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passing it on:

the intergenerational transmission of human capital in new zealand families

DAVID C MARÉ AND STEVEN STILLMAN
MOTU ECONOMIC AND PUBLIC POLICY RESEARCH

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Families Commission
Public Trust Building
Level 6, 117-125 Lambton Quay
PO Box 2839
Wellington 6140

Telephone: 04 917 7040
Email: enquiries@nzfamilies.org.nz
www.nzfamilies.org.nz

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Author contact details

David C. Maré
Motu Economic and Public Policy Research
Email: dave.mare@motu.org.nz

Steven Stillman
Motu Economic and Public Policy Research
Email: stillman@motu.org.nz

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EXECUTIVE SUMMARY

Overview

This study examines whether differences in parental education are reflected in differences in children's scores on cognitive tests, drawing attention to the role of family context in educational outcomes.

The primary focus is on the parental education/test-score gradient in New Zealand, although the study also presents comparative results for other OECD countries. Separate analyses are carried out for subgroups of children in New Zealand defined by immigrant status, gender and family type, and for children of New Zealand parents living in Australia.

To gain a better understanding of the factors associated with the gradient, the study analyses the statistical contribution of five broadly defined sets of educational inputs – student characteristics, household characteristics, household educational resources, student-school interactions and school characteristics (the components of which are listed in the glossary and in Table 10, and described in Appendix 1).

Data and methods

This study uses data from the 2003 OECD Programme for International Student Assessment (PISA). PISA is an internationally standardised assessment administered to 15-year-olds in schools. In this report, we focus on the data collected in PISA 2003, which surveyed 4,511 15-year-old students in New Zealand in 173 secondary schools. Nearly identical data were collected in 30 OECD countries. Each student completed an assessment covering reading literacy, mathematical literacy, scientific literacy and problem-solving, with the focus on mathematical literacy.

The report contains various descriptive summaries in the form of tables and graphs. More detailed analyses of the parental education/test-score gradient and the contribution of the various educational inputs are undertaken using regression methods.

Findings

Children with more highly educated parents do better on cognitive tests.

A child whose parents have a degree qualification has test scores that are, on average, 0.75 to 0.90 standard deviations higher than one whose parents' highest qualification is having finished intermediate school (Table 7).

This test-score gradient is mostly explained (statistically) by differences in educational inputs, with student-school interactions having the strongest association.

These overall patterns are evident with minor variations across the four test score domains and across selected population subgroups.

The overall patterns are evident for subgroups defined by family type (living with both biological parents; living in a step-family; living with a single parent).

Within New Zealand, there is a larger test-score gradient for both first- and second-generation immigrants compared with New Zealand-born children. Differences in student-school interactions are extremely important for explaining the test-score gradient among first-generation immigrants.

The test-score gradient for children of New Zealanders living in Australia is similar to that of New Zealand-born children residents. While in New Zealand, a significant portion of this gradient is not explained by educational inputs, among New Zealanders living in Australia the gap is entirely explained, in particular by school characteristics.

The raw test-score gradient is slightly larger for boys than for girls, although this is not statistically significant. Controlling for educational inputs, the unexplained gradient is small, though both boys and girls whose parents finished only intermediate school still score 0.20 standard deviations lower than those with a degree-qualified parent. Boys' test scores are more strongly associated with their fathers' education whereas girls' test scores are more strongly associated with their mothers' education.

The differences in test scores between children of highly qualified and less qualified parents are larger in New Zealand than in most other OECD countries.

A stronger parental education–child test-score gradient is found in only nine of the 29 countries examined – Japan, Austria, the United States, Poland, Germany, the Czech Republic, Turkey, Hungary and Slovakia.

New Zealand also has a relatively high residual gradient (ie, unexplained by variation in educational inputs).

GLOSSARY OF TERMS AND ABBREVIATIONS

CHDS: Christchurch Health and Development Study

ISCED: International Standard Classification for Education

IZA: Institute for the Study of Labour (Institut zur Zukunft der Arbeit)

NILF: Not in the Labour Force

OECD: Organisation for Economic Co-operation and Development

PIRLS: Progress in International Reading Literacy Study

PISA: Programme for International Student Assessment

SCQ: School Questionnaire

STQ: Student Questionnaire

TIMSS: Third International Maths and Science Study

UNESCO: United Nations Educational, Scientific and Cultural Organization

UK: United Kingdom

US, USA: United States of America

$\alpha, \beta, \gamma, \delta, \lambda, \theta, \kappa$: regression parameters from equation (1) or equation (2)

Elasticity:
An index of the strength of the relationship between two variables. For instance, the elasticity of test scores with respect to parental education denotes the percentage change in test scores that is associated with a one percent change in parental education.

Educational inputs:
This is a generic term used in the report to refer to various factors associated with test scores. We distinguish six subsets of factors: student characteristics; parental education; household characteristics; household educational inputs; student-school interactions; and school characteristics. (See Table 10 and Appendix 1 for details of the sources and derivation of measures.)

Student characteristics (X_{fs}):
A subset of educational inputs, including students' age and gender. (See Table 10 and Appendix 1 for details of the sources and derivation of measures.)

Parental education (E_{fs}):
A subset of educational inputs including measures of mother's and father's education. (See Table 10 and Appendix 1 for details of the sources and derivation of measures.)

Household characteristics (B_{fs}):
A subset of educational inputs including living arrangements, home possessions, employment status, occupational status and location. (See Table 10 and Appendix 1 for details of the sources and derivation of measures.)

Household educational resources (H_{fs}):
A subset of educational inputs including educational resources, cultural possessions, books at home and computer availability. (See Table 10 and Appendix 1 for details of the sources and derivation of measures.)

Student-school interactions (I_{is}):
A subset of educational inputs including school grade, class size, students' expectations, students' attitudes to school and student-teacher relationships. (See Table 10 and Appendix 1 for details of the sources and derivation of measures.)

School characteristics (S_s):
A subset of educational inputs. It includes measures such as whether a school is private or public, and co-educational or single-sex; school size; student-teacher ratio and relationships; teachers' certifications, participation and morale; availability of computers; the number of weeks in a school year; school funding; school selectivity; school streaming; teacher shortages; material resources; educational resources; students' and teachers' behaviour; and school autonomy. (See Table 10 and Appendix 1 for details of the sources and derivation of measures.)

School fixed effects:
An alternative way to statistically control for differences in the characteristics of schools is to allow for each school to have its own intercept in the regression model. In other words, when this approach is used all comparisons are made between students in the same schools (and within-school differences are then averaged over the different schools in the sample). Thus, it is not possible to simultaneously estimate the relationship between individual school characteristics and students' test scores.

Std Dev: Standard Deviation

1. INTRODUCTION

1.1 Preface

Children's socio-economic outcomes are correlated with those of their parents. The degree of intergenerational mobility in a country is an important indicator of how that society functions. The extent to which children from poorer backgrounds can realistically aspire to better their parents, or the extent to which wealthier children can expect to remain in the same position as their parents, relates to important social issues such as the long-term consequences of child poverty. More generally, the strength of the relationship between a child's successes as an adult and his or her family background is indicative of the degree of equality of opportunity.

This study uses data from the 2003 OECD Programme for International Student Assessment (PISA) to examine the relationship between parents' education and socio-economic background and the cognitive skills of their children in a multivariate framework which allows us to consider the roles that schools and home environments play in the intergenerational transmission of human capital. There are three main components to this analysis.

First, we examine the relationship between parental education and socio-economic background and PISA test scores among children in non-migrant households in New Zealand. This analysis also considers the roles that schools and home environments play in the intergenerational transmission of human capital. Second, we examine the same relationships in the other OECD countries in PISA, including Australia. This allows us to determine whether the intergenerational transmission of human capital in New Zealand is stronger or weaker than in these other countries. Third, we examine the intergenerational transmission of human capital for migrants in New Zealand and for children of New Zealanders now living in Australia. Unique to PISA survey data collected in New Zealand is the collection of information on country of birth for both children and their parents. This allows us to separately examine the relationship between parental education and socio-economic background and children's cognitive skills in first- and second-generation immigrant households and among trans-Tasman migrants.

Our modelling framework also enables us to provide estimates of the extent to which children with better-educated parents have higher levels of cognitive skill, and provides a broad indication of the pathways (household characteristics, household educational resources, student-school interactions and school characteristics) through which this relationship operates.[1] We also provide estimates of the direct impact of household characteristics and educational resources, student-school interactions and school characteristics on the cognitive skills of 15-year-olds in New Zealand. All of these results are then compared with analogous findings for the other OECD countries in PISA to provide context for our findings.

Furthermore, we also examine whether our findings differ for migrant children in New Zealand, for children of New Zealanders now living in Australia, by the gender of the children or of the parents, or by the structure of the household. While an examination of the variation in outcomes by ethnicity would be a valuable extension in the New Zealand context, we do not do this because an ethnicity question is not included in the international version of the PISA data and thus cannot be used for comparisons across OECD countries. Ethnicity is collected as a country-specific option for New Zealand and Lock and Gibson (2008) examine the relationship between ethnicity and PISA test scores in New Zealand.

It is worth noting that our findings provide a limited summary of key relationships in the data which should not be interpreted as being necessarily causal. While the PISA data capture numerous educational inputs that are related to both parental background and children's test scores, there are undoubtedly other pathways that may also play important roles in cognitive development.

1.2 Theoretical background

Theories of parental investment in children suggest several channels through which families' economic circumstances may influence their children's educational attainment. One influential line of theorising, pioneered by Becker (1991) and Becker and Tomes (1979, 1986), hypothesises that parents are altruistic toward their children in the sense that they care about their children's welfare and thus invest in

[1] We do not explicitly model the specific pathways between the various educational inputs and children's test scores. To do so would require us to make additional assumptions and restrictions in our modelling. Our 'reduced-form' estimates are appropriate for the research questions that we address in this paper, though future work that applies structural equation modelling methods would be a useful extension to our analyses.

their human capital (education and health) up to the point where the future return from further investment equals the rate of interest (the current cost of the investment).

Within the framework of this model, children may inherit the economic circumstances of their parents for any of three reasons. Firstly, genetic inheritance makes it more likely for parents with higher levels of human capital to have children with more innate human capital (including such factors as attitudes, motivation and learning styles) and thus, if there are positive economic returns to human capital, there will be a positive correlation between the economic circumstances of parents and the educational attainment of their children. Secondly, poorer parents may find it more expensive, or have to make greater sacrifices, to make formal or informal investments in their children's human capital, and thus their children may end up with less human capital than children with similar innate abilities but wealthier parents. Thirdly, poorer parents may be unable to make the investments that they wish to because they cannot borrow the necessary money, and thus again their children may end up with less human capital than children with similar innate abilities but wealthier parents.

1.3 International literature

Empirical studies of intergenerational mobility date back to the earliest days of statistical social science (see, for example, Galton's 1886 British study of the inheritance of height). Many recent papers have used the framework of the Becker-Tomes model to estimate empirically the degree of intergenerational income mobility in different countries (see Solon (2002) and D'Addio (2007) for reviews and Jäntti et al (2006) for recent evidence). The majority of these studies examine the connection between sons' and fathers' earnings (Corak & Heisz, 1999), but a few recent studies examine outcomes for daughters as well as sons and consider family income as well as individual earnings (Chadwick & Solon, 2002).

A smaller literature examines the intergenerational transmission of human capital. Over the past two decades, there has been a larger increase in the earnings gain associated with additional years of education, particularly at the university level (Card, 1999). The cognitive skills formed in childhood have also been found to be strongly related to educational attainment and economic success at older ages (Murnane, Willett, & Levy, 1995). Thus, the relationship between parents' education and children's cognitive ability is an important mechanism for the intergenerational transmission of economic opportunities.

Papers on the US and UK find intergenerational education elasticities[2] between 0.20 and 0.45 (Dearden, Machin, & Reed, 1997; Mulligan, 1999). However, these studies do not attempt to distinguish a causal relationship. In recent work, there has been some effort to distinguish causation from correlation in ability across generations, as well as the impact of other factors associated with parental education, such as income, socio-economic status, household background and school resources. For example, Black, Devereux, and Salvanes (2005) use data from Norway to examine the impact of educational reforms on parental education, which allows them to isolate the causal impact of parents' education on children's outcomes. They find that although there is a strong correlation, there is little evidence of a causal relationship between the two. In contrast, Oreopoulos, Page, and Stevens (2006) examine compulsory schooling laws in the US and find that a one-year increase in the education of either parent reduces the probability that a child repeats a grade and significantly lowers the likelihood of teenagers dropping out.

A number of papers include New Zealand in international comparisons of the intergenerational transmission of human capital. For example, de Broucker and Underwood (1998) use data from the International Adult Literacy Survey (IALS) to compare intergenerational education mobility in a group of OECD countries in the mid-1990s. They find that the correlation between parents' education and that of their children in New Zealand is around 0.3, which is stronger than in Australia, the UK and Sweden, but weaker than in the other eight OECD countries that they examine.

D'Addio (2007) presents results, from OECD Secretariat computations using the 2003 PISA data, on the impact of parents' education on mathematical literacy. In addition to the relatively low correlation found by de Broucker and Underwood (1998), D'Addio also finds a relatively flat gradient with respect to parents'

[2] This measures the percentage difference in children's education associated with a percentage difference in parental education. An elasticity of 0.2 implies that the child of a parent with education that is one percent above average has education that is 0.2 percent above average.

education. One extra year of education for a parent is estimated to be associated with a nearly seven-point increase in average maths scores in New Zealand. This is below the OECD average of 8.4 and, among the 29 OECD countries that she considers, this relationship is weaker only in Finland, Italy, Spain, Luxembourg and Portugal.[3] D'Addio and OECD (2004) further examine the relationship between various measures of parental socio-economic status (occupation, family living arrangements, migrant status and language spoken at home) and maths scores in the 2003 PISA. However, the analyses in these papers are purely descriptive and focus on the relationship between each particular measure of parental socio-economic status and children's test scores without considering how these measures are interrelated.

A number of studies also examine the factors that explain international differences in students' performance as measured in PISA (Fertig & Schmidt, 2002; Fuchs & Woessmann, 2007; Levels & Dronkers, 2007). These studies, which include data on New Zealand, estimate multivariate models of the relationship between parental socio-economic background, home inputs into children's education and school resources and institutions, and child test scores. However, they do not focus specifically on the intergenerational transmission of human capital, and instead aim to explain overall differences in students' achievement between countries. Furthermore, the models estimated in these papers are generally constrained so that the relationship between particular factors (such as socio-economic background) and children's test scores are the same in each country. Differences in test scores are then attributed to differences in particular factors across countries. Thus, these studies have not produced any New Zealand-specific estimates of the relationship between parental education and children's test scores.

Given the mixed results in the international literature on whether there is a causal relationship between parents' and children's education, this is a research area that is open to additional contributions. Our study will be one of the first to provide cross-country evidence on the relationship between parental education and children's cognitive outcomes, while also controlling for a large number of factors that are related to parental education and to children's achievement.

1.4 New Zealand evidence

Some prior work has examined intergenerational issues in New Zealand using empirical methods. For example, Fergusson and Woodward (2000) examine the relationship between families' socio-economic status at birth and university participation at age 21 in the Christchurch Health and Development Study (CHDS), a cohort study of children born in Christchurch over a four-month period in 1977. They find that young people from families of professional or managerial socio-economic status are significantly more likely to go to university than young people from families of unskilled or semi-skilled socio-economic status, even after controlling for the mother's education and age, the family's income and living arrangements and the cognitive ability and educational achievement of the children.

Similarly, Maloney, Maani, and Pacheco (2003) examine the intergenerational correlation of receipt of the Unemployment and Domestic Purposes Benefit using the CHDS. They estimate that the intergenerational correlation of benefit receipt is 0.37 for the whole sample, and is higher for female recipients, for Māori and for individuals without educational qualifications. The proportion of years spent in a single-parent household and the educational attainment of both parents explain nearly two-thirds of this relationship, while the remaining one-third reflects the lower educational attainment of children reared in families receiving social welfare benefits.

A number of New Zealand studies examine the relationship between the educational achievement of parents and their children. Most merely document a positive association between parental and child education, although a few attempt to separately determine the influence of other factors that may be associated with parental education and test scores. Sturrock and May (2002) summarise the relationship between maternal education and mathematics scores of 15-year-old children using data from the 2000 PISA survey, finding a positive association by gender and by ethnicity. Likewise, OECD (2004, Tables 4.2c and 4.2d) includes New Zealand results in their examination of 15-year-olds' mathematics, reading and science scores from the 2003 PISA study, finding a positive association between test scores and both maternal and paternal education.

[3] Our results in Table 8 show New Zealand having a relatively steep gradient. The difference reflects that fact that D'Addio (2007) estimates a linear relationship between years of parental education and test scores whereas our Table 8 contrasts two specific parental education levels (ISCED 2 and ISCED 5A/6). The linearisation approach taken by D'Addio does a poor job of fitting the observed relationship between parental education and children's test scores in New Zealand and in many other OECD countries, and in our opinion any results using this approach should be interpreted with caution.

Further evidence is provided by the Competent Children, Competent Learners study, which is a longitudinal study of the long-term development of around 500 children from the Wellington region, first interviewed at age five. At age 16, their test scores across a range of different competencies were positively correlated with maternal education. The relationship remained positive even when controlling for the separate influence of gender, ethnicity and family income when the child was aged five. In fact, maternal education was the single biggest contributor to the variance in scores (Hodgen, 2007; Wylie & Hodgen, 2007). The relationship was, however, slightly less strong at age 16 than was observed for the same children at age 14 (Wylie, Ferral, Hodgen, & Thompson, 2006).

Barker and Maloney (2000) use the CHDS to determine the various influences on children's test scores. Using a combined measure of mother's and father's education, they find a strong positive relationship with children's reading scores at ages eight to 13, even when controlling for various other child, family and school factors using regression methods. They state that the educational attainment of parents has "some of the strongest and most consistent effects on the test performance of children in this study. The higher the qualifications of parents, the higher the average scores on the Burt Word Reading Test" (p. 36). They also find that the influence of parental university education is stronger in two-parent households.

Many other studies of New Zealand children document influences on students' achievement and performance other than that of parental education. Major studies include analysis of results from the Third International Maths and Science Study (TIMSS) by Chamberlain, Chamberlain and Walker, (2001) and of the Progress in International Reading Literacy Study (PIRLS) by Caygill and Chamberlain (2004), both of which relate to Year 5 students. The TIMSS study documents the influence of factors in the domains of home background, social and economic background, out-of-school activities, perceptions and attitudes and school environment. The PIRLS study examines the home context, including employment and economic wellbeing and household educational resources; the classroom context; and the school context, including school characteristics, resources and climate. Chamberlain et al (2001) provide an extensive review of the New Zealand and international literature on community and family influences on children's achievement. The review not only summarises the evidence on the impact of different influences, but also discusses research on how different factors influence performance, and emphasises the complexity of causality for many of the factors.

2. METHODS

2.1 OECD Programme for International Student Assessment (PISA)[4]

The OECD Programme for International Student Assessment (PISA) is an internationally standardised assessment that was jointly developed by participating countries and administered to 15-year-olds in schools. The survey was implemented in 43 countries in the first assessment in 2000, in 41 countries in the second assessment in 2003 and in 57 countries in the third assessment in 2006. Tests are typically administered to between 4,500 and 10,000 students in each country.

PISA assesses the extent to which students near the end of compulsory education have acquired the knowledge and skills that are essential for full participation in society. In all cycles, the domains of reading and mathematical and scientific literacy are covered not merely in terms of mastery of the school curriculum, but in terms of important knowledge and skills needed in adult life. In the PISA 2003 cycle, an additional domain of problem-solving was introduced to continue the examination of cross-curriculum competencies.

In each assessment, pencil-and-paper tests are used, with the tests lasting a total of two hours for each student. Test items are a mixture of multiple-choice items and questions requiring students to construct their own responses. The items are organised in groups based on a passage setting out a real-life situation. A total of about seven hours' worth of test items is covered, with different students taking different combinations of test items. Students also answer a background questionnaire, which takes 20 to 30 minutes to complete, providing information about themselves and their homes. School principals are given a 20-minute questionnaire about their schools.

In this report, we focus on the data collected in PISA 2003,[5] which surveyed 4,511 students in New Zealand aged between 15 years and three months and 16 years and two months[6] in 173 secondary schools.[7] Each student completed an assessment covering reading literacy, mathematical literacy, scientific literacy and problem-solving. Although multiple domains of cognitive skills are assessed in PISA 2003, the focus was on mathematical literacy, for which a larger number of questions were asked. PISA 2003 collected nearly identical data for all 30 OECD countries. The overall sample sizes ranged from 3,350 for Iceland to 29,983 for Mexico.[8]

Our main analyses restrict attention to students who were born in a particular country and whose parents were also both born in that country. We call these individuals non-immigrants throughout the remainder of the paper. We also omit from all analyses those students for whom the questions on either age, gender or school grade are not answered. Table 1 presents the pertinent information on the analysis sample used for each country, with New Zealand on the first line.

