(1.960) | 0.00009 | 0.038*<br>(2.915) | 0.002 |
| PEER_DEV | -0.022<br>(0.345) | 0.003 | -0.071<br>(1.118) | -0.006 | -0.087<br>(1.228) | -0.006 |

* Estimates significant at 0.05. Sample Size=585 Kullback-Leibler $R^2$=0.2702 Log-likelihood=-583.473

**Table 11: Predicted Probabilities of Unemployment, Employment, Attending a Polytechnic, or University at Age 18**

| Characteristics | Unemployed or OLF | Employed | Polytechnic | University |
|---|---|---|---|---|
| Overall Characteristics | 0.2530 | 0.2051 | 0.2103 | 0.3316 |
| Maori | 0.3666 | 0.1420 | 0.1528 | 0.3387 |
| Mother with No Qualification | 0.2534 | 0.2210 | 0.1969 | 0.3287 |
| Mother with a Tertiary Qualification | 0.2634 | 0.1651 | 0.2137 | 0.3577 |
| Father with No Qualification | 0.2536 | 0.2101 | 0.2130 | 0.3234 |
| Father with a Tertiary Qualification | 0.2714 | 0.1821 | 0.2498 | 0.2968 |
| Intelligence Quotient (IQ Score) | | | | |
| Individual IQ's: -2 s.d. | 0.4162 | 0.1316 | 0.1940 | 0.2582 |
| –1 s.d. | 0.3304 | 0.1676 | 0.2055 | 0.2965 |
| +1 s.d. | 0.1869 | 0.2421 | 0.2082 | 0.3629 |
| +2 s.d. | 0.1334 | 0.2766 | 0.2001 | 0.3899 |
| Average School Certificate Mark | | | | |
| Ave. S.C. Mark: D or E | 0.3505 | 0.2570 | 0.3172 | 0.0753 |
| C | 0.2906 | 0.2328 | 0.2575 | 0.2191 |
| B | 0.2005 | 0.1829 | 0.1688 | 0.4477 |
| A | 0.1167 | 0.1261 | 0.0886 | 0.6686 |
| Pass in Sixth Form Certificate | 0.2579 | 0.1614 | 0.2324 | 0.3483 |
| Intention to go to University at Age 16 | 0.2367 | 0.1820 | 0.1815 | 0.3998 |
| Intention to go to Polytechnic or other non-University Tertiary Institution at Age 16 | 0.2279 | 0.1980 | 0.3315 | 0.2426 |
| Own Transportation | 0.1808 | 0.2733 | 0.2528 | 0.2931 |
| Income Decile of : 1 | 0.2796 | 0.1901 | 0.3122 | 0.2181 |
| 4 | 0.2681 | 0.2046 | 0.2471 | 0.2803 |
| 7 | 0.2502 | 0.2148 | 0.1893 | 0.3458 |
| 10 | 0.2276 | 0.2202 | 0.1405 | 0.4116 |

Note: 585 individual predictions are calculated for each category and the average of those predictions is computed.

**Table 12: Multiple Effects**
**Predicted Probabilities of Unemployment, Employment, Attending a Polytechnic or University at Age 18**

| Characteristics | Unemployed or OLF | Employed | Polytechnic | University |
|---|---|---|---|---|
| **Economic and Environmental Scenarios** | | | | |
| No family Income from Benefits and the Rest of the Class Continuing | 0.2265 | 0.1943 | 0.2268 | 0.3524 |
| 50% of Family Income from Benefits and half of the Rest of the Class Continuing | 0.3158 | 0.2292 | 0.1744 | 0.2807 |
| All Family Income from Benefits and none of the Rest of the Class Continuing | 0.4124 | 0.2552 | 0.1245 | 0.2079 |
| **Academic Performance & School and Peer Scenarios** | | | | |
| Average School Certificate Mark of A and passed Sixth Form Certificate, Deviant Affiliation of 0, and all of the Rest of the Class Continuing | 0.0490 | 0.0410 | 0.0711 | 0.8388 |
| Average School Certificate Mark of B and passed Sixth Form Certificate, Deviant Affiliation of 5, and half of the Rest of the Class Continuing | 0.3338 | 0.1850 | 0.1488 | 0.3324 |
| Average School Certificate Mark of C and failed Sixth Form Certificate, Deviant Affiliation of 10, and none of the Rest of the Class Continuing | 0.5445 | 0.3982 | 0.0549 | 0.0024 |
| **Personal Characteristics** | | | | |
| European with IQ +1 s.d. | 0.1823 | 0.2444 | 0.2123 | 0.3611 |
| Maori with IQ +1 s.d. | 0.2879 | 0.1756 | 0.1592 | 0.3774 |
| European with IQ -1 s.d. | 0.3249 | 0.1695 | 0.2100 | 0.2955 |
| Maori with IQ -1 s.d. | 0.4572 | 0.1074 | 0.1416 | 0.2939 |
| **High Probability of University Participation** | | | | |
| IQ +2 s.d., Average School Certificate Mark of A, passed SFC, Deviant Peer Affiliation of 0, urban, no Family Income from Benefits and all of the Rest of the Class Continuing | 0.0222 | 0.0587 | 0.0668 | 0.8523 |
| **High Unemployment Rate Scenario** | | | | |
| IQ -2 s.d., Average School Certificate Mark of D, failed SFC, Deviant Peer Affiliation of 10, rural, all Family Income from Benefits and none of the Rest of the Class Continuing | 0.8866 | 0.0819 | 0.0305 | 0.0010 |