This selection yields a sample of 2,694 non-immigrant New Zealand 15-year-olds in 2003. Of the 40 percent of the New Zealand sample that are immigrants, 13 percent are first-generation immigrants (the child and both parents are foreign-born), 20 percent are second-generation immigrants (the child is New Zealand-born but at least one parent is foreign-born), four percent are foreign-born but have at least one New Zealand-born parent and three percent are missing information on either their own or at least one parent's country of birth. When we examine outcomes for immigrants to New Zealand, we exclude the seven percent of individuals in the last two groups and drop two second-generation immigrants who are missing age or gender, resulting in sample sizes of 601 first-generation immigrants to New Zealand and 893 second-generation immigrants. Of the 43 percent of Australians in PISA who are immigrants, 487 (four percent) are the children of at least one New Zealander and are also included in our analysis of outcomes for immigrants.

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4 Much of the background information in this section is taken from the PISA website at http://www.pisa.oecd.org

5 Initially, we had intended to examine outcomes in both PISA 2000 and 2003. Unfortunately, PISA 2000 only collected data on parental qualifications, the key variable in our analysis, at an extremely aggregated classification. It was determined that this limitation ruled out examining the two studies in parallel.

6 As most of these students were 15 years old this report refers to these students as '15-year-olds' for brevity.

7 In each year, the sampling design was a two-stage stratified design. A random sample of schools was selected and then a random selection of students was chosen from each school.

8 We exclude the UK from all analyses in line with the caveats in OECD (2005b p. 248) that "The uncertainties surrounding the sample and its bias are such that PISA 2003 scores for the UK cannot reliably be compared with those of other countries."

TABLE 1: Sample size for each OECD country

	Full sample	Non-immigrant	% Non-immigrant	Missing age/grade/gender	Analysis sample	Missing parental quals	% Missing parental quals
New Zealand	4,511	2,699	60	5	2,694	312	11.6
Australia	12,551	7,156	57	0	7,156	157	2.2
Austria	4,597	3,696	80	2	3,694	47	1.3
Belgium	8,796	6,475	74	22	6,453	324	5.0
Canada	27,953	20,679	74	3	20,676	242	1.2
Czech Republic	6,320	5,637	89	2	5,635	59	1.0
Denmark	4,218	3,535	84	2	3,533	122	3.5
Finland	5,796	5,349	92	0	5,349	50	0.9
France	4,300	3,065	71	0	3,065	142	4.6
Germany	4,660	3,361	72	102	3,259	156	4.8
Greece	4,627	3,852	83	7	3,845	0	0.0
Hungary	4,765	4,376	92	0	4,376	21	0.5
Iceland	3,350	2,935	88	0	2,935	28	1.0
Ireland	3,880	3,109	80	0	3,109	32	1.0
Italy	11,639	10,356	89	0	10,356	51	0.5
Japan	4,707	4,532	96	0	4,532	5	0.1
Korea	5,444	5,372	99	0	5,372	57	1.1
Luxembourg	3,923	1,877	48	0	1,877	263	14.0
Mexico	29,983	27,598	92	474	27,124	89	0.3
Netherlands	3,992	3,114	78	0	3,114	114	3.7
Norway	4,064	3,406	84	0	3,406	116	3.4
Poland	4,383	4,280	98	0	4,280	0	0.0
Portugal	4,608	3,837	83	1	3,836	58	1.5
Slovakia	7,346	6,683	91	7	6,676	29	0.4
Spain	10,791	9,838	91	1	9,837	435	4.4
Sweden	4,624	3,574	77	0	3,574	141	3.9
Switzerland	8,420	5,017	60	4	5,013	107	2.1
Turkey	4,855	4,674	96	0	4,674	16	0.3
United States	5,456	4,065	75	2	4,063	76	1.9

Note: Authors' calculations for the OECD countries included in PISA 2003.

2.2 Measuring parental educational attainment

A variable of interest for the examination of the transmission of human capital is the highest educational attainment of each student's parents. PISA collects data on parental education from the students being surveyed. Parental education is coded using the International Standard Classification for Education (ISCED) classification developed by UNESCO. This classification is used by countries and international agencies as a means of compiling internationally comparable statistics on education. It grades the level of educational provision on a 0-6 scale with three tracks designated by a/b/c. Table 2 presents this classification and indicates the equivalent New Zealand schooling level or qualification associated with each classification.

TABLE 2: Definition of ISCED classification and equivalent New Zealand qualification

ISCED level	Definition	New Zealand equivalent	Years
ISCED 0 - Pre-primary	Early Childhood	None	0
ISCED 1 - Primary	Primary	Did not finish Intermediate	6
ISCED 2 - Lower Secondary	Lower Secondary	Finished Intermediate	10
ISCED 3 - Upper Secondary	3A: Upper Secondary	Finished Secondary	13
	3B: Bridging programmes 3C: Pre-employment	National Certificate Levels 1-2	12
ISCED 4 - Post-Secondary Non-Teritary	4B: Bridging programmes 4C: Pre-employment	National Certificate Levels 3-5	13
ISCED 5 - First stage of Tertiary	5A: Bachelor's/Postgrad 5B: Vocational 2-3 yrs	University Degree Post-School Diploma	16 16
ISCED 6 - Second stage of Tertiary	PhD	PhD	NA

Note: See page 273 of the PISA 2003 Technical Manual (OECD, 2005b) for more information about the content of this table.

Although post-secondary or non-tertiary (ISCED 4) programmes are considered tertiary in the New Zealand tertiary education policy and funding framework, they straddle the boundary between upper secondary (ISCED 3) and tertiary education. In many other countries, ISCED level 4 qualifications are classified as not being part of the tertiary education sector. Examples of such programmes include pre-degree foundation courses and national certificates which lead to higher qualifications. The first stage of tertiary education (ISCED 5) includes programmes that are largely theory-based and are intended to provide qualifications for entry into ISCED 6 or a profession with high skills requirements. Level 5A represents more academically-or theory-based study, while level 5B represents more vocationally-oriented study. ISCED level 5A programmes include bachelor's degrees, honours degrees, master's degrees and postgraduate diplomas or certificates, while two-year sub-degree diplomas are normally classified as ISCED level 5B.

PISA 2003 has two separate questions that ask the student about their mother's and father's completed education; one question asks about school qualifications and a second asks about tertiary qualifications. The first question asked:

Which of the following did your mother/father complete at [school]? –

(Please [tick] as many boxes as apply.)

- a) [ISCED level 3A]
- b) [ISCED level 3B, 3C]
- c) [ISCED level 2]
- d) [ISCED level 1]
- e) None of the above

and the second question asked:

Does your mother/father have any of the following qualifications? –

(Please [tick] as many boxes as apply.)

- a) [ISCED 5A, 6]
- b) [ISCED 5B]
- c) [ISCED 4].

TABLE 3: Distribution of parental education across OECD countries

Highest parental education %	ISCED 0/1 %	ISCED 2 %	ISCED 3B/C %	ISCED 3A %	ISCED 4B/C %	ISCED 5B %	ISCED 5A/6 %	Missing %	Mean years of education
New Zealand equivalent	Did not finish intermediate	Finished intermediate school	Has National Certificate Levels 1-2	Finished secondary school	Has National Certificate Levels 3-5	Has post-school diploma	Has university degree		
New Zealand	3.5	6.1	17.3	10.2	21.4	22.1	19.5	11.8	13.5
Australia	1.3	12.3	2.7	15.9	16.1	15.3	36.2	2.1	13.0
Austria	0.3	3.1	38.5	9.0	6.0	30.4	12.7	1.4	13.2
Belgium	2.1	3.4	4.1	16.2	15.3	23.0	35.8	5.0	13.8
Canada	0.4	4.8	NA	33.5	NA	26.2	35.1	0.8	14.4
Czech Republic	0.2	1.2	24.7	39.6	7.9	1.7	24.6	1.0	13.7
Denmark	0.8	8.6	8.6	12.9	10.2	38.6	20.4	3.3	14.6
Finland	3.2	6.7	NA	20.9	2.4	32.4	34.2	0.9	13.9
France	1.0	11.7	25.8	23.3	NA	12.6	25.7	4.8	12.3
Germany	0.3	7.5	23.7	5.9	18.2	18.2	26.3	4.9	13.9
Greece	9.2	12.9	4.5	18.4	15.2	13.3	26.5	0.0	12.9
Hungary	0.3	6.7	20.0	16.6	24.0	7.4	25.0	0.4	12.9
Iceland	2.3	11.2	9.5	11.2	27.4	13.7	24.6	1.0	14.4
Ireland	5.8	10.2	NA	17.2	28.4	19.5	18.8	1.1	12.4
Italy	3.8	26.7	4.6	16.1	15.2	14.0	19.6	0.4	12.5
Japan	2.0	2.7	6.3	29.9	NA	16.7	42.4	0.1	13.8
Korea	6.9	13.0	11.3	31.4	NA	6.9	30.5	1.0	12.5
Luxembourg	5.3	2.5	7.4	13.2	15.7	34.6	21.2	14.0	14.6
Mexico	30.9	23.4	2.6	11.8	NA	13.8	17.5	0.5	9.7
Netherlands	3.3	10.6	NA	6.7	31.0	NA	48.4	3.8	13.0
Norway	0.3	3.0	3.9	6.7	23.4	38.5	24.2	3.3	14.6
Poland	0.6	1.9	20.5	42.6	12.3	7.3	14.8	0.0	12.5
Portugal	40.9	17.7	2.9	14.9	NA	6.6	17.0	1.5	8.9
Slovakia	0.7	2.4	15.5	37.9	17.7	3.3	22.6	0.4	13.6
Spain	26.6	7.2	2.2	17.3	9.5	12.0	25.2	3.4	11.1
Sweden	1.2	7.5	7.5	23.2	NA	23.2	37.5	4.1	13.6
Switzerland	0.9	17.8	29.3	7.2	4.9	22.5	17.5	2.4	12.5
Turkey	35.8	20.4	1.1	22.9	0.1	6.2	13.5	0.3	8.9
United States	0.4	1.9	NA	47.8	NA	12.9	37.0	1.9	13.8

Note: Authors' calculations for the OECD countries included in PISA 2003. See Table 2 for further information about the definition of parental education. The values for the non-missing categories are the percentages of the overall non-missing responses.

These questions do not allow parents with ISCED level 6 to be distinguished from those in ISCED level 5A, but otherwise they allow for parental education to be measured at a fairly disaggregated level. Previous summaries of New Zealand PISA data have focused on the relationship between students' achievement and their mothers' education, on the basis that mothers' rather than fathers' education is more strongly associated with students' performance.[9] Instead, we focus initially on the highest qualification of the more-qualified parent and subsequently analyse the relative influence of mothers' and fathers' education.

Table 3 presents the distribution of parental education in each OECD country surveyed in PISA 2003. As few parents of 15-year-olds in most OECD countries have only pre-primary (ISCED level 0) and primary (ISCED level 1) schooling, we aggregate these two categories in all analyses. We also present the mean years of parental education for each country, which is derived by the OECD by using information from each country to assign the 'normal years of schooling' that it takes to achieve an ISCED category in that country (the assignment rules for New Zealand are given in Table 2).

The more-educated parent of the average 15-year-old in New Zealand has 13.5 years of education, which is towards the upper-middle of the distribution among OECD countries. However, only 20 percent of New Zealand parents have a university degree, which is lower than all but seven OECD countries (Austria, Turkey, Poland, Portugal, Mexico, Switzerland, Ireland). On the other hand, 44 percent of New Zealand parents have National Certificate Levels 3–5 or post-school diplomas, while many of the countries that have a large proportion of parents with university degrees have very few parents with high-level vocational degrees (for example, less than 20 percent of parents in Japan and the US have these).

In Table 4 we present the distribution of parental education across the three migrant groups examined in this report. Compared with non-immigrant New Zealanders, the parents of first-generation New Zealanders have a slightly higher average number of years of education, but are much more likely to be university educated (35 percent have at least one parent with a university degree versus 20 percent for non-immigrants). They are also more likely to have low levels of education, with twice as many parents of first-generation New Zealanders failing to finish intermediate as parents of non-immigrants. The educational distribution for parents of second-generation New Zealanders is quite similar to that for parents of non-immigrants, although again twice as many immigrant parents fail to finish intermediate and the average number of years of education is slightly lower than for non-immigrant parents.

TABLE 4: Distribution of parental education across New Zealand migrant groups

Highest parental education %		1st generation New Zealander	2nd generation New Zealander	New Zealander in Australia
ISCED 0/1	Did not finish intermediate school	7.0	6.8	1.1
ISCED 2	Finished intermediate school	0.9	4.9	10.6
ISCED 3B/C	Has National Certificate Levels 1-2	6.4	14.3	1.5
ISCED 3A	Finished secondary school	11.7	10.0	19.5
ISCED 4B/C	Has National Certificate Levels 3-5	15.4	19.8	14.7
ISCED 5B	Has post-school diploma	24.0	20.4	13.9
ISCED 5A/6	Has university degree	34.6	23.7	38.7
Missing parental education		9.2	9.4	5.1
Mean years of education		13.8	13.2	13.1
Number of students		601	893	487

Note: Authors' calculations. See Table 2 for further information about the definition of parental education. The values for the non-missing categories are the percentages of the overall non-missing responses.

[9] See Sturrock and May (2002, p. 102) and Comparative Education Research Unit, Ministry of Education (2004, p. 21) for summaries of intergenerational gradients by mothers' education.

Finally, turning to the children of New Zealanders living in Australia, we see that the educational distribution is much different for the parents of these children from those of non-migrants. For example, very few have vocational degrees – only two percent have National Certificate Levels 1–2; 15 percent have National Certificate Levels 3–5; and 14 percent have post-school diplomas, versus 17 percent, 21 percent and 22 percent for the parents of non-immigrants. On the other hand, they are much more likely to have university degrees, with 39 percent of the trans-Tasman migrant parents having degrees, versus 20 percent of non-migrants. However, on average, trans-Tasman migrant parents have 0.4 years less education than non-migrants in New Zealand.

TABLE 5: Variation in test scores across OECD countries – mean (Std Dev)

	Maths	Reading	Science	Problem-solving	Number of students
New Zealand	524.0	523.1	523.1	533.1	2,694
	(93.6)	(95.8)	(94.7)	(88.7)	
Australia	524.1	527.1	527.5	532.9	7,156
	(89.0)	(88.8)	(92.1)	(83.6)	
Austria	514.4	500.4	500.9	513.5	3,694
	(87.7)	(92.5)	(88.1)	(82.4)	
Belgium	550.9	528.2	529.1	545.5	6,453
	(95.2)	(89.9)	(90.2)	(89.0)	
Canada	535.7	533.3	526.7	534.7	20,676
	(83.3)	(80.2)	(91.0)	(81.6)	
Czech Republic	524.1	497.4	529.6	524.1	5,635
	(90.1)	(81.7)	(90.7)	(82.8)	
Denmark	519.6	496.0	481.6	522.8	3,533
	(86.1)	(79.1)	(91.9)	(79.8)	
Finland	546.3	546.0	550.9	549.5	5,349
	(79.3)	(72.3)	(81.3)	(74.7)	
France	520.8	506.2	522.7	530.4	3,065
	(84.4)	(85.2)	(98.5)	(82.4)	
Germany	527.3	519.3	531.5	536.1	3,259
	(87.8)	(86.6)	(90.0)	(80.2)	
Greece	448.3	476.4	484.7	451.5	3,845
	(87.9)	(92.7)	(89.6)	(88.5)	
Hungary	490.1	482.0	504.1	501.1	4,376
	(88.9)	(84.8)	(89.2)	(88.6)	
Iceland	514.4	492.7	495.7	506.1	2,935
	(85.5)	(88.5)	(86.6)	(76.4)	
Ireland	500.6	515.2	504.4	497.6	3,109
	(82.0)	(81.6)	(86.8)	(75.1)	
Italy	466.2	477.0	487.8	471.1	10,356
	(93.2)	(93.0)	(99.8)	(94.9)	
Japan	536.5	499.4	548.6	548.4	4,532
	(95.4)	(96.3)	(101.4)	(96.6)	
Korea	543.7	534.2	538.6	550.5	5,372

	(89.7)	(75.6)	(92.9)	(80.8)	
Luxembourg	510.4	503.6	503.6	510.1	1,877
	(82.9)	(82.6)	(88.5)	(80.0)	
Mexico	389.7	406.2	409.6	391.6	27,124
	(77.5)	(83.5)	(75.2)	(82.8)	
Netherlands	551.7	524.6	537.8	532.1	3,114
	(82.9)	(74.5)	(88.7)	(81.4)	
Norway	498.9	504.4	490.0	495.0	3,406
	(87.5)	(91.8)	(92.0)	(89.9)	
Poland	490.5	497.2	498.3	487.3	4,280
	(86.5)	(87.9)	(93.5)	(83.0)	
Portugal	467.0	480.1	470.2	474.0	3,836
	(82.0)	(84.5)	(84.1)	(83.6)	
Slovakia	497.6	469.3	495.7	492.2	6,676
	(90.8)	(85.1)	(91.3)	(86.3)	
Spain	487.1	483.2	490.0	483.9	9,837
	(83.7)	(86.5)	(90.3)	(85.9)	
Sweden	517.1	522.0	516.5	517.0	3,574
	(88.0)	(83.2)	(92.6)	(77.7)	
Switzerland	548.2	517.7	534.8	541.3	5,013
	(86.0)	(76.7)	(89.7)	(76.5)	
Turkey	424.3	441.0	433.5	408.3	4,674
	(99.7)	(87.8)	(89.1)	(90.6)	
United States	487.9	502.6	498.4	482.6	4,063
	(89.4)	(90.9)	(92.6)	(90.4)	

Note: Authors' calculations for the OECD countries included in PISA 2003.

2.3 Measuring cognitive outcomes for students

For each student, we derive a mean test score for each domain by averaging the five 'plausible values' provided in the PISA dataset[10]. Scores are standardised across the OECD so that each score has a mean of 500 and a standard deviation of 100. Table 5 presents the distribution of four test scores for non-immigrants across the OECD countries surveyed in PISA 2003. New Zealand students perform higher than the OECD average, with mean test scores ranging from 523 for reading and science, 524 in maths and 533 in problem-solving.

TABLE 6: Variation in test scores across New Zealand migrant groups – mean (Std Dev)

	Maths	Reading	Science	Problem-solving	Number of students
1st generation New Zealander	523.2	502.6	510.5	533.9	601
	(96.2)	(105.2)	(102.3)	(92.6)	
2nd generation New Zealander	526.4	531.3	525.6	533.2	893
	(96.8)	(98.5)	(99.9)	(92.7)	
New Zealander in Australia	519.1	513.8	514.4	519.4	487
	(93.1)	(95.6)	(100.3)	(86.4)	

Note: Authors' calculations for the New Zealand immigrants and New Zealanders in Australia included in PISA 2003.

[10] The plausible values are random numbers drawn from the distribution of scores that could be reasonably assigned to each individual – that is, the marginal posterior distribution. This is a statistical method for recognising that a student's performance on any individual assessment is somewhat random. See Adams and Wu (2002) for technical details.

Table 6 shows the same results for the three migrant groups being examined. Perhaps surprisingly, except for in reading and science scores, which are a bit lower for first-generation immigrants, the two New Zealand migrant groups have mean scores that are quite similar to those for the non-migrant New Zealanders. On the other hand, test scores for the children of trans-Tasman migrants are, on average, five to 10 points lower than those for non-immigrants.

We now turn to examining the test-score/parental education gradient among non-immigrant 15-year-olds in New Zealand. For this analysis, we standardise test scores so that each test has a mean of zero and a standard deviation of one within the sample of non-immigrant New Zealanders. Table 7 presents the mean and standard deviation of each of the four test domains for each level of parental education.

TABLE 7: Parental education and mean test scores in New Zealand

	Standardised test scores			
Highest parental education	**Maths**	**Reading**	**Science**	**Problem-solving**
Did not finish intermediate ISCED 0/1	-0.92 (0.09)	-0.90 (0.08)	-0.91 (0.09)	-0.97 (0.08)
Finished intermediate school ISCED 2	-0.40 (0.07)	-0.35 (0.08)	-0.41 (0.08)	-0.34 (0.07)
Has National Certificate Levels 1-2 ISCED 3B/C	-0.02 (0.05)	0.01 (0.05)	-0.03 (0.05)	-0.01 (0.05)
Finished secondary school ISCED 3A	0.04 (0.08)	0.09 (0.08)	0.07 (0.07)	0.07 (0.08)
Has National Certificate Levels 3-5 ISCED 4B/C	0.00 (0.05)	0.02 (0.05)	0.01 (0.05)	0.03 (0.05)
Has post-school diploma ISCED 5B	0.14 (0.05)	0.13 (0.05)	0.12 (0.05)	0.14 (0.05)
Has university degree ISCED 5A/6	0.48 (0.06)	0.44 (0.06)	0.49 (0.06)	0.41 (0.06)
Missing	-0.49 (0.07)	-0.58 (0.07)	-0.53 (0.07)	-0.53 (0.07)
Difference between mean for parents with ISCED 5A/6 versus ISCED 2	0.88 (0.09)	0.78 (0.09)	0.90 (0.09)	0.75 (0.09)

Note: Authors' calculations for non-immigrants in New Zealand. Standard deviations are in parentheses. See Table 2 for further information about the definition of parental education. Test scores are standardised so that each test has a mean of zero and a standard deviation of one within the sample of non-immigrant New Zealanders.

We find a strong relationship between parental education and children's test scores. For example, 15-year-olds whose parents finish only intermediate score 0.34–0.41 standard deviations lower, on average, on each PISA domain than the average non-immigrant 15-year-old. Conversely, 15-year-olds with at least one parent with a university degree score 0.41–0.49 standard deviations higher, on average, than the average non-immigrant 15-year-old. Overall, children whose parents are at the highest educational level score 0.75–0.90 standard deviations higher on PISA than those whose parents finished only intermediate. In the next table, we compare this gradient to that found in other OECD countries.

In general, we find that test scores are higher for students with more-educated parents. However, there is little difference between the test scores for students whose parents' highest education is National Certificate Levels 1–2 and those who finished secondary school or had National Certificate Levels 3–5. These

three categories are more or less equivalent in their relationship to child outcomes. One final observation is that students who did not report their parents' qualifications have, on average, quite low test scores. These descriptive findings are consistent with those reported in Sturrock and May (2002) for the whole sample of New Zealand children and concentrating only on mothers' education.

We next examine how the test-score/parental education gradient varies across OECD countries. For this analysis, we standardise test scores so that each test has a mean of zero and a standard deviation of one within the sample of non-immigrant students in all OECD countries. Given how similar the results are for New Zealanders across the four test domains, we focus here only on maths scores, which are the focus area for PISA 2003.

Table 8 presents the mean standardised maths scores by parental education in each OECD country. The countries are ordered in these results from the weakest to strongest parental education/test-score gradient. Students in New Zealand with at least one parent with a university degree score, on average, 0.82 standard deviations higher on the maths domain than students with parents who have completed only intermediate. The correlation between parental education and test scores is stronger in New Zealand than in all but nine other OECD countries – Japan, Austria, the US, Poland, Germany, the Czech Republic, Turkey, Hungary and Slovakia – but is also similar to the gradient in Denmark and Switzerland. In comparison, this same gradient is only 0.58 in Australia, which is similar to that found in the Scandinavian countries.

TABLE 8: Mean standardised maths scores by parental education across OECD countries

Highest parent	ISCED 0/1	ISCED 2	ISCED 3B/C	ISCED 3A	ISCED 4B/C	ISCED 5B	ISCED 5A/6	Missing
New Zealand equivalent	Did not finish intermediate	Finished intermediate School	Has National Certificate Level 1-2	Finished secondary school	Has National Certificate Levels 3-5	Has post-school diploma	Has university degree	
Luxembourg	-0.10	0.40	0.22	0.28	0.09	0.22	0.54	-0.15
Mexico	-1.33	-1.07	-0.74	-0.71	NA	-0.56	-0.89	-1.66
Spain	-1.34	0.03	0.03	-0.01	-0.11	0.02	0.34	-0.49
Netherlands	0.08	0.49	NA	0.53	0.48	NA	0.84	-0.13
Portugal	-0.47	-0.22	-0.02	-0.02	NA	-0.37	0.24	-0.77
Norway	...	-0.29	-0.14	-0.08	-0.07	0.24	0.22	-0.47
Iceland	-0.33	0.00	0.09	0.18	0.25	0.22	0.52	-0.17
Finland	0.21	0.25	NA	0.45	0.43	0.53	0.78	0.12
Sweden	-0.45	-0.13	0.26	0.24	NA	0.35	0.41	-0.28
Australia	0.03	0.10	-0.04	0.16	0.22	0.21	0.68	-0.23
France	...	0.02	0.09	0.48	NA	0.28	0.64	-0.19
Belgium	-0.17	0.28	0.11	0.64	0.40	0.70	0.91	-0.40
Ireland	-0.52	-0.16	NA	-0.05	0.13	0.21	0.47	-0.58
Canada	-0.31	-0.03	NA	0.33	NA	0.46	0.67	-0.29
Korea	0.09	0.18	0.39	0.53	NA	0.40	0.90	0.09
Italy	-0.89	-0.58	-0.04	0.11	-0.31	-0.34	0.15	-0.23
Greece	-0.88	-0.77	-0.64	-0.42	-0.38	-0.48	-0.03	None
Denmark	...	-0.17	0.01	0.17	0.20	0.43	0.62	-0.29
Switzerland	-0.48	0.16	0.67	0.70	0.35	0.62	0.97	-0.09
New Zealand	-0.52	-0.03	0.32	0.38	0.34	0.47	0.78	-0.12
Japan	-0.07	-0.08	0.33	0.23	NA	0.37	0.75	-1.80
Austria	...	-0.18	0.12	0.67	0.15	0.20	0.70	-0.69
United States	...	-0.60	NA	-0.17	NA	-0.13	0.28	-0.63
Poland	...	-0.60	-0.35	-0.06	0.13	0.24	0.54	None
Germany	...	-0.37	0.25	0.27	0.37	0.40	0.83	-0.20
Czech Republic	...	-0.46	-0.08	0.36	0.28	0.34	0.81	-0.06
Turkey	-0.96	-0.97	-0.67	-0.45	...	-0.72	0.35	-1.63
Hungary	...	-0.80	-0.35	0.05	-0.15	0.04	0.62	-0.49
Slovakia	-0.31	-0.92	-0.34	0.11	-0.12	-0.11	0.62	-0.84

Note: Authors' calculations for the OECD countries included in PISA 2003. See Table 2 for further information about the definition of parental education. Test scores are standardised so that each test has a mean of zero and a standard deviation of one within the sample of non-immigrant students in all OECD countries. Cells that correspond to fewer than 40 observations are suppressed, noted by ... .

Table 9 presents the same comparisons for the three migrant groups and the non-migrant New Zealanders. Here, test scores are standardised within the combined sample of New Zealanders and Australians in PISA. The difference in maths test scores for 15-year-olds with parents who have completed only intermediate and those with a parent with a university degree is 0.97 for first-generation immigrants in New Zealand, 1.14 for second-generation immigrants and 0.75 for New Zealanders in Australia, compared with 0.89 for non-migrants in New Zealand.

TABLE 9: Mean standardised maths scores by parental education across New Zealand migrant groups

Highest parental education	Non-migrant New Zealander	1st generation New Zealander	2nd generation New Zealander	3rd generation New Zealander
Did not finish intermediate	-0.93	-0.64	-0.60	-0.14
Finished intermediate school	-0.40	-0.61	-0.51	-0.40
Has National Certificate Levels 1-2	-0.01	-0.25	-0.03	-0.56
Finished secondary school	0.05	0.15	0.13	-0.19
Has National Certificate Levels 3-5	0.01	-0.21	-0.02	-0.08
Has post-school diploma	0.15	0.00	-0.01	-0.18
Has university degree	0.49	0.36	0.62	0.35
Missing parental education	-0.49	-0.39	-0.43	-0.86
Difference between means for parents with ISCED 5A/6 vs ISCED 2	0.89	0.97	1.14	0.75

Note: Authors' calculations for the New Zealand immigrants and New Zealanders in Australia included in PISA 2003. See Table 2 for further information about the definition of parental education. Test scores are standardised so that each test has a mean of zero and a standard deviation of one within the full sample of New Zealanders and Australians.

2.4 Regression estimates

We next turn to a multivariate regression analysis to examine the relationship between parents' education and socio-economic background and the cognitive skills of their children. This framework also allows consideration of the roles that schools and home environments play in the intergenerational transmission of human capital.

We begin by estimating the relationship between parental education and children's test scores for non-immigrant 15-year-olds in New Zealand, controlling for student characteristics. The following linear regression model is estimated using Ordinary Least Squares (OLS) separately for each PISA domain:[11]

$$T_{ifs} = \alpha + X_{ifs}\beta + E_{fs}\gamma + u_{ifs} \quad (1)$$

where T_{ifs} is the standardised achievement test score of student i in family f and school s, X_{ifs} is the age in months and gender of the student, E_{fs} is a vector of dummy variables capturing the highest educational attainment of the parents of the student as presented in Table 3, and u_{ifs} is a random white-noise error term.[12]

The dummy variables that measure parental education are created in such a manner that the γ coefficients measure the difference in average test scores between children with parents at a particular education level and the average non-immigrant child.[13] In this model, the coefficient vector γ measures the 'raw' gradient between parental education and children's cognitive ability without controlling for any of the channels through which this effect might occur. In other words, this reveals both the child's endowment of human capital and the parents' investments in the child's skills that are related to parental educational attainment.

[11] All estimation is performed in STATA 10. We also estimated this model using quantile regression techniques to examine the relationship between parental education and the 25th percentile, median and 75th percentile of the test score distribution. In all cases, qualitatively similar results were found at all points in the test score distribution and compared to OLS regression estimates.

[12] All regression models estimated in this paper use the student weights provided with the data to ensure the representativeness of the sample of students in each country. All estimated standard errors also account for the fact that students in clusters of schools are surveyed. Estimates for subgroups that were not used in the derivation of the weights are not necessarily representative.

[13] We include children whose parents' education status is missing in all regression models, treating them as a separate parental education group. This allows us to use the information provided by these observations on the relationship between educational inputs and test scores.

We next estimate the relationship between parental education and children's test scores, controlling for four sets of factors that may have a direct effect on students' test scores and that are correlated with parental education. The four sets of factors are household characteristics, household educational resources, student-school interactions and school characteristics. These estimates indicate the extent to which the gradient of students' test scores across parental education, as shown in Table 7, reflects the fact that students whose parents have higher qualifications are also exposed to other inputs that tend to raise test scores.

Consider a full education production function as in Fertig and Schmidt (2002), Fertig (2003) and Fuchs and Woessmann (2007), as summarised by the following regression model:

$$T_{ifs} = \alpha + X_{ifs}\beta + E_{fs}\gamma + B_{fs}\delta + H_{fs}\lambda + I_{is}\theta + S_s\kappa + u_{ifs} \quad (2)$$

This augments equation (1) with additional controls for a range of household characteristics (B_{fs}), household educational resources (H_{fs}), student-school interactions (I_{is}) and school characteristics (S_s). Table 10 lists the full set of control variables that are included in this regression model. It also shows which PISA questionnaires and question numbers are used to derive the particular variable. Appendix 1 explains in detail how each variable included in our regressions is coded and Appendix Table 1 (p. 60) displays the sample mean of each covariate for a sample of OECD countries.

The coefficient γ now measures the correlation between parental education and children's cognitive ability, controlling for the direct relationship between household characteristics, household educational resources, student-school interactions and school characteristics, and child outcomes. This model captures the main pathways through which parental education might influence children's cognitive ability. Thus, γ now mainly captures the degree of inheritance of human capital from parent to child. This is not entirely the case because parental education might also affect children's cognitive ability through pathways not captured in the data, such as the ability of more-educated parents to provide higher-quality home inputs with the same measured resources (for instance, by being more efficient at helping with homework).

Overall, the results from these models provide evidence of the extent to which children with better-educated parents have higher cognitive abilities, and provide a broad indication of the pathways (household characteristics, household educational resources, student-school interactions and school characteristics) through which this relationship operates. Assuming that the parental education/child test-score gradient is reduced when these control variables are added to the model, we can conclude that more-educated parents have more household resources that aid their children's learning, provide better household educational resources, encourage their children to have a better attitude towards school and higher expectations about future achievement, or send their children to better schools, and that this contributes to the overall relationship between parental education and child test scores. It would be valuable in future work to investigate further the causal relationships behind these associations.

TABLE 10: Variable definitions for all regression controls

Student characteristics		**School characteristics**	
Age and gender	STQ(2-3)	Private school	SCQ(3)
Parental education		School size	SCQ(2)
Mother/father's education	STQ(11-14)	School gender mix	SCQ(2)
Household characteristics		Student-teacher ratio	SCQ(2,18)
Living arrangements	STQ(4)	Teacher certification	SCQ(2,18)
Home possessions*	STQ(17,19)	Computer availability	SCQ(2,9)
Employment status	STQ(5,6)	Weeks in school year	SCQ(7)
Occupational status*	STQ(7-10)	School funding	SCQ(4)
Location	SCQ(1)	School selectivity	SCQ(10)
Household educational resources		School streaming	SCQ(16)
Educational resources*	STQ(17:a,c,g,k)	Teacher-student relationships	SCQ(25c)
Cultural possessions*	STQ(17:h-j)	Teacher shortages*	SCQ(8: a-c,e,f)
Books at home	STQ(19)	Material resources*	SCQ(8:k-m)
Computer availability	STQ(17:d-f)	Educational resources*	SCQ(8:i,o-t)
Student-school interactions		Teacher morale*	SCQ(24)
School grade	STQ(1a)	Student behaviours*	SCQ(25: b,d,g,h,j,l)
Class size	STQ(36)	Teacher behaviours*	SCQ(25: a,c,e,f,i,k,m)
Student expectations	STQ(23)	School autonomy*	SCQ(26)
Student attitudes to school	STQ(24)	Teacher participation*	SCQ(26)
Student relationships with teachers*	SCQ(26)		

Note: STQ: Student Questionnaire; SCQ: School Questionnaire; * denotes measures based on a statistical index that combines information from multiple responses. For further details, see OECD (2005b) and Appendix 1.

2.5 Blinder-Oaxaca Regression Decomposition

The Blinder-Oaxaca decomposition is a methodology often used to examine the factors that explain differences in labour-market outcomes for different groups of individuals, such as gender or ethnicity (Blinder, 1973, Oaxaca, 1973). In this paper, we use it to measure the separate contribution that differences in household characteristics (B_{fs}), household educational resources (H_{fs}), student-school interactions (I_{fs}), and school characteristics (S_s) make towards explaining the raw test-score gap between children of parents with different educational status. Jann (2008) provides a detailed explanation of the mechanics behind this approach and contributes a user-written command for Stata 10, which we use to estimate the decompositions described in this paper.

In simplified terms, we examine what the predicted test scores for children whose parents have a particular educational status would be if, on average, the educational inputs for this group were the same as for children of parents of higher educational status. We create this prediction by combining information on the average inputs for children whose parents have a higher educational status (say a university degree) with coefficient estimates from regression model (2), which measures the relationship between educational inputs and test scores for all non-immigrant New Zealanders. By doing this separately for each subset of educational inputs one at a time, we can estimate the relative contribution that each makes to explaining the raw association between parental education and test scores.

3. RESULTS

3.1 The raw relationship between parental education and test scores in New Zealand

We begin by presenting the results from estimating regression model (1) for non-immigrant 15-year-olds in New Zealand, controlling only for the age and gender of the student. These results show the raw gradient between parental education and children's cognitive ability without controlling for any of the channels through which it might occur. The regression coefficients from this model for each of the four test domains are presented in Table 11. The raw relationship between parental education and children's test scores is also presented graphically in Figure 1.

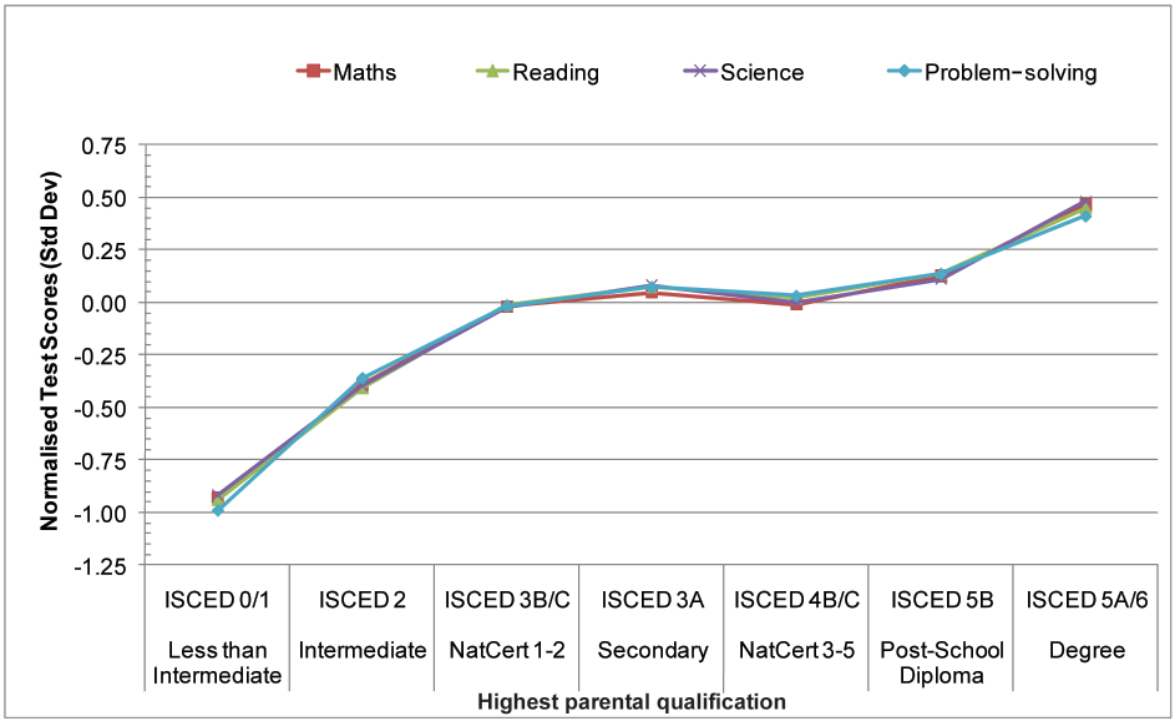
TABLE 11: The raw relationship between test scores and parental education in New Zealand

	Maths (1)	Reading (2)	Science (3)	Problem-solving (4)
Age in months	0.0160***	0.0195***	0.0120**	0.0203***
	(0.006)	(0.005)	(0.005)	(0.006)
Female	-0.123***	0.346***	-0.143***	0.0961**
	(0.047)	(0.045)	(0.046)	(0.047)
Highest parent did not finish intermediate	-0.929***	-0.940***	-0.917***	-0.992***
ISCED 0/1	(0.089)	(0.086)	(0.086)	(0.085)
Highest parent finished intermediate	-0.391	-0.408***	-0.397***	-0.361***
ISCED 2	(0.071)	(0.071)	(0.072)	(0.071)
Highest parent has National Cert Levels 1-2	-0.019	-0.013	-0.021	-0.016
ISCED 3B/C	(0.042)	(0.042)	(0.044)	(0.042)
Highest parent finished secondary school	0.047	0.073	0.080	0.072
ISCED 3A	(0.068)	(0.069)	(0.059)	(0.066)
Highest parent has National Certificate Levels 3-5	-0.010	0.020	0.000	0.032
ISCED 4B/C	(0.038)	(0.038)	(0.039)	(0.038)
Highest parent has post-school diploma	0.127***	0.136***	0.112***	0.136***
ISCED 5B	(0.041)	(0.041)	(0.041)	(0.041)
Highest parent has university degree	0.465***	0.450***	0.480***	0.412***
ISCED 5A/6	(0.045)	(0.042)	(0.044)	(0.046)
Difference between parents with ISCED 5A/6 and 2	0.855***	0.855***	0.877***	0.773***
	(0.091)	(0.091)	(0.092)	(0.093)
R-squared	0.113	0.141	0.119	0.109
Observations	2694	2694	2694	2694

Note: Parental education variables are defined as relative to the parental education for the mean student. Student weights, which are provided with the data, are used to ensure the representativeness of the sample of students. Robust standard errors, which account for the fact that students in clusters of schools are surveyed, are in parentheses. *** significant p<0.01, ** p<0.05, * p<0.1.

First examining the covariates, older students do better on each of the four test domains. This relationship is strongest for reading and problem-solving, with a student who is one year older scoring 0.23 to 0.24 standard deviations higher than a younger student on the same domains, as well as 0.19 standard deviations higher on maths and 0.14 standard deviations higher on science. Female students score, on average, 0.34 standard deviations higher than male students on the reading domain and 0.10 standard deviations higher on the problem-solving domain, but 0.12 standard deviations lower on the maths domain and 0.14 standard deviations lower on the science domain.

FIGURE 1: The raw relationship between test scores and parental education in New Zealand



These results also show that controlling for student characteristics, 15-year-olds with parents who did not finish intermediate score, on average, 0.92 to 0.99 standard deviations lower on each of the PISA domains than the average non-immigrant 15-year-old, with the largest difference found for problem-solving. Those with parents who finished only intermediate score 0.36 to 0.41 standard deviations lower than the average student. Similar test scores are found for students with parents whose highest educational achievement is a National Certificate Levels 1–2 or 3–5; these students score roughly the same as the average student on each domain. Students whose parents finished secondary school do slightly better, with average test scores 0.05 to 0.08 standard deviations higher than the average student on each domain, although these differences are all insignificant. Students with at least one parent with a university degree do the best, scoring 0.41 to 0.48 standard deviations above the average student on each of the PISA domains.