Note: 585 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 for Models 1 and 2

| | |
|---|---|
| Secondary Dummy (DROPOUT) | Binary dependent variable:<br>0 for an individual leaving school at the post-compulsory level (age 16, the fifth form or below);<br>1 for an individual at school beyond the post-compulsory level (age 16, the sixth form or beyond). |
| Average School Certificate Mark (AVE_GRADE) | 0 for an individual who did not sit School Certificate (Year 11);<br>otherwise the average value of all School Certificate subjects sat with weightings of 3 for an A, 2 for a B, 1 for a C and 0 for a D or E. |
| Proportion of Students Continuing (PROP_CONT) | 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. Results are only accurate for Christchurch Schools. |
| FEMALE | 0 for a male;<br>1 for a female. |
| MAORI | 1 if Maori;<br>0 otherwise. |
| Pacific Islander (P_ISLAND) | 1 if a Pacific Islander;<br>0 otherwise. |
| Mother without Qualifications (MOTHER_NO_Q) | 1 if child's mother does not have formal educational qualifications (School Certificate or higher);<br>0 otherwise. |
| Mother with Tertiary Qualifications (MOTHER_TERT_Q) | 1 if child's mother has a tertiary qualification;<br>0 otherwise. |
| Father without Qualifications (FATHER_NO_Q) | 1 if child's father does not have formal educational qualifications (School Certificate or higher);<br>0 otherwise. |
| Father with Tertiary Qualifications (FATHER_TERT_Q) | 1 if child's father has a tertiary qualification;<br>0 otherwise. |
| Number of Siblings (NUM_SIB) | Number of siblings in the home at 15 years. |

**Table A1: Continued**

| | |
|---|---|
| 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;<br>0 otherwise. |
| Rural Lifestyle (RURAL) | 1 if child was not living in a main urban centre at 15 years of age;<br>0 otherwise. |
| Proportion of Family Income from Benefits (BEN_PROP) | The proportion (between 0 and 1) of the family's income derived from social welfare benefits. |
| Registered Unemployment (LOCAL_UNEM) | Regional unemployment rate by gender in which each individual was living at 15 years of age. (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. |
| Average Income Decile (INC_DEC) | Average income decile of the family for when each child was between 11 and 14 years of age:<br>1 is consistently poor;<br>10 is consistently affluent. |
| Total Intelligence Quotient (IQ8) | The child's measured total IQ score at 8 years of age (revised Wechsler Intelligence Scale for Children). |
| Affiliation with Deviant Peers (PEER_DEV) | 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. |
| Multinomial Study or Work (STUDWORK) | Multinomial dependent variable expressing actual circumstances at age 18:<br>0=Unemployed or out of the labour force (base category);<br>1=Employed in the majority;<br>2=Student in the majority. |

## Table A2: Additional Variables for Models 3 and 4

| | |
|---|---|
| Binomial Tertiary (TERT18) | Binary dependent variable excluding all individuals where DROPOUT=1:<br>0 for an individual who has left (or is leaving) school and is not attending a tertiary institution at 18 years of age;<br>1 for an individual attending or about to attend a tertiary institution at 18 years of age. |
| Multinomial Tertiary (WORKTERT18) | Multinomial dependent variable excluding all individuals where DROPOUT=1:<br>0 for an individual who has left (or is leaving) school and is unemployed (or does not have employment arranged) and is not attending a tertiary institution at 18 years of age;<br>1 for an individual who has left (or is leaving) school and is employed (or has a job arranged) and is not attending a tertiary institution at 18 years of age;<br>2 for an individual who is attending (or about to attend) a Polytechnic or other non-University tertiary institution at 18 years of age;<br>3 for an individual who is attending (or about to attend) a University at 18 years of age; |
| Pass in Sixth Form Certificate (PASS_SIXTH_FORM_CERT) | 1 for a pass in Sixth Form Certificate (the year following School Certificate);<br>0 otherwise. |
| Intention to go to University (INTEND_16_UNI) | 1 for an intention expressed to go to University at age 16;<br>0 otherwise. |
| Intention to go to a Polytechnic (INTEND_16_POLY) | 1 for an intention expressed to go to a Polytechnic or other non-University tertiary institution at age 16;<br>0 otherwise. |
| PARENTAL_ASSISTANCE_18 | Amount of assistance from parents and relatives given to each individual at age 18 (average weekly amount in dollars). |
| OWN_TRANSPORTATION | 1 if an individual owns a car or motorcycle at 18 year of age;<br>0 otherwise. |

## APPENDIX B

### A Comment on Missing Observations

The entire data set consisted of 1265 participants in the Christchurch Health and Development Study. For a complete set of observations for the variables specified in Table A1, the set of observations reduced to 694 individuals. Unfortunately, this amounts to the loss of data from 571 participants. (The additional variables specified in Table A2 only required the extra loss of three participants). Those who had already left school at age 16 were purposefully excluded from the age 18 sample (because the age 18 analysis attempts to determine whether someone who did not leave school at age 16 would continue on to post-secondary education).

It is impossible to completely determine whether those individuals who were excluded from the sample due to missing data were different from those included, due to the very nature of the missing data. However, significant portions of data that were excluded are still available. For example, every individual's gender is available for all 1265 individuals. However IQ8 started with only 881 observations. Thus we have no data on the IQ of 384 individuals out of the 1265 total individuals in the data set. But there is a remaining 881-694=187 individuals with known intelligent quotients who were excluded from the data set. The means and standard deviations of these excluded groups are set out with information on the other excluded groups in Table B1 in this Appendix. The means and standard deviations of the utilised data are set out for comparison, and the percentages calculated in the right hand side of Table B1 below are the differences in means from the utilised data. For example, the known but unused data contained 6.5% less females (because females are assigned a value of 1).

More emphasis should be placed on those variables with the greatest amount of unused but known data, such as gender, ethnicity and the educational background of parents.

There is a small but recognisable bias towards socio-economic disadvantage in the data of those known but unused due to other missing variables.