The gradient is strikingly similar for maths, reading and science, and slightly smaller for problem-solving. Overall, there is a 0.86 standard deviation difference in maths scores, 0.86 difference in reading scores, 0.88 difference in science scores and a 0.77 difference in problem-solving scores between students with at least one university-educated parent and those whose parents finished only intermediate school.

TABLE 12: The relationship between test scores and parental education in New Zealand controlling for all measured characteristics

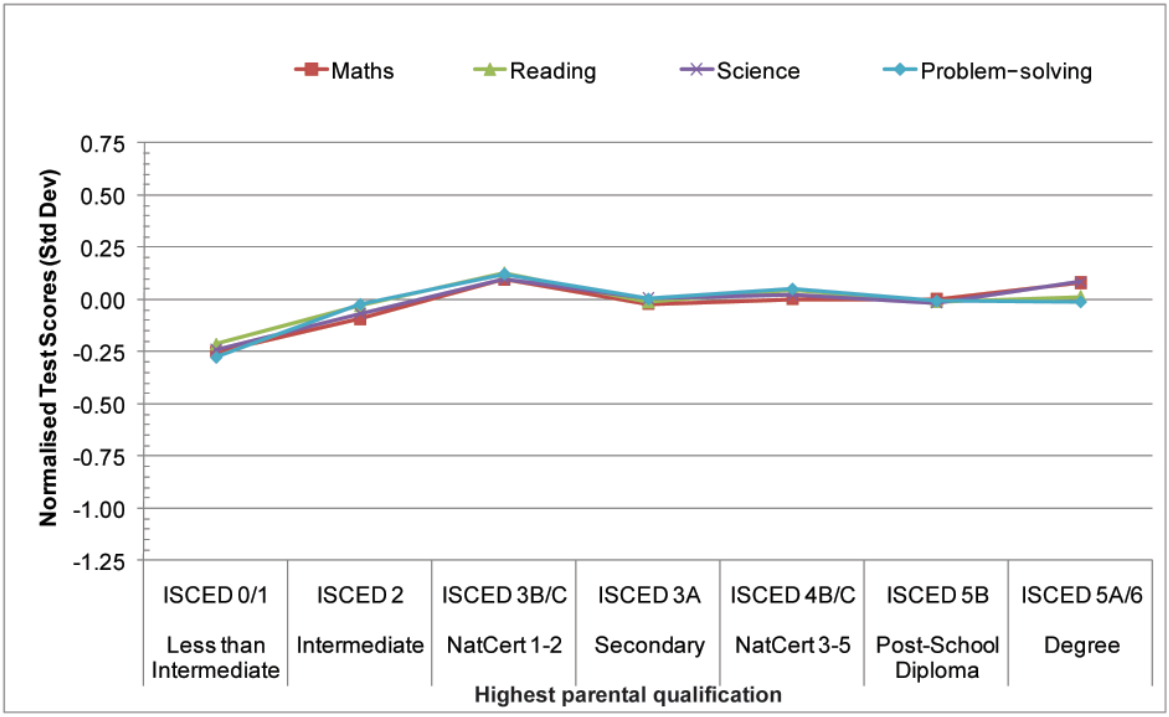
	Maths (1)	Reading (2)	Science (3)	Problem-solving (4)
Age in months	-0.004	0.000	-0.007	0.003
	(0.005)	(0.005)	(0.006)	(0.005)
Female	-0.225***	0.228***	-0.218***	-0.006
	(0.039)	(0.037)	(0.039)	(0.039)
Highest parent did not finish intermediate school	-0.251***	-0.212***	-0.239***	-0.275***
ISCED 0/1	(0.082)	(0.075)	(0.082)	(0.088)
Highest parent finished intermediate school	-0.094	-0.029	-0.067	-0.022
ISCED 2	(0.067)	(0.064)	(0.068)	(0.065)
Highest parent has National Cert Levels 1-2	0.0959***	0.127***	0.0961**	0.122***
ISCED 3B/C	(0.036)	(0.037)	(0.039)	(0.035)
Highest parent finished secondary school	-0.021	-0.012	0.007	0.003
ISCED 3A	(0.050)	(0.046)	(0.047)	(0.047)
Highest parent has National Certificate Levels 3-5	0.002	0.045	0.023	0.051
ISCED 4B/C	(0.032)	(0.031)	(0.034)	(0.031)
Highest parent has post-school diploma	0.001	-0.010	-0.015	-0.007
ISCED 5B	(0.029)	(0.029)	(0.030)	(0.029)
Highest parent has university degree	0.0802**	0.014	0.0843**	-0.011
ISCED 5A/6	(0.035)	(0.032)	(0.034)	(0.034)
Difference between parents with ISCED 5A/6 and 2	0.074**	0.044	0.151*	0.011
	(0.079)	(0.075)	(0.077)	(0.078)
R-squared	0.47	0.523	0.448	0.488
Observations	2694	2694	2694	2694

Note: Parental education variables are defined as relative to the parental education for the mean student. Student weights, which are provided with the data, are used to ensure the representativeness of the sample of students. All covariates listed in Table 10 and summarised in Appendix Table 2, as well as covariates which measure whether particular variables are missing, are included in the regressions. Robust standard errors, which account for the fact that students in clusters of schools are surveyed, are in parentheses. *** significant p<0.01, ** p<0.05, * p<0.1.

3.2 Do educational inputs explain the parental education/test-score gradient in New Zealand?

We next present the results for estimating regression model (2) for non-immigrant 15-year-olds in New Zealand, controlling for the age and gender of the student as well as household characteristics, household educational resources, student-school interactions and school characteristics. The full set of regression coefficients from this model for each of the four test domains is presented in Appendix Table 2. Table 12 presents the subset of coefficients for student characteristics and parental education. Figure 2 summarises the result for the parental education/test-score gradient graphically.

FIGURE 2: The relationship between test scores and parental education controlling for differences in household educational inputs



First, comparing the results in the first two rows of this table to those in Table 11 allows us to judge whether age and gender differences in test scores reflect differing resources. Once we control for these other characteristics (in particular, what grade the students are in), there is no longer a relationship between students' age and test scores. On the other hand, gender differences in test scores, except for the problem-solving tests, persist even when controlling for the other characteristics, indicating that these differences are unlikely to be caused by gender differences in educational inputs.

Second, by comparing the results for the relationship between parental education and test scores in this table to those in Table 11, we can evaluate the extent to which the raw parental education/test-score gradient reflects differences in the inputs provided by parents with different levels of educational status. Controlling for differences in parental inputs, 15-year-olds with parents who did not finish intermediate score, on average, 0.21 to 0.28 standard deviations lower on each of the PISA domains than the average non-immigrant 15-year-old, with the largest difference still found for the problem-solving domain. Students with parents

who finished only intermediate, finished only secondary school, whose highest degree is a National Certificate Levels 3–5 or who have a post-school diploma are found to have the same test scores as the average non-immigrant 15-year-old, controlling for differences in parental inputs. On the other hand, students whose parents' highest education is a National Certificate Levels 1–2 have 0.10 to 0.13 higher test scores than the average non-immigrant 15-year-old.[14] Students with at least one parent with a university degree still do better than average on maths and science, by 0.08 standard deviations, but have similar reading and problem-solving scores to those of the average non-immigrant 15-year-old, after controlling for differences in parental inputs.

Overall, once we control for differences in educational inputs, there is a 0.17 standard deviation difference in maths scores, 0.04 difference in reading scores, 0.15 difference in science scores and a 0.01 difference in problem-solving scores between students with at least one university-educated parent and those whose parents finished only intermediate, and the gradient for reading and problem-solving scores is not significantly different from zero. These gradients are considerably smaller than the raw gradients in Table 11. Hence, differences in household characteristics, household educational resources, student-school interactions and school characteristics explain 80 to 99 percent of the raw differential in test scores between students with at least one university-educated parent and those whose parents finished only intermediate.

3.3 Which educational inputs are related to test scores in New Zealand?

We now examine the direct contributions of each set of educational inputs separately, investigating which particular inputs are most strongly linked to students' performance. Returning to regression model (2), the coefficient vector δ measures the relationship between household characteristics and test scores, the coefficient vector λ measures the relationship between household educational resources and test scores, the coefficient vector θ measures the relationship between student-school interactions and test scores and the coefficient vector κ measures the relationship between school characteristics and test scores.

Appendix Table 2 (p. 65) presents the results for each of these coefficient vectors. Starting with the relationship between household characteristics and test scores, we find that living arrangements are an important correlate of student achievement. For example, students living with single parents are also found to score 0.09 to 0.25 standard deviations lower on the PISA tests than students living with both their biological parents or with one biological parent and a step-parent. This difference is even larger for students living with no biological parents, who score 0.28 to 0.46 standard deviations lower than students living with both of their biological parents. It is important to stress that these results cannot be interpreted as showing a causal relationship between family living arrangements and students' achievement, since it may just be that living arrangements are correlated with other inputs, such as having time available to help children with homework.

There is some evidence that students in households with fewer home possessions do worse on PISA, although the magnitude of this relationship differs across test domains. Students whose mothers work part-time or are out of the labour force score 0.07 to 0.14 standard deviations higher than those whose mothers work full-time or who are unemployed. We also find a positive relationship between mother's and father's occupational status and test scores, with a one standard deviation increase in mother's or father's occupational status index associated with a 0.05 to 0.10 standard deviation increase in students' test scores.[15] Students attending school in cities do 0.18 to 0.27 standard deviations worse on PISA than those attending school in towns or rural areas.

We next examine the relationship between household educational resources and test scores. We find no direct relationship between household educational resources and student test scores, but students in households with more cultural possessions do 0.15 to 0.20 standard deviations better than those in households with normal or low levels of cultural possessions. There is also a large positive correlation between the number of books in the student's household and their performance on each test domain. For example, students who live in households with

[14] The relatively high value reflects the fact that differences in the educational inputs that we include in our model are less able to account for the level of test scores for students whose parents have National Certificate Levels 1–2, although they do account for the even stronger test-score premium for students with more highly qualified parents.

[15] These figures are calculated by multiplying the appropriate coefficients in Table 12 by 15.9 for father's occupational status and 14.5 for mother's occupational status, which are the sample standard deviations for each of these variables.

more than 500 books score 0.35 standard deviations higher on maths, 0.45 standard deviations higher on reading, 0.25 standard deviations higher on science and 0.60 standard deviations higher on problem-solving than those with 10 or fewer books in their household. Students with a computer available at home score better on the maths and science domains, but have the same results on reading and problem-solving as students without a computer available at home.

We next examine the relationship between student-school interactions and test scores. Controlling for age, children who are a grade or two ahead of their peers do much better on PISA. In fact, children two grades ahead score around one standard deviation higher on each domain. This is consistent with more able students being moved ahead and with additional years of education increasing student knowledge. Perhaps surprisingly, we also find that students in bigger mathematics classes do better on all four PISA domains, with a 10-student increase in class size associated with 0.32 to 0.43 standard deviation higher test scores.

Unsurprisingly, students' expectations about their future schooling are also strongly correlated with their test scores. For example, students who expect to at most finish high school score 0.14 to 0.36 standard deviations higher; those who expect to, at most, get a post-school diploma score 0.31 to 0.66 standard deviations higher; and those who expect to get a university degree score 0.51 to 0.76 standard deviations higher than students who do not expect to finish high school. Interestingly, this correlation is always strongest for reading scores and weakest for science. Controlling for expectations (and other controls), students' attitude towards school is generally unrelated to how they do on PISA, with the one exception being that students with more positive attitudes towards school do better on the reading domain. We also find that students do worse on maths and reading when they report having bad student-teacher relationships in the school.

Finally, we examine the relationship between school resources and children's outcomes. Few individual school characteristics are related to students' performance on PISA, which may reflect the fact that many of these characteristics are strongly correlated with each other and thus insignificant on an individual basis. We do find that students in larger schools do better on PISA. The relationship for school size is fairly weak, with a 100-student increase in school size related to a 0.01 standard deviation increase in test scores. As with all the results discussed in this section, this correlation does not imply causality, since generally more able students may attend larger schools or classes, or more unmeasured resources may be available in larger classes.

Students who attend schools with a higher proportion of female students do worse on all PISA domains besides reading, but female students attending all-girl schools generally do better compared to those attending mixed-sex schools. Students at schools that stream students of different abilities into different maths classes do worse on average on the maths domain of PISA than the less than one percent of students who attend schools that do not stream students of different abilities. It is important to recognise that it is difficult to interpret these results because they reflect differences at the school level and not the experiences of individual students. For example, it is not possible to determine whether the lower average scores for students in schools with streaming reflect lower scores for the students who have been placed in less difficult maths classes or higher scores for lower or higher-ability students in the schools that do not stream. Students are found to do better on all PISA domains when the principal reported teacher/student relationships as fair rather than either good or bad.

3.4 Which educational inputs are most important for explaining the parental education/test-score gradient in New Zealand?

We now examine the separate contribution that differences in household characteristics, household educational resources, student-school interactions and school characteristics make towards explaining the raw test-score gap between children whose parents have finished only intermediate and those with a university degree, as well as between parents with secondary school education and the other two groups of children.

As discussed in Section 3.5, we use the Blinder-Oaxaca decomposition methodology to examine what the predicted test scores for children whose parents have

not completed one level of education would be if, on average, the educational inputs for this group were the same as for children whose parents had a higher level of education. The regression models estimated here extend those previously estimated by including a separate intercept for each school to control for variation not only in observed school characteristics, but in any (even unobserved) factor that is school-specific.[16]

The results from this decomposition are presented in Table 13. Of the 0.75 to 0.86 standard deviation raw gap in test scores between children with a degree-qualified parent and those whose parents completed only intermediate school, 15 to 24 percent is explained (statistically) by differences in household characteristics, 17 to 21 percent is explained (statistically) by differences in household educational resources, 34 to 43 percent is explained (statistically) by differences in student-school interactions, nine to 13 percent is explained (statistically) by differences in school characteristics and one to 20 percent remains unexplained by the characteristics that are measured in PISA.[17] Almost all of the test-score differences in the reading and problem-solving domains are explained (statistically) by characteristics, while a significant proportion of the gradient remains unexplained in the science and maths domains (99 percent explained for problem-solving, 97 percent for reading, 84 percent for science and 80 percent for maths). Differences in household characteristics and household educational resources, in particular, explain much more of the variation in reading and science scores across parental educational groups compared to the variation in the other test domains.

Very similar results are found if we instead focus on the test-score gap between children whose parents have only a secondary school education and those whose parents finished only intermediate. The only difference here is that school characteristics account for a slightly smaller share of the gap and student-school interactions a slightly larger share. Overall, variation in educational inputs explains a slightly higher proportion of the raw gap here than when the focus is on the gap between the most- and least-educated parents. More pronounced differences are found when we examine the test-score gap between children whose parents have university degrees and those whose parents only have a secondary-school education. Less of the gap is explained by variation in educational inputs, with school characteristics in particular contributing very little (zero to four percent). In contrast, differences in student-school interactions now explain 43 to 53 percent of the raw gap.

[16] The results from these models are generally very similar to those from the reported regressions, including controls for observable school resources, but do not allow an examination of the impact of particular school characteristics on student test scores. This approach produces unbiased estimates even when school effects are correlated with any of the other educational inputs included in the regression model.

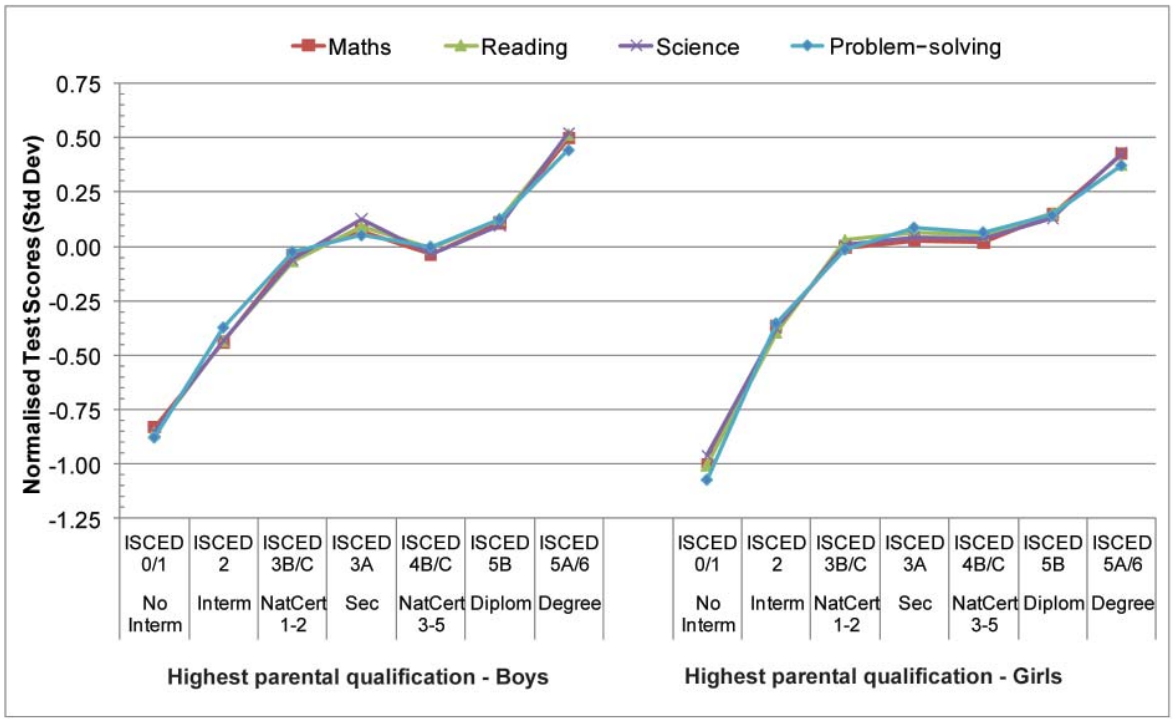
[17] The raw gap in test scores presented in this table accounts for differences in the age and gender of children with differently educated parents and thus is not exactly the same as the numbers presented in Table 7. Because these variables are strictly predetermined, we focus on the raw gap after removing their contribution (which in an infinitely large sample should be zero). This figure also differs from that presented in Table 11 because the relationship between age and gender and test scores now also depends on the relationship between these variables and the other covariates included in the full regression model.