## Table B1: Comparison between Total and Utilised Data

| Dependent and Explanatory variables | Unused but Available Data (number of individuals)* | Means (Standard Deviations) of Total Available Data (column 1+694) | Means (Standard Deviations) of Utilised Data (694 individuals) | Percentage Change from All Data to Utilised Data |
|---|---|---|---|---|
| DROPOUT | 331 | 0.1581 | 0.1527 | -3.4% |
| AVE_GRADE | 309 | 1.0255<br>(0.848) | 1.0690<br>(0.854) | 4.2% |
| PROP_CONT | 304 | 0.8345<br>(0.151) | 0.8372<br>(0.162) | 0.3% |
| FEMALE | 571 | 0.4980 | 0.5130 | 3.0% |
| MAORI | 571 | 0.0996 | 0.0720 | -27.7% |
| P_ISLAND | 571 | 0.0316 | 0.0259 | -18.0% |
| MOTHER_NO_Q | 571 | 0.5115 | 0.4870 | -4.8% |
| MOTHER_TERT_Q | 571 | 0.1858 | 0.2089 | 12.4% |
| FATHER_NO_Q | 520 | 0.4835 | 0.4697 | -2.9% |
| FATHER_TERT_Q | 520 | 0.1820 | 0.1989 | 9.3% |
| NUM_SIB | 292 | 1.4990<br>(0.981) | 1.4885<br>(0.916) | -0.7% |
| OWN_HOME | 292 | 0.8611 | 0.8905 | 3.4% |
| RURAL | 296 | 0.2303 | 0.1657 | -28.1% |
| BEN_PROP | 277 | 0.1496<br>(0.336) | 0.1356<br>(0.323) | -9.4% |
| LOCAL_UNEM | 296 | 10.5305<br>(0.543) | 10.5638<br>(0.422) | 0.3% |
| INC_DEC | 356 | 5.4637<br>(2.618) | 5.5561<br>(2.557) | 1.7% |
| IQ8 | 187 | 101.7446<br>(15.969) | 102.8012<br>(15.441) | 1.0% |
| PEER_DEV | 271 | 2.4632<br>(2.499) | 2.2752<br>(2.427) | -7.6% |

* Observations unused due to other missing variables.

## APPENDIX C

### Statistics on the Individuals who Left School at Age 16

There were 106 individuals who left school before Form Six, comprised of 60 males and 46 females (Figure 2). A percentages of those individuals cited items from the list of categories below as definite reasons for leaving. Since it is possible for an individual to cite more than one definite reason for leaving, the sum of the percentages exceed 100%.

| Definite Reasons for Leaving | Agreement by % of Males and Females | Agreement by % of Males | Agreement by % of Females |
|---|---|---|---|
| Courses offered at school not relevant | 16.0% | 18.3% | 13.0% |
| Didn't think he or she would be able to cope | 7.5% | 5.0% | 10.9% |
| Disliked being at school | 50.9% | 48.3% | 54.3% |
| Found school boring | 50.9% | 51.7% | 50.0% |
| Was offered a full-time job | 26.4% | 36.7% | 13.0% |
| Eligible for a government employment scheme | 21.7% | 13.3% | 32.6% |
| Wanted to move away from home | 8.5% | 5.0% | 13.0% |
| Family needed help with income | 0.9% | 0% | 2.2% |
| Wanted to earn own living | 24.5% | 28.3% | 19.6% |
| Domestic reasons, e.g. care for child/relative | 0.9% | 0% | 2.2% |
| Personal health reasons (mental or physical) | 1.9% | 0% | 4.3% |
| Other | 32.1% | 31.7% | 32.6% |

APPENDIX D

## Calculation of the Multinomial Logit Probabilities

A multinomial logit was estimated with a sample size of 585 individuals. The dependent variable is WORKTERT18 and the explanatory variables are set out as reported in Table 9. The estimated coefficients are then saved. There are 69 estimated coefficients in total. This consists of the estimated coefficients of each constant and the 22 additional explanatory variables for each of the three categories in WORKTERT18 (excluding zero, the base category).

For each individual (i=1, …, 585) 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 $\beta^l$ is the column vector of corresponding coefficients for each category. For the overall calculations in Tables 10 and 11, all the actual observations for each individual are used. In calculating different scenarios—for example, "what if everyone was rural?"—the observation rural is set to one for all individuals. This introduces the direct effect of the coefficients on rural. Such direct effects will understate the actual magnitude of any changes because all the other factors are held constant. For instance, it is plausible that if the sample consisted of all rural persons their average incomes would actually be lower. These could flow through into even lower tertiary participation, especially at University.

Having calculated $Xi\beta^l$ for each individual and category, it is now possible to calculate each individual probability for each category. The probabilities for each individual for the base category are:[22]

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

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 are calculated for each category by taking the *average* of all the individual probabilities in each category.

[22] Refer Davidson and MacKinnon, 531.

## APPENDIX E

### Table E1: Probit Model of Participation in Tertiary Education: Sample excluding secondary pupils

Estimates (t-statistics)

**Model 3:** (Dependent Variable TERT18: 1=Entered tertiary education; 0=Otherwise)

| Explanatory variables | Probit | Mean of $\frac{dP}{dX}$ |
|---|---|---|
| CONSTANT | -2.158<br>(0.520) | |
| AVE_GRADE | 0.384*<br>(2.439) | 0.107 |
| PASS_SIXTH_FORM_CERT | 0.771*<br>(3.590) | 0.215 |
| INTEND_16_UNI | 0.332<br>(1.622) | 0.093 |
| INTEND_16_POLY | 0.433*<br>(2.097) | 0.121 |
| PROP_CONT | 0.460<br>(0.615) | 0.128 |
| FEMALE | -0.005<br>(0.022) | -0.001 |
| MAORI | 0.135<br>(0.373) | 0.038 |
| P_ISLAND | -0.485<br>(0.869) | -0.135 |
| MOTHER_NO_Q | 0.250<br>(1.236) | 0.070 |
| MOTHER_TERT_Q | 0.393<br>(1.497) | 0.110 |
| FATHER_NO_Q | -0.043<br>(0.222) | -0.012 |
| FATHER_TERT_Q | 0.137<br>(0.518) | 0.038 |
| NUM_SIB | 0.034<br>(0.379) | 0.009 |
| OWN_HOME | 0.032<br>(0.091) | 0.009 |
| RURAL | 0.581<br>(1.441) | 0.162 |
| BEN_PROP | 0.434<br>(1.270) | 0.121 |
| LOCAL_UNEM | 0.001<br>(0.002) | 0.0002 |
| INC_DEC | 0.045<br>(0.971) | 0.013 |
| PARENTAL_ASSISTANCE_18 | 0.029*<br>(3.146) | 0.008 |
| OWN_TRANSPORTATION | -0.160<br>(0.873) | -0.045 |
| IQ8 | 0.00002<br>(0.002) | <0.00001 |
| PEER_DEV | -0.072<br>(1.926) | -0.020 |
| Log Likelihood | -156.650 | |
| Sample Size | 317 | |

* Estimates significant at 0.05.

**Table E2: Multinomial Logit Model of Work, Polytechnic or University Participation compared to Unemployment at Age 18**
Estimates (t-statistics)

**Model 4:** (Dependent Variable WORKTERT18: 3=University participation; 2=Polytechnic/other tertiary participation; 1=Employed or job arranged; 0=Unemployed or out of the labour force [excludes current secondary pupils])

| Explanatory variables | $\ln\left(\frac{P(\text{Employed})}{P(\text{Unemployed or OLF})}\right)$ | Mean of $\frac{dP}{dX}$ | $\ln\left(\frac{P(\text{Polytechnic})}{P(\text{Unemployed or OLF})}\right)$ | Mean of $\frac{dP}{dX}$ | $\ln\left(\frac{P(\text{University})}{P(\text{Unemployed or OLF})}\right)$ | Mean of $\frac{dP}{dX}$ |
|---|---|---|---|---|---|---|
| CONSTANT | -9.035<br>(0.713) | | -6.416<br>(0.494) | | -36.840<br>(0.007) | |
| AVE_GRADE | 1.478*<br>(2.771) | 0.025 | 1.296*<br>(2.365) | -0.044 | 2.954*<br>(4.387) | 0.130 |
| PASS_SIXTH_FORM_CERT | -0.402<br>(0.773) | -0.867 | 0.843<br>(1.498) | -0.525 | 18.703<br>(0.004) | 1.474 |
| INTEND_16_UNI | -0.739<br>(1.243) | -0.106 | -0.472<br>(0.754) | -0.026 | 0.542<br>(0.780) | 0.089 |
| INTEND_16_POLY | 0.177<br>(0.318) | -0.056 | 1.071<br>(1.848) | 0.157 | -0.253<br>(0.303) | -0.066 |
| PROP_CONT | 0.677<br>(0.386) | -0.126 | 1.311<br>(0.688) | 0.019 | 3.245<br>(1.115) | 0.184 |
| FEMALE | -0.335<br>(0.546) | -0.036 | -0.102<br>(0.157) | 0.027 | -0.329<br>(0.428) | -0.009 |
| MAORI | -0.868<br>(0.926) | -0.064 | -1.157<br>(1.185) | -0.141 | 0.920<br>(0.843) | 0.015 |
| P_ISLAND | -0.323<br>(0.281) | 0.743 | -1.176<br>(0.947) | 0.512 | -17.970<br>(0.001) | -1.376 |
| MOTHER_NO_Q | 0.841<br>(1.594) | 0.002 | 0.760<br>(1.336) | -0.031 | 1.945<br>(2.598) | 0.094 |
| MOTHER_TERT_Q | -0.048<br>(0.059) | -0.071 | 0.331<br>(0.395) | 0.023 | 0.867<br>(0.932) | 0.059 |

## Table E2 Continued

| Explanatory variables | $\ln\left(\frac{P(Employed)}{P(Unemployed\ or\ OLF)}\right)$ | Mean of $\frac{dP}{dX}$ | $\ln\left(\frac{P(Polytechnic)}{P(Unemployed\ or\ OLF)}\right)$ | Mean of $\frac{dP}{dX}$ | $\ln\left(\frac{P(University)}{P(Unemployed\ or\ OLF)}\right)$ | Mean of $\frac{dP}{dX}$ |
|---|---|---|---|---|---|---|
| FATHER_NO_Q | -0.360<br>(0.679) | -0.034 | -0.096<br>(0.170) | 0.036 | -0.502<br>(0.694) | -0.023 |
| FATHER_TERT_Q | -0.210<br>(0.217) | -0.038 | 0.277<br>(0.278) | 0.083 | -0.585<br>(0.546) | -0.049 |
| NUM_SIB | 0.824*<br>(3.146) | 0.051 | 0.689*<br>(2.496) | 0.003 | 0.772<br>(2.242) | 0.004 |
| OWN_HOME | -0.654<br>(0.790) | -0.075 | -0.468<br>(0.523) | -0.017 | 0.113<br>(0.074) | 0.052 |
| RURAL | -0.301<br>(0.265) | -0.139 | 0.159<br>(0.138) | -0.018 | 1.877<br>(1.405) | 0.155 |
| BEN_PROP | 0.249<br>(0.273) | -0.058 | 0.883<br>(0.934) | 0.091 | 0.567<br>(0.421) | 0.003 |
| LOCAL_UNEM | 0.451<br>(0.394) | 0.057 | 0.089<br>(0.076) | -0.039 | 0.322<br>(0.256) | 0.005 |
| INC_DEC | 0.121<br>(0.895) | -0.003 | 0.068<br>(0.477) | -0.017 | 0.450*<br>(2.650) | 0.029 |
| PARENTAL_ASSISTANCE_18 | -0.047<br>(1.640) | -0.010 | 0.018<br>(0.670) | 0.006 | 0.017<br>(0.607) | 0.002 |
| OWN_TRANSPORTATION | 1.467*<br>(2.648) | 0.127 | 1.193*<br>(2.043) | 0.032 | 0.503<br>(0.711) | -0.061 |
| IQ8 | 0.034<br>(1.772) | 0.002 | 0.025<br>(1.228) | -0.001 | 0.050<br>(1.909) | 0.002 |
| PEER_DEV | -0.245*<br>(2.445) | -0.0007 | -0.285<br>(2.632) | -0.006 | -0.415*<br>(3.028) | -0.013 |

* Estimates significant at 0.05. Sample Size=317 Kullback-Leibler $R^2$=0.3676 Log-likelihood=-265.088