TABLE 13: Decomposing the impact of educational inputs on the relationship between test scores and parental education in New Zealand

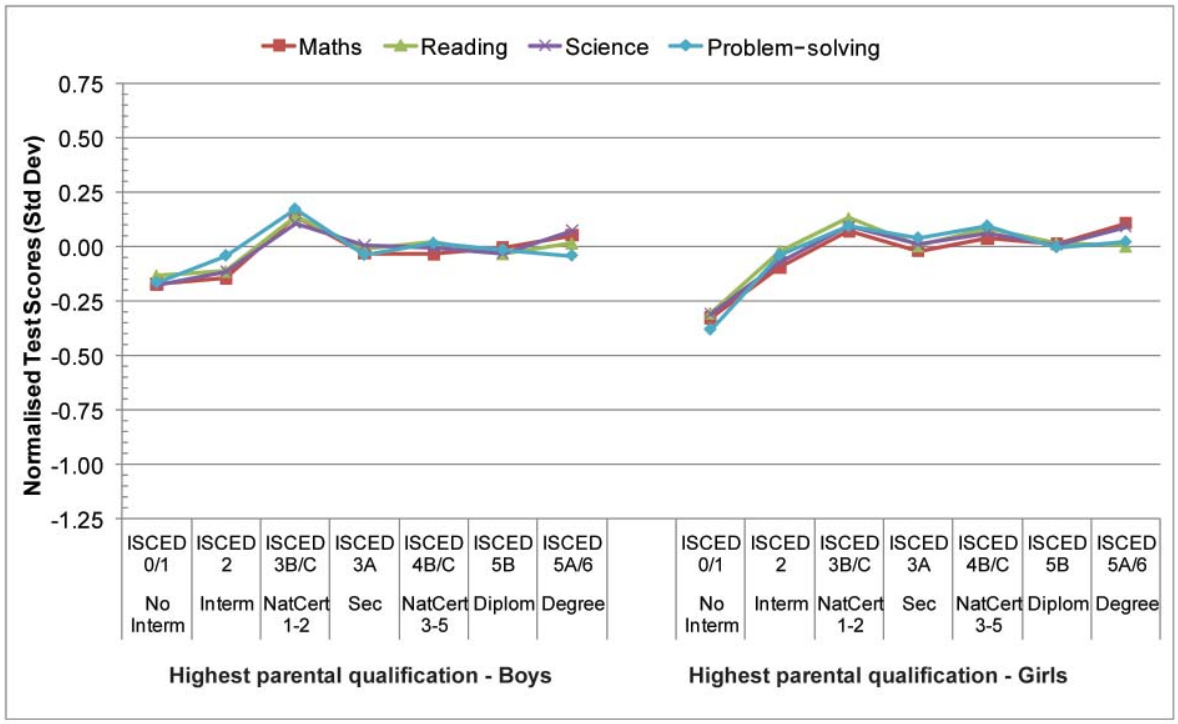
	Maths (1)	Reading (2)	Science (3)	Problem-solving (4)
(1) Difference between parents with ISCED 5A/6 and 2 (Degree v not finished intermediate)	0.83	0.83	0.86	0.75
Household characteristics	0.13	0.20	0.16	0.18
	(15.1%)	(23.6%)	(18.8%)	(24.2%)
Household educational resources	0.14	0.17	0.16	0.16
	(17.0%)	(20.0%)	(18.6%)	(21.1%)
Student-school interactions	0.32	0.34	0.29	0.32
	(39.0%)	(40.8%)	(34.1%)	(43.1%)
School characteristics	0.07	0.11	0.10	0.08
	(8.8%)	(12.8%)	(12.1%)	(10.4%)
Remaining unexplained	0.17	0.02	0.14	0.01
	(20.2%)	(2.8%)	(16.4%)	(1.3%)
(2) Difference between parents with ISCED 3A and 2 (Secondary v not finished intermediate)	0.41	0.46	0.46	0.41
Household characteristics	0.08	0.12	0.11	0.10
	(18.9%)	(26.2%)	(23.1%)	(24.5%)
Household educational resources	0.08	0.09	0.09	0.09
	(19.0%)	(20.8%)	(19.9%)	(21.0%)
Student-school interactions	0.14	0.16	0.12	0.14
	(33.7%)	(35.9%)	(25.9%)	(34.8%)
School characteristics	0.07	0.09	0.09	0.08
	(17.7%)	(20.2%)	(20.4%)	(18.3%)
Remaining unexplained	0.04	-0.01	0.05	0.01
	(10.8%)	-(3.1%)	(10.7%)	(1.4%)
(3) Difference between parents with ISCED 5A/6 and 3A (Degree v secondary)	0.42	0.37	0.40	0.34
Household characteristics	0.05	0.08	0.06	0.08
	(11.3%)	(20.4%)	(14.0%)	(23.9%)
Household educational resources	0.06	0.07	0.07	0.07
	(14.9%)	(19.0%)	(17.0%)	(21.2%)
Student-school interactions	0.18	0.18	0.17	0.18
	(44.3%)	(46.9%)	(43.4%)	(53.0%)
School characteristics	0.00	0.01	0.01	0.00
	(0.0%)	(3.8%)	(2.7%)	(0.7%)
Remaining unexplained	0.12	0.04	0.09	0.00
	(29.5%)	(9.9%)	(22.9%)	(1.2%)

Note: The results presented here are from a Blinder-Oaxaca decomposition using coefficients estimated for a pooled model of all non-immigrant students in New Zealand and presented in Appendix Table 2. The numbers in parentheses are the share of the parental education/test-score gradient explained (statistically) by a particular set of characteristics. School characteristics are measured using fixed effects which control for observed and unobserved differences in schools. Weights are used to ensure the representativeness of the sample.

FIGURE 3: The relationship between test scores and parental education in New Zealand: by gender, baseline and full model



(a) adjusted for the student's age



(b) fully adjusted

3.5 Gender differences in the parental education/test-score gradient in New Zealand

We now extend our analysis to examine whether the relationship between parental education and children's test scores differs for boys and girls, and whether it matters whether we are looking at the mother's or father's education. We first estimate equations (1) and (2) above separately for boys and girls. This allows us to examine whether the intergenerational transmission of human capital or the impact of other factors on test scores, such as household educational resources or school characteristics, differ for boys and girls. Figure 3 summarises graphically the parental education gradient for boys and girls, controlling for the student's age and their parents' education (top graph) and with the complete set of control variables included (bottom graph). These results are also presented in Table 14.

The 'raw' test-score gradient is fairly similar for girls and boys, although there are a few differences. First, boys whose parents have completed only intermediate school do worse relative to the average non-immigrant New Zealander than girls whose parents are also in this educational group. Second, boys with a parent with university education do better relative to the average non-immigrant New Zealander than girls whose parents are also in the highest educational group. Thus, comparing children of degree-qualified parents with children whose parents completed only intermediate school, the test score gap is smaller for girls than for boys. Another interesting finding is that, for girls, test scores are similar for students with parents whose highest degree is a National Certificate Levels 1-2 or 3-5 and whose parents finished secondary school, while boys with a parent who finished secondary school do better, on average, than those with parents whose highest degree is a National Certificate Levels 1-2 or 3-5.

Overall, after controlling for differences in educational inputs, there are no statistical differences in the test scores of either boys or girls with at least one university-educated parent and those whose parents finished only intermediate school, except for maths scores for girls, where there is a significant 0.20 standard deviation difference. However, in all cases, the results for boys are overall statistically indistinguishable from those for girls and are typically quite similar in magnitude, suggesting that the unexplained test-score gap does not differ by gender.

TABLE 14: The relationship between test scores and parental education in New Zealand stratified by gender: baseline and full model

	Maths		Reading		Science		Problem-solving	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
A) Controlling for student characteristics								
Highest parent did not finish intermediate	-0.830***	-1.002***	-0.853***	-1.003***	-0.851***	-0.962***	-0.878***	-1.073***
ISCED 0/1	(0.141)	(0.104)	(0.151)	(0.096)	(0.135)	(0.111)	(0.138)	(0.098)
Highest parent finished intermediate	-0.439***	-0.363***	-0.432***	-0.393***	-0.432***	-0.375***	-0.372***	-0.353***
ISCED 2	(0.133)	(0.075)	(0.131)	(0.073)	(0.124)	(0.077)	(0.131)	(0.073)
Highest parent has National Cert Levels 1-2	-0.037	-0.005	-0.066	0.029	-0.059	-0.008	-0.023	-0.012
ISCED 3B/C	(0.066)	(0.058)	(0.064)	(0.060)	(0.o70)	(0.059)	(0.065)	(0.058)
Highest parent finished secondary school	0.073	0.027	0.091	0.063	0.126	0.044	0.053	0.088
ISCED 3A	(0.098)	(0.075)	(0.091)	(0.080)	(0.082)	(0.072)	(0.092)	(0.074)
Highest parent has National Cert Levels 3-5	-0.035	0.020	-0.007	0.055	-0.034	0.039	0.001	0.067
ISCED 4B/C	(0.053)	(0.061)	(0.053)	(0.058)	(0.054)	(0.062)	(0.057)	(0.060)
Highest parent has post-school diploma	0.109***	0.148**	0.124**	0.152**	0.0963*	0.131**	0.128**	0.145**
ISCED 5B	(0.055)	(0.063)	(0.057)	(0.059)	(0.057)	(0.062)	(0.057)	(0.062)
Highest parent has university degree	0.499***	0.426***	0.514***	0.376***	0.523***	0.431***	0.445***	0.375***
ISCED 5A/6	(0.062)	(0.066)	(0.059)	(0.063)	(0.062)	(0.062)	(0.063)	(0.070)
Diff between parents with ISCED 5A/6 and 2	0.938***	0.789***	0.946***	0.769***	0.955***	0.807***	0.818***	0.728**
	(0.152)	(0.112)	(0.151)	(0.108)	(0.147)	(0.109)	(0.152)	(0.114)
R-squared	0.103	0.155	0.117	0.125	0.111	0.117	0.099	0.120

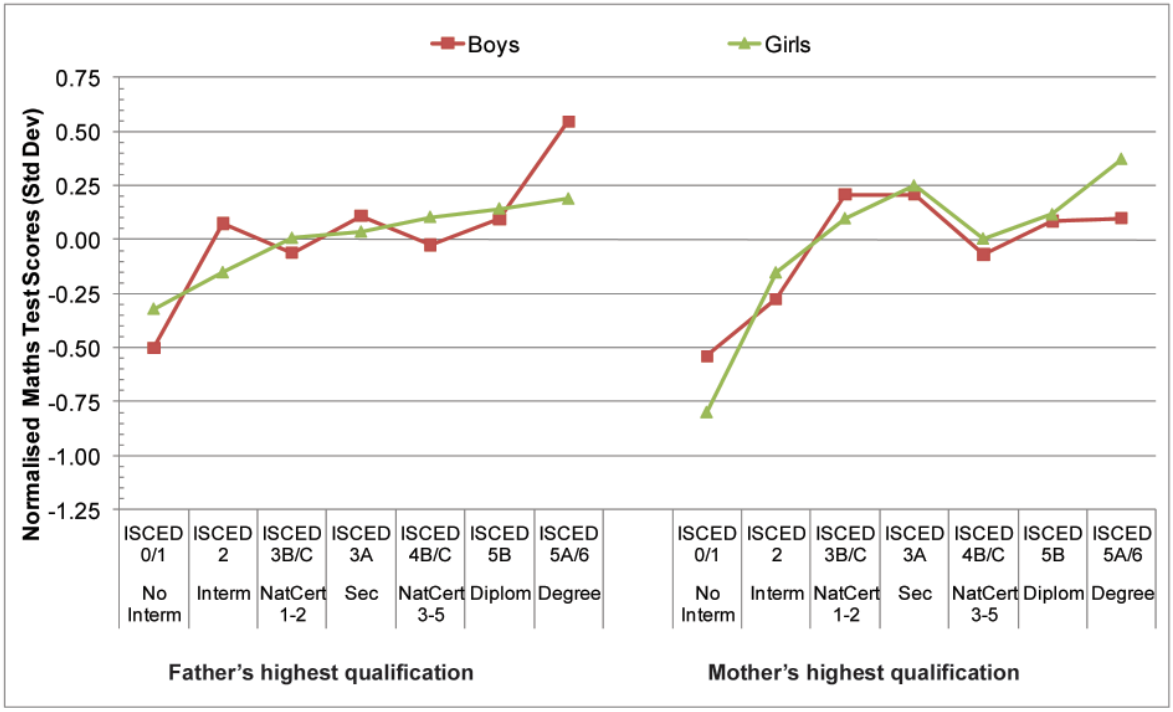
B) Controlling for all measured characteristics								
Highest parent did not finish intermediate	-0.172	-0.327***	-0.132	-0.305***	-0.175	-0.309***	-0.164	-0.380***
ISCED 0/1	(0.156)	(0.091)	(0.130)	(0.095)	(0.140)	(0.114)	(0.161)	(0.094)
Highest parent finished intermediate	-0.143	-0.094	-0.112	-0.019	-0.113	-0.070	-0.041	-0.039
ISCED 2	(0.108)	(0.089)	(0.114)	(0.075)	(0.110)	(0.084)	(0.115)	(0.085)
Highest parent has National Cert Levels 1-2	0.140***	0.072	-0.138***	0.132***	0.109*	0.0931*	0.173***	0.0938**
ISCED 3B/C	(0.053)	(0.049)	(0.053)	(0.049)	(0.059)	(0.051)	(0.052)	(0.046)
Highest parent finished secondary school	-0.031	-0.019	-0.012	0.005	0.007	0.012	-0.038	0.040
ISCED 3A	(0.075)	(0.058)	(0.058)	(0.060)	(0.062)	(0.061)	(0.064)	(0.059)
Highest parent has National Cert Levels 3-5	-0.035	0.040	0.021	0.0836**	-0.007	0.064	0.015	0.0947**
ISCED 4B/C	(0.045)	(0.046)	(0.047)	(0.042)	(0.047)	(0.051)	(0.046)	(0.043)
Highest parent has post-school diploma	-0.005	0.015	-0.031	0.016	-0.030	0.009	-0.014	-0.003
ISCED 5B	(0.042)	(0.046)	(0.040)	(0.043)	(0.044)	(0.048)	(0.042)	(0.042)
Highest parent has university degree	0.053	0.109**	0.017	0.004	0.076	0.0917*	-0.041	0.021
ISCED 5A/6	(0.053)	(0.048)	(0.047)	(0.049)	(0.051)	(0.049)	(0.051)	(0.048)
Diff between parents with ISCED 5A/6 and 2	0.196	0.203*	0.129	0.023	0.189	0.161	0.000	0.060
	(0.127)	(0.109)	(0.133)	(0.093)	(0.130)	(0.101)	(0.135)	(0.105)
R-squared	0.516	0.458	0.554	0.513	0.494	0.440	0.527	0.400
Observations	1358	1336	1358	1336	1358	1336	1358	1336

Note: Parental education variables are defined as relative to the parental education for the mean student. Student weights are used to ensure the representativeness of the sample of students. Robust standard errors, which account for the fact that students in clusters of schools are surveyed, are in parentheses. All additional covariates included in Appendix Table 2 as well as covariates which measure whether particular variables are missing are included in the regressions in panel B. *** significant p<0.01, ** p<0.05, * p<0.1.

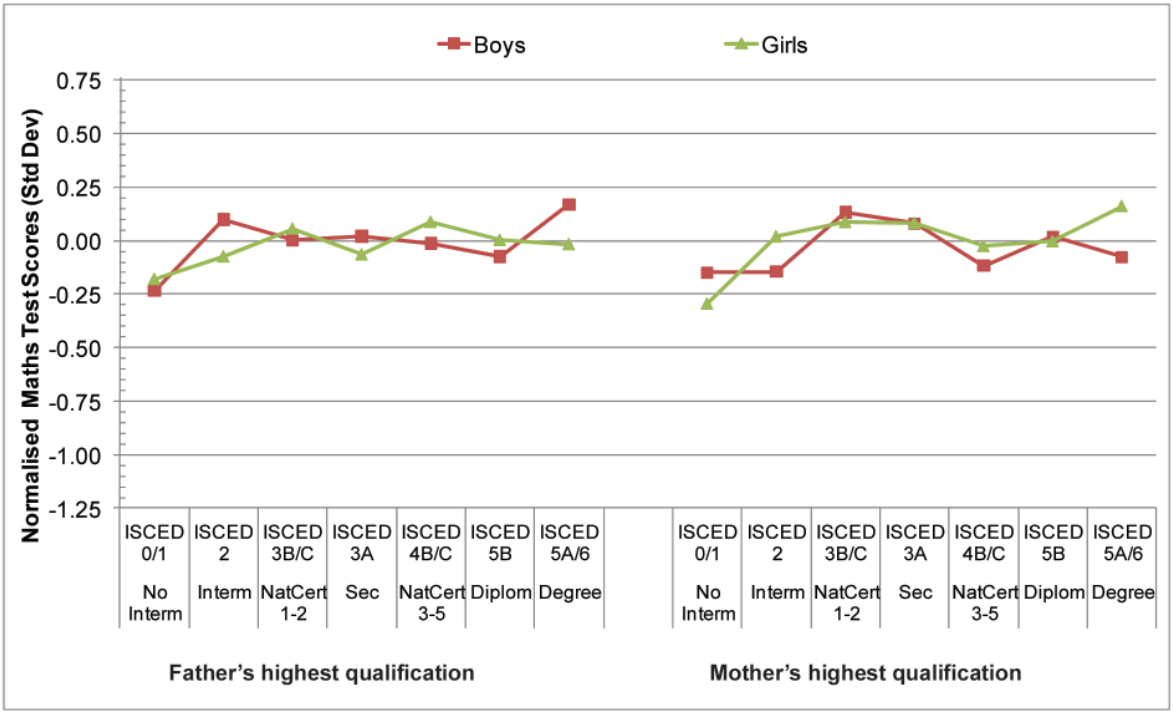
We next extend this model to separately include the mother's and father's educational status instead of the combined parental education variable. This allows us to evaluate whether a particular parent's education matters more for boys or girls, and the relative impact of one parent's education controlling for the others. Given the similarity of the previous results across the test domains, here we focus only on math scores. Figure 4 summarises the mother's and father's education gradient for boys and girls, both when controlling for the student's age and their parent's education (top graph) and when the complete set of control variables are included (bottom graph). These results are also presented in Table 15.

These results show that the education of both parents is an important input into the performance of both boys and girls on the PISA tests; controlling for father's education, mother's education still has a large impact on test scores for both boys and girls (and similarly for father's education, controlling for mother's education). In other words, students with two highly educated parents do better on the PISA tests than students with only one highly educated parent. However, there is also a noticeably stronger relationship between fathers' education and their sons' test scores and mothers' education and their daughters' test scores than the relationship between the education of a parent of one gender and a child of the other gender.

FIGURE 4: The relationship between maths-test scores and mother's and father's education in New Zealand by gender, baseline and full model



(a) adjusted for the student's age



(b) fully adjusted

Turning to the bottom graph, controlling for household characteristics, household educational resources, student-school interactions and school characteristics lessens the gradient with respect to both mother's and father's education for both boys and girls, and in no case is the parental education/test-score gradient significantly different from zero. However, maths scores are significantly higher than for the average child for boys with university-educated fathers and girls with university-educated mothers, while there is no relationship between boys' test scores and having a highly educated mother or girls' test scores and having a highly educated father. Overall, the findings are quite similar to those where we do not stratify by gender; the strong relationship between the educational status of both mothers and fathers and the performance of their children on PISA is mostly explained (statistically) by the fact that more-qualified parents are better able to provide financial and educational resources for their children, which leads to better performance by students.

TABLE 15: The relationship between maths test scores and mother's and father's education in New Zealand stratified by gender; baseline and full model

Child's gender	**Boys**		**Girls**	
Which parent's education	**Father**	**Mother**	**Father**	**Mother**
A) Controlling for student characteristics				
Mother/father did not finish intermediate	-0.501***	-0.540***	-0.321***	-0.800***
ISCED 0/1	(0.095)	(0.127)	(0.095)	(0.103)
Mother/father finished intermediate	0.075	-0.274***	-0.152**	-0.153**
ISCED 2	(0.082)	(0.091)	(0.066)	(0.070)
Mother/father has National Cert Levels 1-2	-0.062	0.209***	0.007	0.0978*
ISCED 3B/C	(0.070)	(0.051)	(0.061)	(0.050)
Mother/father finished secondary school	0.109	0.208**	0.036	0.249***
ISCED 3A	(0.111)	(0.094)	(0.095)	(0.067)
Mother/father has National Cert Levels 3-5	-0.025	-0.068	0.104**	0.004
ISCED 4B/C	(0.055)	(0.071)	(0.047)	(0.075)
Mother/father has post-school diploma	0.094	0.086	0.143	0.116*
ISCED 5B	(0.094)	(0.053)	(0.101)	(0.067)
Mother/father has university degree	0.546***	0.098	0.189**	0.373***
ISCED 5A/6	(0.076)	(0.094)	(0.084)	(0.103)
Diff between M/F with ISCED 5A/6 and 2	0.471***	0.372***	0.342***	0.526***
	(0.115)	(0.140)	(0.112)	(0.135)
R-squared	0.143		0.148	

B) Controlling for all measured characteristics				
Mother/Father did not finish intermediate	-0.234***	-0.150	-0.180***	-0.295***
ISCED 0/1	(0.089)	(0.124)	(0.078)	(0.085)
Mother/Father fnished intermediate	0.098	-0.146*	-0.075	0.018
ISCED 2	(0.062)	(0.080)	(0.065)	(0.063)
Mother/Father has National Cert Levels 1-2	0.001	0.132***	0.055	0.0859*
ISCED 3B/C	(0.055)	(0.041)	(0.049)	(0.048)
Mother/Father finished secondary school	0.020	0.080	-0.065	0.082
ISCED 3A	(0.079)	(0.073)	(0.065)	(0.057)
Mother/Father has National Cert Levels 3-5	-0.013	-0.118**	0.0864**	-0.026
ISCED 4B/C	(0.043)	(0.059)	(0.041)	(0.059)
Mother/Father has post-school diploma	-0.075	0.019	0.002	-0.005
ISCED 5B	(0.069)	(0.040)	(0.078)	(0.053)
Mother/Father has university degree	0.169**	-0.077	-0.017	0.160*
ISCED 5A/6	(0.067)	(0.075)	(0.065)	(0.084)
Diff between M/F with ISCED 5A/6 and 2	0.072	0.069	0.057	0.142
	(0.100)	(0.120)	(0.102)	(0.118)
R-squared	0.525		0467	
Observations	1358		1336	

Note: Mother's and father's education variables are defined as relative to the parental education for the mean student. Student weights are used to ensure the representativeness of the sample of students. Robust standard errors, which account for the fact that students in clusters of schools are surveyed, are in parentheses. All additional covariates included in Appendix Table 2 as well as covariates which measure whether particular variables are missing are included in the regressions in panel B. *** significant p<0.01, ** p<0.05, * p<0.1.