**Table E3: Predicted Probabilities of Unemployed, Employment, Attending a Polytechnic or University at Age 18**
**(Sample excluding secondary pupils)**

| Characteristics | Unemployed or OLF | Employed | Polytechnic | University |
|---|---|---|---|---|
| Overall Characteristics | 0.1262 | 0.3722 | 0.2398 | 0.2618 |
| Maori | 0.1832 | 0.2969 | 0.1259 | 0.3940 |
| Mother with No Qualification | 0.1013 | 0.3804 | 0.2181 | 0.3001 |
| Mother with a Tertiary Qualification | 0.1553 | 0.3103 | 0.2699 | 0.2645 |
| Father with No Qualification | 0.1343 | 0.3614 | 0.2419 | 0.2623 |
| Father with a Tertiary Qualification | 0.1176 | 0.3546 | 0.2912 | 0.2366 |
| <u>Intelligence Quotient (IQ Score)</u> | | | | |
| Individual IQ's: -2 s.d. | 0.2144 | 0.3133 | 0.2654 | 0.2069 |
| -1 s.d. | 0.1669 | 0.3445 | 0.2543 | 0.2344 |
| +1 s.d. | 0.0924 | 0.3959 | 0.2228 | 0.2890 |
| +2 s.d. | 0.0654 | 0.4148 | 0.2042 | 0.3156 |
| <u>Average School Certificate Mark</u> | | | | |
| Ave. S.C. Mark: D or E | 0.2538 | 0.3702 | 0.3213 | 0.0547 |
| C | 0.0918 | 0.4378 | 0.3003 | 0.1702 |
| B | 0.0243 | 0.4209 | 0.2160 | 0.3389 |
| A | 0.0053 | 0.3591 | 0.1302 | 0.5055 |
| Pass in Sixth Form Certificate | 0.1214 | 0.3116 | 0.2931 | 0.2739 |
| Intention to go to University at Age 16 | 0.1766 | 0.3166 | 0.1828 | 0.3241 |
| Intention to go to Polytechnic or other non-University Tertiary Institution at Age 16 | 0.0938 | 0.3560 | 0.4008 | 0.1494 |
| Own Transportation | 0.0676 | 0.4512 | 0.2590 | 0.2221 |
| Income Decile of : 1 | 0.1669 | 0.3839 | 0.3418 | 0.1075 |
| 4 | 0.1371 | 0.3923 | 0.2874 | 0.1833 |
| 7 | 0.1093 | 0.3859 | 0.2286 | 0.2762 |
| 10 | 0.0845 | 0.3659 | 0.1720 | 0.3776 |

Note: 317 individual predictions are calculated for each category and the average of those predictions is computed.

## APPENDIX F

### Table F1: Probit Model of Participation in Tertiary Education: Male and Female Samples

Estimates (t-statistics)

**Model 3:** (Dependent Variable TERT18: 1=Entered or entering tertiary education; 0=Otherwise)

| Explanatory variables | Males | | Females | |
|---|---|---|---|---|
| | Coefficient Estimates | Mean of $\frac{dP}{dX}$ | Coefficient Estimates | Mean of $\frac{dP}{dX}$ |
| CONSTANT | -6.822<br>(1.382) | | -6.871<br>(1.442) | |
| AVE_GRADE | 0.388*<br>(2.289) | 0.110 | 0.410*<br>(2.726) | 0.126 |
| PASS_SIXTH_FORM_CERT | 0.551*<br>(2.278) | 0.157 | 0.522*<br>(2.089) | 0.161 |
| INTEND_16_UNI | 0.515*<br>(2.483) | 0.146 | 0.310<br>(1.612) | 0.095 |
| INTEND_16_POLY | 0.130<br>(0.541) | 0.040 | 0.536*<br>(2.618) | 0.165 |
| PROP_CONT | 1.555<br>(1.763) | 0.442 | 0.956<br>(1.265) | 0.295 |
| MAORI | -0.963*<br>(2.002) | -0.274 | 0.120<br>(0.374) | 0.037 |
| P_ISLAND | 0.096<br>(0.214) | 0.027 | -0.029<br>(0.033) | -0.009 |
| MOTHER_NO_Q | 0.137<br>(0.623) | 0.039 | -0.145<br>(0.729) | -0.045 |
| MOTHER_TERT_Q | -0.063<br>(0.253) | -0.018 | 0.184<br>(0.745) | 0.057 |
| FATHER_NO_Q | -0.101<br>(0.471) | -0.029 | -0.028<br>(0.143) | -0.009 |
| FATHER_TERT_Q | -0.214<br>(0.829) | -0.061 | 0.083<br>(0.324) | 0.025 |
| NUM_SIB | 0.210*<br>(1.975) | 0.060 | -0.148<br>(1.618) | -0.046 |
| OWN_HOME | 0.327<br>(0.786) | 0.093 | 0.282<br>(0.840) | 0.087 |
| RURAL | 0.632<br>(1.104) | 0.180 | 0.318<br>(1.058) | 0.098 |
| BEN_PROP | 0.531<br>(1.250) | 0.151 | 0.288<br>(0.835) | 0.089 |
| LOCAL_UNEM | 0.176<br>(0.403) | 0.050 | 0.420<br>(1.001) | 0.129 |
| INC_DEC | 0.032<br>(0.648) | 0.009 | 0.011<br>(0.246) | 0.003 |
| PARENTAL_ASSISTANCE_18 | 0.002<br>(0.367) | 0.0006 | 0.013<br>(1.755) | 0.004 |
| OWN_TRANSPORTATION | -0.251<br>(1.301) | -0.071 | 0.173<br>(0.921) | 0.053 |
| IQ8 | 0.017*<br>(2.189) | 0.005 | 0.003<br>(0.457) | 0.001 |
| PEER_DEV | -0.005<br>(0.117) | -0.002 | -0.056<br>(1.430) | -0.017 |
| % Correct Predictions | 76.5% | | 73.3% | |
| Log Likelihood | -139.681 | | -166.496 | |
| Sample Size | 277 | | 308 | |

* Estimates significant at 0.05.

**Table F2: Multinomial Logit Model of Work, Polytechnic or University Participation compared to Unemployment at Age 18: Male Sample**

Estimates (t-statistics)

**Model 4:** (Dependent Variable WORKTERT18: 3=University participation; 2=Polytechnic/other tertiary participation; 1=Employed or job arranged; 0=Actual and likely unemployed or out of the labour force)

| Explanatory variables | $\ln\left(\frac{P(\text{Employed})}{P(\text{Unemployed or OLF})}\right)$ | Mean of $\frac{dP}{dX}$ | $\ln\left(\frac{P(\text{Polytechnic})}{P(\text{Unemployed or OLF})}\right)$ | Mean of $\frac{dP}{dX}$ | $\ln\left(\frac{P(\text{University})}{P(\text{Unemployed or OLF})}\right)$ | Mean of $\frac{dP}{dX}$ |
|---|---|---|---|---|---|---|
| CONSTANT | 95.339*<br>(2.259) | | 95.074*<br>(2.201) | | -32.256<br>(1.486) | |
| AVE_GRADE | 0.004<br>(0.010) | -0.054 | -0.246<br>(0.612) | -0.093 | 2.334*<br>(4.782) | 0.227 |
| PASS_SIXTH_FORM_CERT | Variable not included* | — | — | — | — | — |
| INTEND_16_UNI | 0.028<br>(0.051) | -0.037 | -0.179<br>(0.324) | -0.070 | 1.720*<br>(3.399) | 0.167 |
| INTEND_16_POLY | -0.024<br>(0.049) | -0.007 | 0.462<br>(0.914) | 0.073 | -0.587<br>(0.852) | -0.067 |
| PROP_CONT | 1.499<br>(0.857) | -0.066 | 4.367*<br>(1.983) | 0.393 | 2.392<br>(1.089) | 0.065 |
| MAORI | -2.098<br>(1.803) | -0.061 | -4.318*<br>(2.168) | -0.405 | -0.772<br>(0.641) | 0.104 |
| P_ISLAND | 0.462<br>(0.496) | 0.014 | 0.002<br>(0.002) | -0.065 | 1.642<br>(1.299) | 0.142 |
| MOTHER_NO_Q | -0.312<br>(0.654) | -0.036 | 0.078<br>(0.155) | 0.031 | -0.289<br>(0.510) | -0.021 |
| MOTHER_TERT_Q | -0.818<br>(1.340) | -0.068 | -0.714<br>(1.084) | -0.042 | -0.275<br>(0.456) | 0.016 |

* PASS_SIXTH_FORM_CERT could not be estimated due to singularity of the data or derivatives

## Table F2 Continued

| Explanatory variables | $\ln\left(\frac{P(Employed)}{P(Unemployed\ or\ OLF)}\right)$ | Mean of $\frac{dP}{dX}$ | $\ln\left(\frac{P(Polytechnic)}{P(Unemployed\ or\ OLF)}\right)$ | Mean of $\frac{dP}{dX}$ | $\ln\left(\frac{P(University)}{P(Unemployed\ or\ OLF)}\right)$ | Mean of $\frac{dP}{dX}$ |
|---|---|---|---|---|---|---|
| FATHER_NO_Q | 0.926*<br>(1.982) | 0.091 | 0.847<br>(1.683) | 0.068 | -0.261<br>(0.459) | -0.074 |
| FATHER_TERT_Q | 0.212<br>(0.334) | 0.025 | 0.748<br>(1.170) | 0.110 | -1.092<br>(1.663) | -0.129 |
| NUM_SIB | 0.219<br>(0.909) | -0.001 | 0.442<br>(1.843) | 0.033 | 0.372<br>(1.356) | 0.017 |
| OWN_HOME | -0.553<br>(0.740) | -0.126 | -0.629<br>(0.770) | -0.129 | 2.878<br>(1.923) | 0.305 |
| RURAL | -12.810*<br>(2.623) | -1.241 | -11.623*<br>(2.332) | -0.898 | 2.723<br>(1.109) | 0.934 |
| BEN_PROP | 0.259<br>(0.290) | -0.074 | 1.047<br>(1.203) | 0.055 | 2.177<br>(1.937) | 0.170 |
| LOCAL_UNEM | -9.396*<br>(2.371) | -0.843 | -9.887*<br>(2.441) | -0.816 | 1.762<br>(0.879) | 0.700 |
| INC_DEC | 0.201<br>(1.685) | 0.014 | 0.162<br>(1.310) | 0.006 | 0.173<br>(1.370) | 0.006 |
| PARENTAL_ASSISTANCE_18 | -0.087*<br>(2.892) | -0.011 | -0.013<br>(0.817) | 0.003 | -0.011<br>(0.961) | 0.002 |
| OWN_TRANSPORTATION | 0.934*<br>(2.131) | 0.119 | 0.259<br>(0.579) | -0.003 | -0.282<br>(0.566) | -0.060 |
| IQ8 | 0.016<br>(0.943) | -0.001 | 0.040*<br>(2.135) | 0.003 | 0.038<br>(1.864) | 0.002 |
| PEER_DEV | 0.025<br>(0.265) | 0.004 | 0.012<br>(0.120) | 0.001 | -0.040<br>(0.318) | -0.005 |

* Estimates significant at 0.05. Sample Size=277 Kullback-Leibler $R^2$=0.3409 Log-likelihood=-247.614

## Table F3: Multinomial Logit Model of Work, Polytechnic or University Participation compared to Unemployment at Age 18: Female Sample

Estimates (t-statistics)

**Model 4:** (Dependent Variable WORKTERT18: 3=University participation; 2=Polytechnic/other tertiary participation; 1=Employed or job arranged; 0=Actual and likely unemployed or out of the labour force)