3.6 Differences in the parental education/test-score gradient in New Zealand by family type

We now examine whether the relationship between parental education and children's test scores differs depending on whether the child lives with both biological parents or in a different type of family relationship. The strength of intergenerational human capital transmission may differ across family types because either the quantity of educational inputs or the nature of child-parent interactions varies in different types of households. We estimate equation (1) and (2) separately for students living with biological parents (around 65 percent of students), with one biological parent and one step-parent (around 10 percent of students) and those living with a single biological parent (just under 20 percent of students). Parental qualification measures are collected for biological parents, and thus we might expect the relationship between parental education and test scores to be weaker when one of the parents is absent.

FIGURE 5: The relationship between maths-test scores and parental education in New Zealand by family type, baseline and full model

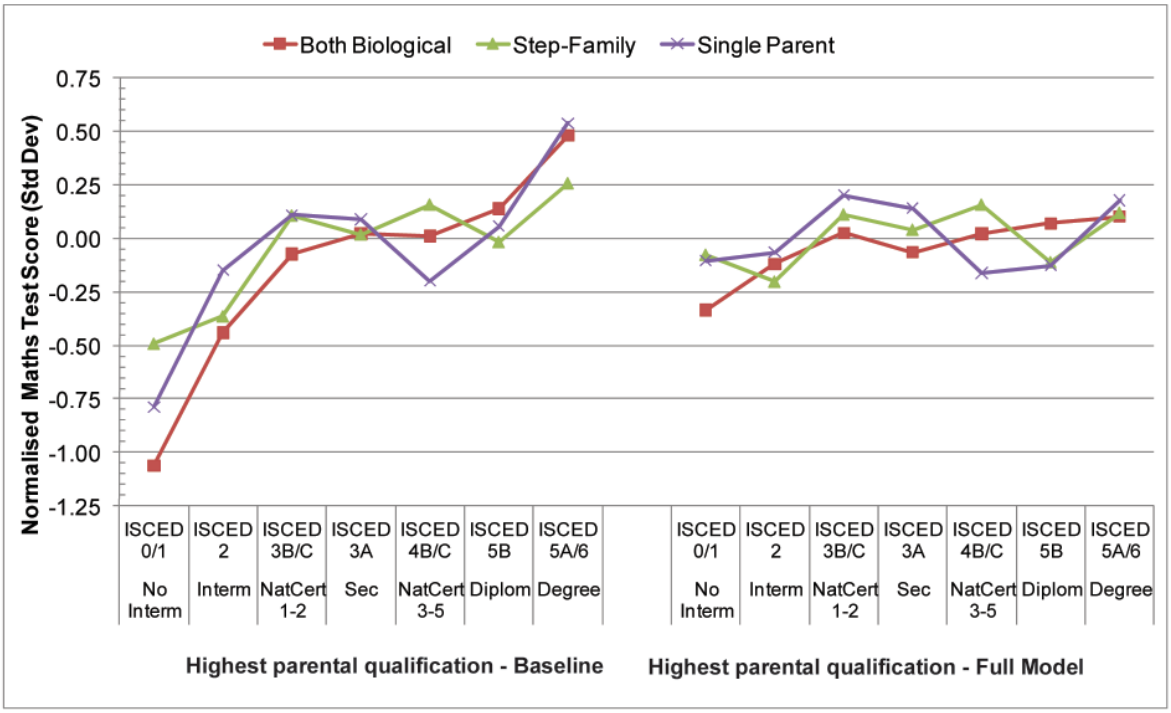


TABLE 16: The relationship between test scores and parental education in New Zealand stratified by gender: baseline and full model

Child's family type	Both biological	Step-family	Single parent
A) Controlling for student characteristics			
Highest parent did not finish intermediate	-1.061***	-0.493**	-0.788***
ISCED 0/1	(0.112)	(0.222)	(0.146)
Highest parent finished intermediate	-0.440***	-0.365	-0.148
ISCED 2	(0.092)	(0.144)	(0.138)
Highest parent has National Cert Levels 1-2	-0.073	0.106	0.110
ISCED 3B/C	(0.049)	(0.100)	(0.119)
Highest parent finished secondary school	0.023	0.018	0.090
ISCED 3A	(0.086)	(0.164)	(0.135)
Highest parent has National Cert Levels 3-5	0.012	0.157*	-0.199**
ISCED 4B/C	(0.049)	(0.081)	(0.085)
Highest parent has post-school diploma	0.139***	-0.018	0.058
ISCED 5B	(0.044)	(0.106)	(0.105)
Highest parent has university degree	0.482***	0.257*	0.539***
ISCED 5A/6	(0.053)	(0.143)	(0.115)
Diff between parents with ISCED 5A/6 and 2	0.923***	0.622***	0.688***
	(0.114)	(0.219)	(0.197)
R-squared	0.115	0.085	0.137

B) Controlling for all measured characteristics			
Highest parent did not finish intermediate	-0.335***	-0.078	-0.104
ISCED 0/1	(0.109)	(0.300)	(0.189)
Highest parent finished intermediate	-0.119	-0.203	-0.065
ISCED 2	(0.094)	(0.189)	(0.152)
Highest parent has National Cert Levels 1-2	0.026	0.111	0.203**
ISCED 3B/C	(0.040)	(0.100)	(0.097)
Highest parent finished secondary school	-0.065	0.040	0.142
ISCED 3A	(0.059)	(0.168)	(0.122)
Highest parent has National Cert Levels 3-5	0.023	0.157*	-0.162*
ISCED 4B/C	(0.041)	(0.079)	(0.082)
Highest parent has post-school diploma	0.0698**	-0.112	-0.126
ISCED 5B	(0.034)	(0.119)	(0.092)
Highest parent has university degree	0.103**	0.119	0.178*
ISCED 5A/6	(0.045)	(0.130)	(0.097)
Diff between parents with ISCED 5A/6 and 2	0.222*	0.322	0.243
	(0.114)	(0.232)	(0.199)
R-squared	0.467	0.520	0.548
Observations	1739	312	517

Note: Highest parental education variables are defined as relative to the parental education for the mean student. Student weights are used to ensure the representativeness of the sample of students. Robust standard errors, which account for the fact that students in clusters of schools are surveyed, are in parentheses. All additional covariates included in Appendix Table 2 as well as covariates which measure whether particular variables are missing are included in the regressions in panel B. *** significant p<0.01, ** p<0.05, * p<0.1.

The left panel of Figure 5 shows the baseline gradient for the maths-test score, controlling only for students' age and sex. These results are also presented in Table 16. The gradient is similar to the overall pattern shown in Figure 1, especially for the majority group of students who live with both biological parents. For both students living with a step-parent and those living in single-parent households, there is a much weaker relationship between parental education and maths-test scores.

The right panel shows the relationship between parental education and maths scores, controlling for educational inputs. As in all previous cases, these inputs explain most of the relationship between parental education and children's test scores. However, for students living with both biological parents, there remains a moderate gradient in test scores between students whose parents have not completed intermediate and those with a university-educated parent. For the other family types, the entire relationship between parental education and test scores is explained (statistically) by educational inputs. However, the unexplained test-score gradient is similar in magnitude and not significantly different for children in all three types of living arrangements. Thus, it appears that the relationship between parental education and children's test scores, controlling for educational inputs, does not vary by family living arrangements.

3.7 How does the New Zealand parental education/test-score gradient compare to the gradient in other OECD countries?

We now turn to examining how the test-score/parental education gradient varies across OECD countries. Again, we focus on the gap between non-immigrant children with university-educated parents and those with parents who at most have finished intermediate. Here, we focus only on the maths domain. The first column of Table 17 presents the average difference in maths scores between children in these two educational groups in each OECD country, controlling only for the age and gender of the child. The countries in this table are listed in the order of the size of their raw parental education/test-score gradient.

TABLE 17: Decomposing the impact of educational inputs on the difference in maths-test scores between students with a parent with a university degree and students with a parent who completed intermediate across OECD countries

	Gap adusted for diff in student characteristics	% Explained by household characteristics	% Explained by household educational resources	% Explained by student-school interactions	% Explained by school characteristics	% Remaining unexplained	Unexplained difference
Luxembourg	0.07	99.2	39.7	127.6	69.9	-236.4	-0.18
Mexico	0.17	13.5	37.4	15.6	82.5	-49.1	-0.18
Spain	0.27	7.4	21.2%	72.4	34.5	-35.5	-0.09
Netherlands	0.34	23.4	9.8%	42.6	66.9	-42.6	-0.15
Portugal	0.44	28.7	22.6	33.9	10.8	4.1	0.02
Norway	0.48	44.3	30.5	61.6	5.4	-41.8	-0.20
Finland	0.50	41.7	23.7	35.2	-6.0	5.3	0.03
Iceland	0.52	8.3	12.0	80.1	-17.7	17.4	0.09
Sweden	0.54	28.7	29.3	51.2	4.2	-13.4	-0.07
Australia	0.56	14.9	20.4	41.4	24.7	-1.3	-0.01
Belgium	0.58	22.9	11.7	53.4	46.3	-34.3	-0.20
France	0.60	14.5	14.8	67.5	22.1	-18.8	-0.11
Ireland	0.61	27.1	24.6	37.8	16.6	-6.2	-0.04
Canada	0.67	15.8	16.6	53.5	-0.3	14.4	0.10
Korea	0.71	-1.8	27.3	15.2	54.8	4.6	0.03
Italy	0.71	7.9	15.6	16.0	68.5	-8.0	-0.06
Greece	0.72	19.0	16.3	30.2	29.5	5.0	0.04
Denmark	0.76	29.0	16.7	42.9	11.4	0.0	0.00
New Zealand	0.78	15.2	17.0	39.0	8.6	20.3	0.16
Switzerland	0.81	9.2	9.5	63.0	13.2	5.2	0.04
Japan	0.83	-2.0	13.0	18.6	77.8	-7.4	-0.06
United States	0.87	21.4	24.8	41.5	8.3	4.0	0.03
Austria	0.88	3.6	18.9	17.9	70.3	-10.6	-0.09
Poland	1.14	16.2	18.1	59.6	7.7	-1.5	-0.02
Germany	1.21	0.3	11.6	37.4	44.4	6.3	0.08
Czech Republic	1.26	1.4	15.7	41.0	39.0	2.9	0.04
Turkey	1.31	6.9	10.8	7.6	66.0	8.7	0.11
Hungary	1.39	0.9	18.7	22.4	55.9	2.1	0.03
Slovakia	1.52	4.5	22.7	60.8	2.0	10.0	0.15

Note: The results presented here are from a Blinder-Oaxaca decomposition using coefficients estimated for a pooled model of all non-immigrants in each OECD country. School characteristics are measured using fixed effects. Weights are used to ensure the representativeness of the sample. The darker shaded cells in columns 2–5 indicate which column accounts for the largest share of the gap. Darker cells in column 6 highlight countries for which more than five percent of the gap remains unexplained.

As was the case in Table 8 when we examined the raw test-score gap between children with at least one university-educated parent and those with a parent who has at most finished only intermediate, the correlation between parental education and maths scores, once we have controlled for students' gender and age, is stronger in New Zealand than for most OECD countries. While children in New Zealand with a university-educated parent score, on average, 0.78 standard deviations higher on the PISA maths domain than children whose parents at most finished intermediate, in comparison, the gap for students in Luxembourg is only 0.07 standard deviations (this is the smallest gap in the OECD) and in Australia, it is 0.56 standard deviations. At the other end of the scale, the parental education/test-score gradient is largest in Slovakia, where children with at least one university-educated parent score 1.52 standard deviations higher on the maths domain than those whose parents have only finished intermediate school.

In general, the parental education/test-score gradient is weaker in Mexico (0.17 Std Dev), Spain and the Netherlands (0.27 to 0.34 Std Dev), Portugal and the Scandinavian countries (Norway, Finland, Sweden, Iceland; 0.44 to 0.54 Std Dev), Australia, Belgium, France and Ireland (0.56 to 0.67 Std Dev), and Korea, Italy, Greece and Denmark (0.71 to 0.76 Std Dev). The gradient is stronger in Switzerland, Japan, the US and Austria (0.81 to 0.88 Std Dev), Poland and Germany (1.14 to 1.21 Std Dev), the Czech Republic and Turkey (1.26 to 1.31 Std Dev), Hungary (1.39 Std Dev) and Slovakia. Notably, the majority of countries with raw test-score gradients stronger than New Zealand either use very strong selection mechanisms in their educational systems (Germany, Switzerland, Austria and Japan) or are former Communist countries (Poland, Hungary, the Czech Republic and Slovakia).

As discussed in Section 2.5, we use the Blinder-Oaxaca decomposition methodology to examine the separate contribution that differences in household characteristics, household educational resources, student-school interactions and school characteristics make towards explaining this test-score gap in each OECD country. The last two columns of Table 17 present the difference in maths-test scores between children with at least one university-educated parent and those with a parent who has at most finished only intermediate in each OECD country that remains unexplained after accounting for average differences in the educational inputs provided by these parents.

In 15 of the 29 OECD countries that we examine in PISA, the entire test-score gap between children with at least one university-educated parent and those with a parent who has at most finished only intermediate is accounted for by differences in educational inputs.[18] In a further five countries, less than five percent of the test-score gap remains unexplained, and in an additional five countries less than 10 percent remains unexplained. Thus, there are only four countries where a sizeable proportion of the raw test-score gap between children of at least one university-educated parent and children of parents who finished only intermediate remains unexplained: Slovakia, Canada, Iceland and New Zealand. In fact, the remaining unexplained component of the test-score gap is largest in both a relative (20.3 percent) and an absolute (0.16 Std Dev) sense in New Zealand compared with all OECD countries.

The remaining columns of Table 17 allow us to evaluate the relative importance of the four different pathways – differences in household characteristics, in household educational resources, in student-school interactions and in school characteristics – in explaining the parental education/test-score gradient in each country. Household characteristics are generally the least important pathway, explaining zero to 29 percent of the difference in average test scores between children of parents with a degree qualification and those of parents who completed at most intermediate school, except in Finland and Norway, where this component explains 42 percent and 44 percent, respectively, of the test-score gradient.[19] Only in Finland is this the most important component explaining the parental education/test-score gradient. In 19 of the 29 countries, differences in student-school interactions are the most important component explaining the gradient, while in the remaining nine countries (Mexico, Netherlands, Korea, Italy, Japan, Austria, Germany, Turkey and Hungary), school characteristics are the most important component. However, even in these countries, student-school interactions typically explain a large proportion of the parental education/test-score gradient.

Overall, differences in student-school interactions account for eight to 72 percent of the difference in

[18] A negative unexplained percentage means that if the children of the least-educated parents are assumed to have the average educational inputs provided by the most-educated parents it is estimated that they will have, on average, higher maths scores than those achieved by the children of the most-educated parents.

[19] We exclude Luxembourg when discussing the results in this section, since it has only a very small raw parental education/test-score gradient, which typically leads to extreme decomposition results, as the amount of the gap attributed to each component is then divided by this small overall number.

average test scores between children of parents with a degree qualification and those of parents who at most completed intermediate school. The contribution of household educational resources is consistently positive, and ranges between 10 and 40 percent. The importance of school resources in explaining the test-score gap has a greater range, with this component having no explanatory power in Finland, Iceland or Canada, explaining less than 20 percent of the test-score gap in 10 countries (including New Zealand), 20 to 50 percent of the gap in seven countries and over half the gap in the remaining nine countries. As for the importance of different education inputs in explaining the parental education/test-score gradient, the results for New Zealand are similar to those for the majority of the other OECD countries surveyed in PISA.

3.8 How does the parental education/ test-score gradient vary across New Zealand migrant groups?

In this final section, we examine how the parental education/test-score gradient varies across New Zealand migrant groups. As discussed previously, we look at outcomes for three migrant groups – first-generation New Zealanders, second-generation New Zealanders and Australian participants in PISA with at least one New Zealand-born parent – and compare them to the same results estimated so far for non-immigrant New Zealanders. Again, we focus on the gap between children with university-educated parents and those with parents who finished only intermediate in each migrant group.

The first row of each panel in Table 18 presents the average difference in test scores between children in these two parental educational groups for each migrant group, controlling only for the age and gender of the child. The gap is 0.16 to 0.52 standard deviations larger for first-generation New Zealanders than for non-immigrants, with the largest difference for the reading domain and the smallest for the maths domain. The parental education/test-score gradient is also larger for second-generation New Zealanders than for non-immigrants, with the largest difference (0.47 Std Dev) observed in the science domain.

In contrast, there is a relatively small gradient for children of New Zealanders living in Australia. For the reading domain, the children of degree-qualified New Zealanders living in Australia have test scores that are 0.73 standard deviations higher than those of children of New Zealanders living in Australia who have at most finished intermediate school. This is about half-way between the gap observed for non-immigrant New Zealanders in New Zealand (0.84 Std Dev) and that of non-immigrant Australians in Australia (0.58 Std Dev). These differences reflect either a lower degree of intergenerational persistence in Australia or the fact that the intergenerational transmission of human capital is less pronounced for the sort of New Zealanders who move to Australia. Unfortunately, it is not possible to empirically distinguish between these two hypotheses, since immigrant selection is strongly related to unobservable characteristics (McKenzie, Gibson, & Stillman, 2009).

As in the previous section, we use the Blinder-Oaxaca decomposition methodology to examine the separate contribution that differences in household characteristics, household educational resources, student-school interactions and school characteristics make towards explaining this test-score gap for each migrant group. Because our focus here is on migrant groups, we also examine the role that two additional immigrant-specific factors play in explaining the parental education/children's test-score gradient. First, for both first- and second-generation immigrants, we examine the importance of whether English is the main language spoken at home among first- and second-generation New Zealanders. In the PISA sample, 51 percent of first-generation migrant students and nine percent of second-generation migrant students report that a language other than English is mainly spoken at home. It is quite likely that this is correlated with both the education of the students' parents and their ability to do well on the PISA exam, and thus may be an important pathway for explaining the parental education/ test-score gradient among immigrants. Second, for first-generation immigrants, we also control for their age when they arrived in New Zealand. The mean for this variable in the PISA sample is 8.5 years old. As with choices about spoken language, the age that first-generation immigrants arrive in New Zealand is quite likely to be correlated with both the education of the students' parents and their ability to do well on PISA.

TABLE 18: Decomposing the impact of educational inputs on the difference in maths-test scores between students with a parent with a university degree and students with a parent who completed intermediate across New Zealand migrant groups

	Maths	Reading	Science	Problem-solving
(1) Non-immigrants	0.84	0.87	0.85	0.77
Explained by household characteristics	15.1%	23.6%	18.8%	24.2%
Explained by household educational resources	17.0%	20.0%	18.6%	21.1%
Explained by student-school interactions	39.0%	40.8%	34.1%	43.1%
Explained by School characteristics	8.8%	12.8%	12.1%	10.4%
Remaining unexplained	20.2%	2.8%	16.4%	1.3%
Remaining gap Between ISCED 5A/6 and 2	0.17	0.02	0.14	0.01
(2) First-generation New Zealanders	1.00	1.39	1.15	0.99
Explained by household characteristics	22.3%	11.4%	12.0%	21.6%
Explained by English at home/arrival age	-7.3%	14.8%	11.5%	-1.1%
Explained by household educational resources	13.0%	6.3%	8.1%	11.0%
Explained by Student-School interactions	75.3%	64.0%	74.2%	83.8%
Explained by School characteristics	11.8%	7.4%	-1.3%	15.7%
Remaining unexplained	-15.1%	-3.8%	-4.4%	-30.9%
Remaining gap between ISCED 5A/6 and 2	-0.15	-0.05	-0.05	-0.31
(3) Second-generation New Zealanders	1.14	1.14	1.32	1.08
Explained by household characteristics	8.1%	10.9%	7.4%	10.3%
Explained by English spoken at home	0.5%	2.3%	2.3%	1.0%
Explained by household educational resources	14.3%	21.6%	18.8%	18.3%
Explained by Student-School interactions	28.4%	27.9%	20.3%	27.3%
Explained by school characteristics	24.5%	21.3%	24.3%	26.7%
Remaining unexplained	24.2%	16.0%	26.8%	16.5%
Remaining gap between ISCED 5A/6 and 2	0.28	0.18	0.35	0.18
(4) New Zealanders in Australia	0.73	0.68	0.81	0.69
Explained by household characteristics	10.1%	3.7%	-1.3%	-5.8%
Explained by household educational Resources	-0.4%	4.9%	11.7%	8.1%
Explained by Student-School interactions	47.7%	60.5%	49.1%	59.0%
Explained by School characteristics	56.1%	79.7%	66.7%	57.7%
Remaining unexplained	-13.4%	-48.8%	-26.2%	-19.1%
Remaining gap between ISCED 5A/6 and 2	-0.10	-0.33	-0.21	-0.13

Note: The results presented here are from a Blinder-Oaxaca decomposition using coefficients estimated for a pooled model of each New Zealand migrant group. The numbers are the share of the particular parental education/test-score gradient explained (statistically) by a particular set of characteristics. School characteristics are measured using fixed effects which control for observed and unobserved differences in schools. Weights are used to ensure the representativeness of the sample.