| Explanatory variables | $\ln\left(\frac{P(\text{Employed})}{P(\text{Unemployed or OLF})}\right)$ | Mean of $\frac{dP}{dX}$ | $\ln\left(\frac{P(\text{Polytechnic})}{P(\text{Unemployed or OLF})}\right)$ | Mean of $\frac{dP}{dX}$ | $\ln\left(\frac{P(\text{University})}{P(\text{Unemployed or OLF})}\right)$ | Mean of $\frac{dP}{dX}$ |
|---|---|---|---|---|---|---|
| CONSTANT | 1.578<br>(0.114) | | -2.718<br>(0.255) | | -25.788*<br>(2.138) | |
| AVE_GRADE | -0.416<br>(1.029) | -0.080 | -0.027<br>(0.077) | -0.050 | 1.262*<br>(3.368) | 0.167 |
| PASS_SIXTH_FORM_CERT | -0.605<br>(1.192) | -0.140 | 0.662<br>(1.263) | 0.054 | 1.503<br>(1.357) | 0.166 |
| INTEND_16_UNI | -0.528<br>(1.033) | -0.084 | 0.347<br>(0.796) | 0.064 | 0.283<br>(0.644) | 0.031 |
| INTEND_16_POLY | 0.049<br>(0.098) | -0.060 | 1.216*<br>(2.789) | 0.168 | 0.376<br>(0.701) | -0.017 |
| PROP_CONT | -0.563<br>(0.365) | -0.172 | 0.806<br>(0.494) | 0.039 | 2.264<br>(1.147) | 0.253 |
| MAORI | -0.889<br>(1.047) | -0.093 | -0.226<br>(0.314) | 0.005 | 0.007<br>(0.009) | 0.036 |
| P_ISLAND | 1.010<br>(0.612) | 0.856 | 0.356<br>(0.234) | 1.491 | -28.908<br>(0.0001) | -3.590 |
| MOTHER_NO_Q | 0.359<br>(0.728) | 0.046 | -0.390<br>(0.898) | -0.104 | 0.519<br>(1.031) | 0.074 |
| MOTHER_TERT_Q | -0.004<br>(0.006) | -0.030 | 0.290<br>(0.508) | 0.014 | 0.604<br>(1.079) | 0.059 |

## Table F3 Continued

| Explanatory variables | $\ln\left(\frac{P(Employed)}{P(Unemployed\ or\ OLF)}\right)$ | Mean of $\frac{dP}{dX}$ | $\ln\left(\frac{P(Polytechnic)}{P(Unemployed\ or\ OLF)}\right)$ | Mean of $\frac{dP}{dX}$ | $\ln\left(\frac{P(University)}{P(Unemployed\ or\ OLF)}\right)$ | Mean of $\frac{dP}{dX}$ |
|---|---|---|---|---|---|---|
| FATHER_NO_Q | -0.491<br>(1.030) | -0.043 | -0.035<br>(0.080) | 0.041 | -0.470<br>(0.996) | -0.043 |
| FATHER_TERT_Q | -0.527<br>(0.722) | -0.051 | -0.002<br>(0.003) | 0.044 | -0.387<br>(0.655) | -0.034 |
| NUM_SIB | 0.648*<br>(2.929) | 0.074 | 0.111<br>(0.522) | -0.005 | -0.148<br>(0.613) | -0.041 |
| OWN_HOME | 0.058<br>(0.078) | -0.039 | 1.008<br>(1.318) | 0.156 | -0.027<br>(0.032) | -0.056 |
| RURAL | -0.682<br>(0.785) | -0.094 | -0.014<br>(0.022) | -0.001 | 0.593<br>(0.866) | 0.091 |
| BEN_PROP | -0.352<br>(0.413) | -0.068 | 0.027<br>(0.034) | -0.031 | 0.994<br>(1.073) | 0.130 |
| LOCAL_UNEM | -0.626<br>(0.507) | -0.105 | -0.066<br>(0.071) | -0.051 | 1.348<br>(1.263) | 0.185 |
| INC_DEC | -0.090<br>(0.805) | -0.007 | -0.186<br>(1.923) | -0.035 | 0.188<br>(1.767) | 0.035 |
| PARENTAL_ASSISTANCE_18 | -0.075*<br>(2.503) | -0.009 | 0.005<br>(0.388) | 0.004 | 0.010<br>(0.745) | 0.003 |
| OWN_TRANSPORTATION | 1.778*<br>(3.569) | 0.119 | 1.420*<br>(3.047) | 0.097 | 0.833<br>(1.590) | -0.017 |
| IQ8 | 0.060*<br>(3.059) | 0.005 | 0.018<br>(1.069) | -0.002 | 0.047*<br>(2.528) | 0.003 |
| PEER_DEV | -0.069<br>(0.752) | 0.002 | -0.140<br>(1.551) | -0.012 | -0.122<br>(1.322) | -0.006 |

* Estimates significant at 0.05. Sample Size=308 Kullback-Leibler $R^2$=0.2794 Log-likelihood=-303.632

## APPENDIX G

### Table G1: Probit and Linear Probability Models of School Leaving at Age 16

Estimates (t-statistics)

**Model 1:** (Dependent Variable DROPOUT: 1=Left School at Age 16; 0=Enrolled in School at Age 16)

| Explanatory variables | Probit (90.8% correct predictions) | Mean of $\frac{dP}{dX}$ | Linear Probability Model |
|---|---|---|---|
| CONSTANT | -2.144<br>(0.578) | | 0.429<br>(0.989) |
| AVE_GRADE | -1.040*<br>(6.065) | -0.131 | -0.099*<br>(5.074) |
| PROP_CONT | -1.956*<br>(3.798) | -0.246 | -0.465*<br>(5.353) |
| FEMALE | -0.550*<br>(2.687) | -0.069 | -0.065*<br>(2.487) |
| MAORI | 0.247<br>(0.927) | 0.031 | 0.059<br>(1.035) |
| P_ISLAND | -0.154<br>(0.377) | -0.019 | -0.047<br>(0.552) |
| MOTHER_NO_Q | 0.189<br>(0.970) | 0.024 | 0.025<br>(0.893) |
| MOTHER_TERT_Q | -0.263<br>(0.727) | -0.033 | 0.019<br>(0.764) |
| FATHER_NO_Q | 0.221<br>(1.160) | 0.028 | 0.049<br>(1.851) |
| FATHER_TERT_Q | 0.120<br>(0.331) | 0.015 | 0.021<br>(0.830) |
| NUM_SIB | 0.00097<br>(0.011) | 0.00012 | 0.011<br>(0.887) |
| OWN_HOME | -0.413<br>(1.753) | -0.052 | -0.112*<br>(2.115) |
| RURAL | 0.631<br>(1.806) | 0.079 | 0.064<br>(1.564) |
| BEN_PROP | 0.577*<br>(2.193) | 0.073 | 0.162*<br>(3.026) |
| LOCAL_UNEM | 0.392<br>(1.160) | 0.049 | 0.030<br>(0.776) |
| INC_DEC | 0.067<br>(1.392) | 0.0084 | 0.013<br>(2.367) |
| IQ8 | -0.016*<br>(2.306) | -0.0020 | -0.002*<br>(2.192) |
| PEER_DEV | 0.171*<br>(5.384) | 0.021 | 0.033*<br>(5.711) |
| Log Likelihood | -154.328 | | -113.288 |
| Sample Size | 694 | | 694 |

* Estimates significant at 0.05.