The decomposition results reveal some marked differences across the migrant groups in the correlation of test-score gaps with different sets of educational inputs. The last two rows of each panel in Table 18 present the difference in test scores between children with a degree-qualified parent and children whose parents at most finished intermediate school that remains unexplained after accounting for average differences in the educational inputs. For first-generation New Zealanders and, in particular, for New Zealanders in Australia, observed differences in educational inputs more than explain the actual gap. In other words, on the basis of the differences in educational inputs, we would expect a larger parental education/test-score gradient than that which is observed – the children of more-educated parents have more advantageous educational inputs but these differences are not reflected in their test scores to the extent that we would expect. In contrast, differences in educational inputs can account for only 65 to 82 percent of the parental education/test-score gradient among second-generation New Zealand children. Here, the difference in test scores between children with a degree-qualified parent and children whose parents at most finished intermediate school is larger than can be explained by differences in educational inputs.

The remaining rows of Table 18 allow us to evaluate the relative importance of the different pathways – differences in household characteristics; in household educational resources; in student-school interactions; in school characteristics; and for immigrants to New Zealand, in English language and age at arrival for first-generation immigrants – in explaining the parental education/test-score gradient for each migrant group. Compared to non-immigrant children, differences in school characteristics play a larger role in accounting for the gradient for second-generation New Zealanders (21 to 27 percent of the gradient), and to an even greater degree for New Zealanders in Australia, for whom differences in school characteristics account for 56 to 80 percent of the gradient. For first-generation New Zealanders, differences in student-school interactions are by far the biggest contributor to the test-score gap, accounting for 64 to 84 percent of the difference in test scores between children with a degree-qualified parent and children whose parents at most finished intermediate school.

The importance of school characteristics for New Zealanders in Australia means that the children of highly educated New Zealanders in Australia have access to significantly better schools than do the children of less-educated New Zealanders there. The contribution of school characteristics for this group is stronger than for Australians generally, and much stronger than for children in New Zealand. This suggests that the patterns may be related to the type of New Zealanders who move to Australia rather than to cross-country differences in sorting across schools. In particular, educational differences among New Zealand parents in Australia tend to be relatively strongly reflected in the characteristics of schools that their children attend.

4. DISCUSSION

This study uses data from the 2003 OECD PISA study to examine the relationship between parents' education and socio-economic background and the cognitive skills of their children in a multivariate framework which allows us to consider the roles that schools and home environments play in the intergenerational transmission of human capital.

Students whose parents have higher qualifications tend to do better on all PISA domains. However, there is little difference between test scores for students with parents whose highest education is National Certificate Levels 1–2 versus those who finished secondary school or gained National Certificate Levels 3–5. These three categories are more or less equivalent in their relationship to child outcomes. Overall, children who have at least one parent with a university degree score 0.75 to 0.90 standard deviations higher on each PISA domain than those whose parents finished only intermediate.

In general, the parental education/test-score gradient is weakest in Mexico, Spain and the Netherlands, followed by Portugal and the Scandinavian countries, Australia, Belgium, and then France, Ireland and Korea, Italy, Greece and Denmark. New Zealand has a similar gradient to Switzerland, Japan, the US and Austria, and the strongest gradients are found in Poland, Germany, the Czech Republic, Turkey, Hungary and Slovakia. These results suggest that there is less equality of opportunity in New Zealand as far as human capital development is concerned – in particular, when compared with many continental European countries and Australia. Given New Zealand's overall strong results on PISA, this finding also reflects that children of highly educated parents in New Zealand score particularly well on PISA compared to children with highly educated parents in other OECD countries (for example, the average PISA maths score for students with at least one parent with a university degree is higher in only six of the 29 OECD countries in our sample: the Czech Republic, Germany, Netherlands, Korea, Belgium and Switzerland).

We find a strong association between highest parental qualification and the presence of other educational inputs. We determined four sets of factors that are positively correlated both with parental qualifications and with students' test scores: household characteristics; household educational resources; student-school interactions; and school characteristics. Of the 0.75 to 0.90 standard deviation raw gap in test scores between non-immigrant 15-year-olds in New Zealand with at least one university-educated parent and those whose parents at most finished intermediate, 15 to 24 percent is explained (statistically) by differences in household characteristics, 17 to 21 percent is explained by differences in household educational resources, 34 to 43 percent is explained by student-school interactions and nine to 13 percent is explained by differences in school characteristics. Between one and 20 percent remains unexplained by the characteristics that are measured in PISA.

In all OECD countries, differential access to financial and educational resources is the main means by which the positive association between the human capital of parents and children is maintained. In particular, differences in student-school interactions, and to a lesser extent in school characteristics, are found to be crucial components for explaining differences in PISA scores between the children of degree-qualified parents and those whose parents at most completed intermediate school. New Zealand has the largest unexplained gap in test-score performance in the OECD between children with lower- and higher-educated parents. The strong role played by differences in student-school interactions in New Zealand, accounting for 39 percent of the parental education/test-score gradient, suggests that measures to enhance the expectations, attitudes to school and relationships with teachers of the children whose parents have relatively low education may be effective in reducing the variation in students' performance in cognitive tests.

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APPENDIX 1: Variable definitions

For more information on the derivation of variables, see the PISA 2003 Technical Manual (OECD, 2005b).

1) Student characteristics

Age in months and gender are derived from Student Questionnaire questions 2–3 [STQ(2–3)]. Age is included in the regressions as a continuous variable.

Q2: On what date were you born? *(Please write the day, month and year you were born)*	Q3: Are you <female> or <male>? a) Female b) Male

2) Parental education

Mother's, father's and highest family education are derived from Student Questionnaire questions 11–14 [STQ(11–14)]. See the text for further information about how these are defined in the regression.

Q11: Which of the following did your mother complete at school? *(Please tick as many boxes as apply)* a) [ISCED level 3a] b) [ISCED level 3b,3c] c) [ISCED level 2] d) [ISCED level 1] e) [None of the above]	Q13: Which of the following did your father complete at school? *(Please tick as many boxes as apply)* a) [ISCED level 3a] b) [ISCED level 3b,3c] c) [ISCED level 2] d) [ISCED level 1] e) [None of the above]
Q12: Does your mother have any of the following qualifications? *(Please tick as many boxes as apply)* a) [ISCED level 5A,6] b) [ISCED level 5B] c) [ISCED level 4]	Q14: Does your father have any of the following qualifications? *(Please tick as many boxes as apply)* a) [ISCED level 5A,6] b) [ISCED level 5B] c) [ISCED level 4]

3) Household characteristics

Living arrangements

Derived from Student Questionnaire question 4 [STQ(4)]. Indicator variables for whether the student lives in a family with both biological parents (default category), with just their biological father, with just their biological mother, with one biological parent and one step-parent or with non-biological parents, and for whether living arrangements are missing are included in each regression.

Q4: Who usually lives at home with you? *(Please tick as many boxes as apply)* a) Mother b) Other female guardian (eg, stepmother or foster mother) c) Father d) Other male guardian (eg, stepfather or foster father) e) Others (eg, brother, sister, cousin, grandparents)

Home possessions

Derived as an index from Student Questionnaire questions 17 and 19 [STQ(17,19)]. Indicator variables are included for whether overall home possessions are very low, low, normal (default category), high, very high or whether the index is missing.

"In PISA 2003, students reported the availability of 13 different household items at home. Four different indices were derived from these items: computer facilities at home; cultural possessions; home educational resources; and home possessions. The last index is a summary index of all household items and also included a dummy variable indicating more than 100 books (derived from a question (q19) on the number of books at home)."

PISA 2003 Technical Report, p.283

Employment status

Derived from Student Questionnaire questions 5 and 6 [STQ(5,6)]. Indicator variables for whether the student's father and mother are employed full-time (default category), employed part-time, unemployed, not in the labour force (NILF) or whether this information is missing are included in the regressions.

Q5: What is your mother currently doing? *(Please tick only one box)* a) Working full-time for pay b) Working part-time for pay c) Not working, but looking for a job d) Other (eg, home duties, retired)	Q6: What is your father currently doing? *(Please tick only one box)* a) Working full-time for pay b) Working part-time for pay c) Not working, but looking for a job d) Other (eg, home duties, retired)

Parental occupational status

Measures are derived as an index scored from 16–90 from Student Questionnaire questions 7–10 [STQ(7–10)] for the father's occupational status, mother's occupational status and the highest parental occupational status. Continuous variables are included in the regression for each of these variables along with indicator variables for whether a particular index is missing.

"Occupational data for both the student's father and student's mother were obtained by asking open-ended questions. The responses were coded to four-digit ISCO codes and then mapped to the international socio-economic index of occupational status (ISEI). Three indices were obtained from these scores: father's occupational status; mother's occupational status; and the highest occupational status of parents which corresponds to the higher ISEI score of either parent or to the only available parent's ISEI score."

PISA 2003 Technical Report, p.273

Q7: What is your mother's main job? (eg, school teacher, nurse, sales manager) *(If she is not working now, please tell us her last main job)* *Please write in the job title.*	Q9: What is your father's main job? (eg, school teacher, carpenter, sales manager) *(If he is not working now, please tell us his last main job)* *Please write in the job title.*
Q8: What does your mother do in her main job? (eg, teaches high school students, cares for patients, manages a sales team)	Q10: What does your father do in his main job? (eg, teaches high school students, builds houses, manages a sales team)

Location

Measures are derived from School Questionnaire question 1. Indicator variables are included for each size category with village as the default group.

Q1: Which of the following best describes the community in which your school is located?
(Please tick only one box)
A village, hamlet or rural area (fewer than 3,000 people)
A small town (3,000 to about 15,000 people)
A town (15,000 to about 100,000 people)
A city (100,000 to about 1,000,000 people)
A large city with over 1,000,000 people

4) Household educational resources

Educational resources at home*

For home possessions, an index is derived from selected responses from Student Questionnaire question 17 [STQ(17:a,c,g,k,l)]. Indicator variables are then included for whether educational resources at home are very low, low or normal (default category).

Q17 (excerpt): Which of the following do you have in your home?
(Please tick as many boxes as apply)
a) A desk to study at
c) A quiet place to study
g) Your own calculator
k) Books to help with your school work
l) A dictionary

Cultural possessions at home*

For home possessions, an index is derived from selected responses from Student Questionnaire question 17 [STQ(17:h–j)]. Indicator variables are then included for whether cultural possessions at home are low, normal (default category) or high.

Q17 (excerpt): Which of the following do you have in your home?
(Please tick as many boxes as apply)
h) Classic literature (eg, Shakespeare)
i) Books of poetry
j) Works of art (eg, paintings)

Books at home

Derived from Student Questionnaire question 19 [STQ(19)]. Indicator variables are included for whether the home has 0–10 books (default category), 11–100 books, 101–500 books, 501 or more books or whether the question is missing.

Q19: How many books are there in your home?
There are usually about 40 books per metre of shelving. Do not include magazines, newspapers or your schoolbooks.
a) 0–10 books
b) 11–25 books
c) 26–100 books
d) 101–200 books
e) 201–500 books
f) More than 500 books

Computer availability

An indicator variable is included for whether the home has a computer, as measured in Student Questionnaire question 17 [STQ(17:d)]. An indicator variable is also included for whether this question is missing.

> Q17 (excerpt): Which of the following do you have in your home?
> *(Please tick as many boxes as apply)*
> d) A computer you can use for your school work

5) Student-school interactions

School grade

Derived from Student Questionnaire question 1a [STQ(1a)]. Indicator variables are included for whether the student is in grade 7 through 12, with grade 10 as the default, and for whether the current grade is ISCED2 (default category), ISCED3 or is not assigned an ISCED status.

> Q1a: What are you in?

Class size

Derived from Student Questionnaire question 36 [STQ(36)]. We include this as a linear variable along with an indicator variable for whether this information is missing.

> Q36: On average, how many students attend your mathematics class?

Students' educational expectations

Derived from Student Questionnaire question 23 [STQ(23)]. Indicator variables are included for whether the student expects to complete ISCED0/1 (default category), ISCED2, ISCED3B/C, ISCED3A, ISCED4, ISCED5B, ISCED5A/6 or whether this variable is missing.

> Q23 Which of the following do you expect to complete?
> *(Please tick as many as apply)*
> a) ISCED level 2
> b) ISCED level 3B or C
> c) ISCED level 3A
> d) ISCED level 4
> e) ISCED level 5B
> f) ISCED level 5A or 6

Students' attitudes towards school*

Derived as an index from Student Questionnaire question 24 [STQ(24)]. Indicator variables are included for students' attitudes towards school: negative (default category), standard, positive, very positive or whether the question is missing.

> Q24 Thinking about what you have learned in school: To what extent do you agree with the following statements?
> *(Please tick only one box on each row)*
> Strongly agree, Agree, Disagree, Strongly disagree
> a) School has done little to prepare me for adult life when I leave school
> b) School has been a waste of time
> c) School has helped give me confidence to make decisions
> d) School has taught me things which could be useful in a job

Student-teacher relationships*

Derived from students' responses to Student Questionnaire question 26 [STQ(26)]. Indicator variables are included for whether the relationship is bad, fair or good (default category), or whether the information is missing.

"An index of poor student-teacher relations at school was derived from student responses to five items: i) most teachers are interested in students' well-being; ii) students who need extra help will receive it from their teacher; iii) most teachers treat students fairly; iv) students get along well with most teachers; and, v) most teachers really listen to what students have to say. The four-point scale with the response categories 'strongly agree', 'agree', 'disagree' and 'strongly disagree' was recoded into binary variables with strongly disagree coded 1 and other valid responses coded 0. These responses were summarised by taking the average item response per student and computing the mean for each school."

PISA 2003 Technical Report, p.277

Q26 (excerpt): Thinking about the teachers at your school: To what extent do you agree with the following statements?
(Please tick one box in each row)

Strongly agree, Agree, Disagree, Strongly disagree

a) Students get along well with most teachers
b) Most teachers are interested in students' well-being
c) Most of my teachers really listen to what I have to say
d) If I need help, I will receive it from my teachers
e) Most of my teachers treat me fairly

6) School characteristics

Private school

An indicator variable is included for whether the student attends a private school as measured in School Questionnaire question 3 [SCQ(3)]. An indicator variable is also included for whether this question is missing.

Q3: Is your school a public or a private school?
(Please tick only one box)
A public school
(This is a school managed directly or indirectly by a public education authority, government agency or governing board appointed by government or elected by public franchise.)
A private school
(This is a school managed directly or indirectly by a non-government organisation: eg, a church, trade union, business or other private institution.)

School size

Derived from School Questionnaire question 2 [SCQ(2)]. We include this as a linear variable along with an indicator variable for whether this information is missing.

Q2: As at March 31 2003, what was the total school enrolment (number of students)?
(Please write a number in each row. Write 0 (zero) if there is none.)
a) Number of boys
b) Number of girls

School gender mix

From the information in School Questionnaire question 2 [SCQ(2)], we create variables for the proportion of the school enrolment that is female and indicator variables for whether the school is either an all-girls' or an all-boys' school.

Student-teacher ratio

Derived from School Questionnaire questions 2 and 18 [SCQ(2,18)]. We include the student-teacher ratio which was obtained by dividing the number of enrolled students by the total number of teachers. We also include an indicator for whether this is missing (PISA 2003 Technical Report, p.276).

> Q18: How many of the following are on the staff of your school?
> Include both full-time and part-time teachers. A full-time teacher is employed at least 90% of the time as a teacher for the full school year. All other teachers should be considered part-time.
> *(Please write a number in each space provided. Write 0 (zero) if there is none.)*
> Full-time, Part-time
> a) Teachers in TOTAL
> b) Teachers fully certified by [the appropriate authority]
> c) Teachers with an [ISCED5a] qualification in [pedagogy]

Teacher certification

We include a control derived from School Questionnaire questions 2 and 18 [SCQ(2,18)] for the proportion of fully certified teachers calculated by dividing the number of fully certified teachers by the total number of teachers. (PISA 2003 Technical Report, p.276).

Computer-to-student ratio

We include a control derived from School Questionnaire questions 2 and 9 [SCQ(2,9)] for the number of computers at school divided by the number of students at school. We also include an indicator for whether this is missing (PISA 2003 Technical Report, p.275).

> Q9: In your school, about how many computers are:
> *(Please write a number in each row. Write 0 (zero) if there is none.)*
> a) In the school altogether?
> b) Available to 15-year-old students?
> c) Available only to teachers?
> d) Available only to administrative staff?
> e) Connected to the Internet/World Wide Web?
> f) Connected to a local area network (LAN)?

Weeks in school year

Derived from School Questionnaire question 7 [SCQ(7)]. We include this as a continuous variable along with an indicator for whether the information is missing.

> Q7: For each of these programmes in your school:
> a) How many instructional weeks are in the school year?
> b) How many hours in total are there in the school week?
> *(include lunch breaks and after-school activities)*
> c) How many hours for instruction are there in the school week?
> *(exclude lunch breaks and after-school activities)*

School funding

Derived from School Questionnaire question 7 [SCQ(7)]. We include this as a continuous variable along with an indicator for whether the information is missing.

> Q4: About what percentage of your total funding for a typical school year comes from the following sources?
> *(Please write a number in each space provided. Write 0 (zero) if no funding comes from that source.)*
> a) Government (includes departments, local, regional, state and national)
> b) Student fees or school charges paid by parents
> c) Benefactors, donations, bequests, sponsorships, parent fundraising
> d) Other

School selectivity

Derived from School Questionnaire question 10 [SCQ(10)]. We include indicator variables for the four categories of school selectivity discussed below as well as an indicator variable for whether this information is missing.

"School principals were asked about admittance policies at their school. Among these policies, principals were asked how much consideration was given to the following factors when students are admitted to the school, based on a scale with the categories 'not considered', 'considered', 'high priority' and 'prerequisite': students' academic record (including placement tests) and the recommendation of feeder schools. An index of school selectivity was computed by assigning schools to four different categories: (1) schools where none of these factors is considered for student admittance; (2) schools considering at least one of these factors; (3) schools giving high priority to at least one of these factors; and (4) schools where at least one of these factors is a pre-requisite for student admittance."

PISA 2003 Technical Report, p.276

Q10 How much consideration is given to the following factors when students are admitted to your school?
(Please tick one box in each row)
Prerequisite, High priority, Considered, Not considered
a) Residence in a particular area
b) Student's academic record (including placement tests)
c) Recommendation of feeder schools
d) Parents' endorsement of the instructional or religious philosophy of the school
e) Student need or desire for a special programme
f) Attendance of other family members at the school (past or present)
g) Country-specific factor

School streaming

Derived from School Questionnaire question 16 [SCQ(16)]. We include indicator variables for the three categories of school streaming discussed below as well as an indicator variable for whether this information is missing

"To determine the amount of within-school ability grouping, school principals were asked to report the extent to which their school organises instruction differently for students with different abilities regarding the following policies and practices: i) mathematics classes studying similar content, but at different levels of difficulty; and ii) different classes studying different content or sets of mathematics topics that have different levels of difficulty. The index of ability grouping between classes was derived from these items by assigning schools to three categories: (1) schools with no ability grouping between any classes; (2) schools with one of these forms of ability grouping between classes for some classes; and (3) schools with one of these forms of ability grouping for all classes."

PISA 2003 Technical Report, p.277

Q16: Schools sometimes organise instruction differently for students with different abilities and interests in Mathematics. Which of the following options describe what your school does for 15-year-old students in Mathematics classes?

(Please tick one box in each row)

For all classes, For some classes, Not for any classes

a) Mathematics classes study similar content, but at different levels of difficulty

b) Different classes study different content or sets of Mathematics topics that have different levels of difficulty

c) Students are grouped by ability within their Mathematics classes

d) In Mathematics classes, teachers use a pedagogy suitable for students with heterogeneous abilities (ie, students are not grouped by ability)

Teacher-student relationships

Derived from principals' responses to School Questionnaire question 25c [SCQ(25c)]. Indicator variables are included for whether the relationship is bad, fair or good (default category), or whether the information is missing.

> Q25 (excerpt): In your school, to what extent is the learning of students hindered by:
> *(Please tick one box in each row)*
>
> Not at all, Very little, To some extent, A lot
>
> c) Poor student-teacher relations?

Teacher shortages*

Derived as an index from selected responses from School Questionnaire question 8 [SCQ(8:a–c,e,f)]. An indicator variable is included for whether there are any teacher shortages and for whether this question is missing.

"The index on teacher shortage is derived from four items measuring the school principal's perceptions of potential factors hindering instruction at school."

PISA 2003 Technical Report, p.310

> Q8 (excerpt): Is your school's capacity to provide instruction hindered by a shortage or inadequacy of any of the following?
> *(Please tick one box in each row)*
>
> Not at all, Very little, To some extent, A lot
>
> a) Availability of qualified Mathematics teachers
> b) Availability of qualified Science teachers
> c) Availability of qualified English teachers
> e) Availability of qualified foreign language teachers
> f) Availability of experienced teachers

Material resources*

An index of material resources is derived from selected responses from School Questionnaire question 8 [SCQ(8:k-m)]. This variable is scored on a scale from -3 to 3 and is included as a continuous variable. An additional indicator variable is included for whether this is missing.