**Table G2: Predicted Probabilities of Dropping Out of Secondary School at Age 16**

Based on Linear Probability Model

| Characteristics | Overall | Males | Females |
|---|---|---|---|
| Overall Characteristics | 0.1527 | 0.1775 | 0.1292 |
| (Probit comparison) | 0.1548 | 0.1915 | 0.1220 |
| (Logit comparison) | 0.1527 | 0.1810 | 0.1262 |
| Maori | 0.2074 | 0.2224 | 0.2022 |
| Mother with No Qualification | 0.1615 | 0.1868 | 0.1385 |
| Mother with a Tertiary Qualification | 0.1555 | 0.1406 | 0.1645 |
| Father with No Qualification | 0.1748 | 0.2294 | 0.1298 |
| Father with a Tertiary Qualification | 0.1461 | 0.1593 | — |
| Intelligence Quotient (IQ Score) | | | |
| Individual IQ's: -2 s.d. | 0.2142 | 0.3317 | 0.1264 |
| -1 s.d. | 0.1835 | 0.2546 | 0.1278 |
| +1 s.d. | 0.1220 | 0.1004 | 0.1306 |
| +2 s.d. | 0.0913 | 0.0234 | 0.1320 |
| Average School Certificate Mark | | | |
| Ave. S.C. Mark: D or E | 0.2587 | 0.2617 | 0.2479 |
| C | 0.1596 | 0.1759 | 0.1450 |
| B | 0.0605 | 0.0900 | 0.0420 |
| A | -0.0387 | 0.0042 | -0.0609 |
| Proportion of Rest of Class Continuing | | | |
| Proportion of Rest Continuing: 25% | 0.4259 | 0.4615 | 0.4090 |
| 50% | 0.3096 | 0.3404 | 0.2901 |
| 75% | 0.1933 | 0.2193 | 0.1712 |
| 100% | 0.0770 | 0.0981 | 0.0523 |
| Proportion of Family Income from Benefits | | | |
| Benefit Proportion of: 0% | 0.1307 | 0.1661 | 0.0979 |
| 50% | 0.2119 | 0.2117 | 0.2052 |
| 100% | 0.2931 | 0.2573 | 0.3125 |
| Deviant Peer Effects (0-10) | | | |
| Deviant Affiliation of: 0 | 0.0765 | 0.1139 | 0.0470 |
| 5 | 0.2440 | 0.2653 | 0.2164 |
| 10 | 0.4115 | 0.4146 | 0.3859 |
| ***Sample Size*** | 694 | 338 | 356 |

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

**Table G3: Probit and Linear Probability Models of Participation in Tertiary Education**

Estimates (t-statistics)

**Model 3:** (Dependent Variable TERT18: 1=Entered or entering tertiary education; 0=Otherwise)

| Explanatory variables | Probit (76.9% correct predictions) | Mean of $\frac{dP}{dX}$ | Linear Probability Model |
|---|---|---|---|
| CONSTANT | -4.418<br>(1.647) | | -0.814<br>(1.107) |
| AVE_GRADE | 0.413*<br>(3.793) | 0.127 | 0.142*<br>(4.111) |
| PASS_SIXTH_FORM_CERT | 0.508*<br>(3.075) | 0.156 | 0.179*<br>(3.324) |
| INTEND_16_UNI | 0.412*<br>(3.039) | 0.127 | 0.133*<br>(3.023) |
| INTEND_16_POLY | 0.353*<br>(2.350) | 0.109 | 0.108*<br>(2.287) |
| PROP_CONT | 1.106*<br>(2.046) | 0.341 | 0.373*<br>(2.403) |
| FEMALE | 0.057<br>(0.394) | 0.017 | 0.019<br>(0.436) |
| MAORI | -0.170<br>(0.675) | -0.052 | -0.056<br>(0.620) |
| P_ISLAND | 0.092<br>(0.234) | 0.028 | 0.020<br>(0.161) |
| MOTHER_NO_Q | -0.044<br>(0.310) | -0.013 | -0.019<br>(0.413) |
| MOTHER_TERT_Q | 0.125<br>(0.751) | 0.038 | 0.030<br>(0.577) |
| FATHER_NO_Q | -0.065<br>(0.475) | -0.020 | -0.020<br>(0.446) |
| FATHER_TERT_Q | -0.024<br>(0.136) | -0.007 | -0.012<br>(0.225) |
| NUM_SIB | -0.019<br>(0.288) | -0.006 | -0.005<br>(0.257) |
| OWN_HOME | 0.283<br>(1.122) | 0.087 | 0.082<br>(1.156) |
| RURAL | 0.374<br>(1.495) | 0.115 | 0.125<br>(1.798) |
| BEN_PROP | 0.319<br>(1.261) | 0.098 | 0.098<br>(1.155) |
| LOCAL_UNEM | 0.129<br>(0.544) | 0.040 | 0.032<br>(0.507) |
| INC_DEC | 0.019<br>(0.618) | 0.006 | 0.007<br>(0.740) |
| PARENTAL_ASSISTANCE_18 | 0.007<br>(1.475) | 0.002 | 0.001<br>(1.599) |
| OWN_TRANSPORTATION | -0.014<br>(0.105) | 0.004 | -0.012<br>(0.293) |
| IQ8 | 0.007<br>(1.280) | 0.002 | 0.002<br>(1.076) |
| PEER_DEV | -0.043<br>(1.531) | -0.013 | -0.013<br>(1.394) |
| Log Likelihood | -317.196 | | -332.921 |
| Sample Size | 585 | | 585 |

* Estimates significant at 0.05.