"The index of quality of schools' physical infrastructure is derived from three items measuring the school principal's perceptions of potential factors hindering instruction at school."

PISA 2003 Technical Report, p.309

> Q8 (excerpt): Is your school's capacity to provide instruction hindered by a shortage or inadequacy of any of the following? *(Please tick one box in each row)*
>
> Not at all, Very little, To some extent, A lot
>
> k) School buildings and grounds
> l) Heating/cooling and lighting systems
> m) Instructional space (eg, classrooms)

Educational resources*

An index of educational resources is derived from selected responses from School Questionnaire question 8 [SCQ(8:i,o-t)]. This variable is scored on a scale from -3 to 3 and is included as a continuous variable. An additional indicator variable is included for whether this is missing.

"The index of quality of school's educational resources is derived from seven items measuring the school principal's perceptions of potential factors hindering instruction at school."

PISA 2003 Technical Report, p.310

Q8 (excerpt): Is your school's capacity to provide instruction hindered by a shortage or inadequacy of any of the following? *(Please tick one box in each row)*

Not at all, Very little, To some extent, A lot

i) Instructional materials (eg, textbooks)
o) Computers for instruction.
p) Computer software for instruction.
q) Calculators for instruction.
r) Library materials.
s) Audio-visual materials.
t) Science laboratory equipment and materials.

Teacher morale*

An index of teacher morale is derived from responses from School Questionnaire question 24 [SCQ(24)]. This variable is scored on a scale from -3 to 3 and is included as a continuous variable. An additional indicator variable is included for whether this is missing.

"The index of school principals' perception of teacher morale and commitment is derived from four items measuring the school principal's perceptions of teachers at a school. All items were inverted for scaling and the categories 'disagree' and 'strongly disagree' were collapsed into one category in view of very few responses in the these categories. Positive scores on this index indicate principals' reports of higher levels of teacher morale and commitment."

PISA 2003 Technical Report, p.311

Q24: Think about the teachers in your school. How much do you agree with the following statements? *(Please tick one box in each row)*

Strongly agree, Agree, Disagree, Strongly disagree

a) The morale of teachers in this school is high
b) Teachers work with enthusiasm
c) Teachers take pride in this school
d) Teachers value academic achievement

Students' behaviour*

An index of students' behaviour is derived from selected responses from School Questionnaire question 25 [SCQ(25: b,d, g,h,j,l)]. This variable is scored on a scale from -3 to 3 and is included as a continuous variable. An additional indicator variable is included for whether this is missing.

"The index on school principals' perceptions of student-related factors affecting school climate is derived from six items measuring the school principal's perceptions of potential factors hindering the learning of students at school."

PISA 2003 Technical Report, p.313

Q25: In your school, to what extent is the learning of students hindered by:
(Please tick one box in each row)

Not at all, Very little, To some extent, A lot

b) Student absenteeism?
d) Disruption of classes by students?
g) Students skipping classes?
h) Students lacking respect for teachers?
j) Student use of alcohol or illegal drugs?
l) Students intimidating or bullying other students?

Teachers' behaviour*

An index of teachers' behaviour is derived from selected responses from School Questionnaire question 25 [SCQ(25:a,c,e,f,i,k,m)]. This variable is scored on a scale from -3 to 3 and is included as a continuous variable. An additional indicator variable is included for whether this is missing.

"The index of school principals' perceptions of teacher-related factors affecting school climate is derived from seven items measuring the school principal's perceptions of potential factors hindering the learning of students at school."

PISA 2003 Technical Report, pp.312-3

Q25: In your school, to what extent is the learning of students hindered by:
(Please tick one box in each row)

Not at all, Very little, To some extent, A lot

a) Teachers' low expectations of students?
c) Poor student-teacher relations?
e) Teachers not meeting individual students' needs
f) Teacher absenteeism?
i) Staff resisting change?
k) Teachers being too strict with students?
m) Students not being encouraged to reach their full potential?

School autonomy*

An index of school autonomy is derived from responses from School Questionnaire question 26 [SCQ(26)]. This variable is scored on a scale from -3 to 3 and is included as a continuous variable. An additional indicator variable is included for whether this is missing.

"Index of school autonomy: Responses indicating that decision making was not a school responsibility (first column) were recoded to 0 and those with ticks in other columns but not in the first were recoded to 1. The resulting 12 items were scaled using IRT and positive scores indicate higher levels of school autonomy in decision making."

PISA 2003 Technical Report, pp.314-5

Q26: In your school, who has the main responsibility for:
(Please tick as many boxes as appropriate in each row
Not a main responsibility of the school, School's governing board
Principal, Department Head, Teacher(s)
a) Selecting teachers for hire?
b) Firing teachers?
c) Establishing teachers' starting salaries?

d) Determining teachers' salary increases?
e) Formulating the school budget?
f) Deciding on budget allocations within the school?
g) Establishing student disciplinary policies?
h) Establishing student assessment policies?
i) Approving students for admittance to the school?
j) Choosing which textbooks are used?
k) Determining course content?
l) Deciding which courses are offered?

Teacher participation*

An index of teacher participation is derived from responses from School Questionnaire question 26 [SCQ(26)]. This variable is scored on a scale from -3 to 3 and is included as a continuous variable. An additional indicator variable is included for whether this is missing.

"Index on teacher participation: Responses with a tick in the last column (indicating that teachers have a main responsibility) were recoded to 1, responses with no tick but ticks in other columns to 0. The resulting 12 items were scaled using IRT and positive scores indicate higher levels of teacher participation in decision making."

PISA 2003 Technical Report, pp.314–5

APPENDIX TABLE 1: Mean covariates across a sample of OECD countries ordered by mean maths-test scores

	Australia	Belgium	Finland	Germany	Hungary	Ireland	Japan	Holland	NZ	Poland	Slovakia	Sweden	US
Derived maths test score	524.1	550.9	546.3	527.3	490.1	500.6	536.5	551.7	524.0	490.5	497.6	517.1	487.9
Derived reading test score	527.1	528.1	546.0	519.3	482.0	515.2	499.4	524.6	523.1	497.2	469.3	522.0	502.6
Derived science test score	527.5	529.1	550.9	531.5	504.1	504.4	548.6	537.8	523.1	498.3	495.7	516.5	498.4
Derived problem-solving test score	532.9	545.5	549.5	536.1	501.1	497.6	548.4	532.1	533.1	487.3	492.2	517.0	482.6
Age in months	189.2	190.3	188.6	189.2	188.9	188.5	189.6	188.8	189.3	188.5	189.6	188.9	190.0
Female	48.9%	48.1%	50.2%	50.0%	47.7%	49.1%	51.9%	49.5%	50.1%	50.3%	47.9%	49.5%	50.1%
Father's years of education	12.3	13.0	12.8	13.5	12.2	11.3	13.1	12.4	12.4	11.6	13.2	12.4	13.0
Father did not finish intermediate	3.3%	4.4%	9.2%	0.9%	0.6%	14.4%	5.7%	6.6%	5.9%	3.3%	1.3%	4.5%	1.5%
Father finished intermediate	21.1%	6.7%	11.8%	8.8%	8.5%	16.2%	8.4%	13.6%	9.5%	4.8%	3.3%	17.1%	5.7%
Father has National Certficate Levels 1-2	4.0%	4.9%	0.0%	25.8%	30.0%	0.0%	12.2%	0.0%	14.3%	33.4%	26.6%	9.0%	0.0%
Father finished high school	14.2%	15.2%	22.7%	4.9%	16.5%	17.4%	26.0%	5.1%	8.1%	37.1%	32.5%	21.4%	51.9%
Father has National Certficate Levels 3-5	15.5%	17.1%	3.7%	14.6%	19.0%	22.5%	0.0%	29.8%	23.1%	7.1%	13.8%	0.0%	0.0%
Father has post-school diploma	11.4%	16.3%	26.1%	15.8%	4.8%	13.2%	9.1%	0.0%	7.9%	6.6%	1.9%	17.0%	10.0%
Father has university degree	25.0%	26.7%	22.6%	19.8%	16.5%	12.5%	38.3%	37.5%	12.7%	7.7%	17.3%	24.0%	25.0%
Father has missing quals	5.4%	8.9%	4.0%	9.4%	4.1%	3.8%	0.3%	7.3%	18.5%	0.0%	3.3%	7.0%	5.9%
Mother's years of education	12.2	13.0	13.3	13.0	12.2	11.7	13.0	12.1	12.8	12.0	13.1	13.1	13.3
Mother did not finish intermediate	3.4%	4.5%	5.4%	0.8%	0.6%	9.6%	3.1%	6.3%	5.1%	1.4%	1.5%	1.3%	0.8%
Mother finished intermediate	22.3%	7.2%	10.9%	12.5%	15.0%	14.8%	5.2%	17.6%	9.5%	4.9%	4.9%	12.0%	3.7%
Mother has National Certficate Levels 1-2	3.5%	5.9%	0.0%	32.1%	17.5%	0.0%	9.8%	0.0%	20.7%	25.0%	19.1%	9.6%	0.0%
Mother finished high school	17.5%	16.3%	22.5%	6.0%	16.4%	20.7%	34.7%	7.3%	9.3%	39.8%	39.7%	21.2%	54.4%
Mother has National Certficate Levels 3-5	13.3%	14.8%	2.8%	19.4%	23.7%	26.8%	0.0%	36.5%	12.3%	12.5%	16.7%	0.0%	0.0%
Mother has post-school diploma	12.0%	22.6%	32.8%	8.1%	6.1%	15.4%	26.9%	0.0%	19.5%	4.8%	2.7%	24.1%	12.2%
Mother has university degree	24.8%	22.4%	23.7%	14.6%	18.7%	10.8%	20.0%	26.9%	9.3%	11.7%	14.5%	16.7%	26.3%
Mother has missing quals	3.1%	6.3%	1.8%	6.4%	2.1%	1.9%	0.2%	5.4%	14.4%	0.0%	1.0%	5.0%	2.5%
Highest family years of education	13.0	13.8	13.9	13.9	12.9	12.4	13.8	13.0	13.5	12.5	13.6	13.6	13.8
Highest family did not finish intermediate	1.3%	2.0%	3.2%	0.3%	0.3%	5.8%	1.9%	3.2%	3.1%	0.6%	0.7%	1.1%	0.4%
Highest family finished intermediate	12.1%	3.2%	6.6%	7.1%	6.7%	10.1%	2.7%	10.2%	5.4%	1.9%	2.3%	7.2%	1.9%
Highest family has National Certficate Levels 1-2	2.7%	3.9%	0.0%	22.5%	20.0%	0.0%	6.3%	0.0%	15.2%	20.5%	15.4%	7.2%	0.0%
Highest family finished high school	15.6%	15.4%	20.8%	5.6%	16.5%	17.0%	29.9%	6.5%	9.0%	42.6%	37.8%	22.3%	46.9%
Highest family has National Certficate Levels 3-5	15.8%	14.6%	2.4%	17.3%	23.9%	28.1%	0.0%	29.8%	18.8%	12.3%	17.6%	0.0%	0.0%
Highest family has post-school diploma	15.0%	21.9%	32.1%	17.3%	7.3%	19.3%	16.7%	0.0%	19.5%	7.3%	3.3%	22.2%	12.7%
Highest family has University degree	35.5%	34.0%	33.9%	25.0%	24.9%	18.6%	42.4%	46.6%	17.2%	14.8%	22.5%	36.0%	36.3%
Highest family has missing quals	2.1%	5.0%	0.9%	4.9%	0.4%	1.1%	0.1%	3.8%	11.8%	0.0%	0.4%	4.1%	1.9%

	Australia	Belgium	Finland	Germany	Hungary	Ireland	Japan	Holland	NZ	Poland	Slovakia	Sweden	US
Lives with both biological parents	70.6%	75.2%	70.3%	74.2%	72.4%	81.9%	0.0%	81.9%	64.2%	86.2%	82.9%	69.0%	54.7%
Lives with one biological parent and step-parent	8.4%	8.1%	8.6%	7.5%	6.6%	1.9%	0.0%	5.2%	11.7%	1.9%	3.8%	6.2%	10.8%
Lives with mother and no father	15.2%	12.0%	15.6%	13.7%	16.2%	12.2%	0.0%	9.2%	14.6%	9.6%	9.3%	16.8%	22.7%
Lives with father and no mother	3.1%	2.4%	3.3%	3.0%	2.1%	2.0%	0.0%	2.0%	4.5%	1.1%	0.9%	4.6%	4.3%
Lives with no parents	2.1%	1.4%	0.8%	0.9%	2.0%	1.1%	0.0%	1.4%	4.7%	1.1%	1.4%	1.7%	5.1%
Missing living arangements	0.6%	0.9%	1.4%	0.7%	0.7%	0.9%	100.0%	0.5%	0.2%	0.1%	1.6%	1.6%	2.4%
Index of household socio-economic status [16,90]	52.3	51.7	50.1	51.2	48.7	48.2	50.2	51.8	50.6	45.1	48.7	51.3	55.3
Missing houshold SES Index	6.9%	2.2%	1.0%	3.2%	5.2%	2.8%	10.3%	3.3%	9.3%	2.2%	4.0%	1.3%	4.2%
Index of father's socio-economic status [16,90]	44.9	46.8	44.8	45.9	40.8	41.9	43.7	47.4	42.6	38.8	41.6	45.8	46.4
Missing mother's SES index	11.6%	5.9%	5.7%	10.8%	16.7%	7.8%	23.4%	14.5%	15.1%	7.3%	14.4%	6.3%	13.7%
Index of mother's socio-economic status [16,90]	46.3	44.4	42.5	44.7	46.1	43.5	45.6	43.8	45.1	41.8	44.5	43.5	49.3
Missing mother's SES index	16.5%	13.4%	4.9%	14.0%	14.4%	17.0%	25.0%	13.1%	16.9%	8.6%	11.8%	5.6%	12.0%
Very low index of home possessions	0.7%	0.5%	0.5%	0.6%	1.2%	1.0%	1.9%	0.5%	1.3%	1.3%	2.2%	0.5%	1.0%
Low index of home possessions	4.0%	4.1%	3.5%	1.4%	7.8%	9.7%	16.2%	2.4%	5.8%	8.9%	10.5%	3.2%	5.8%
Normal index of home possessions	69.9%	76.0%	70.6%	68.8%	79.6%	74.3%	77.9%	79.8%	72.6%	78.5%	82.3%	64.4%	66.8%
High index of home possessions	12.6%	10.6%	15.4%	15.3%	7.7%	8.4%	2.6%	9.5%	11.0%	7.9%	3.7%	15.2%	12.3%
Very high Index of home possessions	12.7%	8.7%	10.0%	13.9%	3.7%	6.5%	1.4%	7.9%	9.3%	3.4%	1.3%	16.8%	14.0%
Missing index of home possessions	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Father is employed full-time	82.8%	84.6%	79.9%	81.7%	73.2%	81.5%	88.6%	86.7%	84.5%	62.4%	79.0%	82.3%	79.4%
Father is employed part-time	5.6%	4.2%	4.7%	6.3%	6.2%	3.6%	3.4%	4.4%	5.1%	7.1%	3.7%	7.9%	3.8%
Father is unemployed	2.3%	2.0%	4.2%	4.0%	5.3%	1.6%	1.2%	1.7%	2.0%	12.0%	8.1%	2.8%	3.1%
Father is NIFL	6.3%	6.2%	7.3%	4.1%	10.3%	8.6%	2.6%	4.5%	4.9%	14.3%	5.4%	4.3%	8.8%
Father is missing labour force status	3.1%	3.0%	3.8%	3.9%	5.1%	4.6%	4.3%	2.7%	3.5%	4.2%	3.9%	2.7%	4.9%
Mother is employed full-time	42.1%	44.9%	71.2%	32.9%	65.2%	36.2%	33.4%	25.2%	50.0%	50.2%	74.9%	60.8%	60.4%
Mother is employed part-time	28.5%	25.1%	10.1%	40.1%	7.2%	25.7%	38.5%	49.1%	27.7%	7.9%	3.9%	24.7%	14.7%
Mother is unemployed	3.4%	3.6%	5.6%	5.4%	6.2%	1.7%	3.2%	3.6%	3.9%	15.8%	11.1%	4.3%	4.9%
Mother is NIFL	24.2%	24.9%	11.5%	19.6%	19.9%	33.0%	23.3%	19.8%	16.4%	25.0%	8.9%	8.5%	17.8%
Mother Is missing labour force status	1.8%	1.5%	1.7%	2.0%	1.5%	3.5%	1.6%	2.3%	2.0%	1.1%	1.2%	1.8%	2.2%
Father's main occupation is Legislator/Manager	16.8%	15.8%	15.2%	8.3%	5.3%	17.0%	9.7%	14.7%	16.8%	9.2%	10.2%	14.6%	18.3%
Father's main occupation is Professional	13.0%	15.2%	15.1%	15.0%	10.1%	9.5%	10.6%	17.5%	11.2%	5.3%	8.5%	15.6%	13.1%
Father's main occupation is Technician or Assoc Prof	10.2%	13.3%	8.6%	14.5%	5.8%	7.0%	6.6%	12.6%	9.0%	8.9%	9.1%	15.5%	7.9%
Father's main occupation is Clerk	2.8%	4.6%	2.5%	4.4%	1.0%	2.5%	9.5%	4.2%	1.0%	1.6%	1.6%	2.4%	2.3%
Father's main occupation is Service/Sales	4.7%	5.2%	3.8%	5.1%	7.7%	5.2%	11.6%	5.1%	3.9%	3.7%	4.2%	4.8%	5.6%
Father's main occupation is Agricultural/Primary Ind	5.0%	2.3%	5.5%	1.9%	2.2%	6.5%	2.1%	1.2%	9.2%	6.5%	1.7%	1.3%	1.6%
Father's main occupation is Trades	16.6%	17.8%	16.6%	22.9%	28.8%	21.4%	14.8%	16.3%	17.1%	20.4%	25.0%	20.0%	17.0%
Father's main occupation is Operator/Driver	9.0%	8.9%	12.1%	8.4%	9.6%	9.8%	5.8%	6.9%	8.0%	10.0%	13.7%	11.9%	4.3%
Father's main occupation is an elementary occupation	5.5%	4.9%	4.0%	5.1%	7.4%	5.5%	16.2%	11.4%	3.6%	3.1%	7.6%	3.6%	9.0%
Missing info on father's main occupation	4.7%	0.7%	1.2%	2.4%	1.5%	0.9%	5.0%	1.1%	9.6%	0.8%	1.1%	0.5%	4.1%

	Australia	Belgium	Finland	Germany	Hungary	Ireland	Japan	Holland	NZ	Poland	Slovakia	Sweden	US
Mother's main occupation is Legislator/Manager	7.0%	4.8%	4.8%	2.7%	3.9%	5.0%	0.8%	3.2%	9.0%	4.2%	5.0%	4.9%	9.8%
Mother's main occupation is Professional	19.5%	18.7%	13.7%	9.1%	18.0%	15.9%	10.9%	13.6%	17.7%	8.5%	14.0%	19.4%	20.7%
Mother's main occupation is Technician or Assoc Prof	10.4%	13.0%	18.2%	17.5%	11.3%	5.9%	4.5%	17.8%	10.8%	12.9%	16.9%	20.9%	12.3%
Mother's main occupation is Clerk	12.0%	9.4%	11.0%	15.5%	8.8%	11.5%	12.5%	12.2%	9.5%	6.2%	8.4%	7.9%	14.7%
Mother's main occupation is Service/Sales	9.8%	12.4%	20.3%	16.4%	10.8%	14.8%	21.6%	13.4%	12.8%	9.6%	12.4%	23.9%	9.1%
Mother's main occupation is Agricultural/Primary Ind	1.0%	0.7%	2.7%	0.5%	0.9%	0.2%	1.4%	0.8%	2.6%	3.6%	1.0%	0.5%	0.2%
Mother's main occupation is Trades	1.0%	1.5%	1.2%	1.9%	7.1%	0.7%	4.5%	0.5%	1.9%	5.1%	7.9%	1.0%	1.4%
Mother's main occupation is Operator/Driver	1.1%	1.3%	3.0%	1.3%	1.6%	2.4%	0.5%	1.0%	1.2%	1.3%	2.4%	1.7%	2.0%
Mother's main occupation is an Elementary occupation	5.8%	8.0%	5.5%	6.5%	9.2%	4.8%	10.3%	10.8%	4.5%	6.1%	10.2%	4.7%	1.9%
Missing info on mother's main occupation	3.1%	0.2%	0.9%	1.5%	0.9%	0.5%	4.9%	1.1%	7.7%	0.6%	0.6%	0.5%	3.0%
School located in village (<3000)	8.5%	2.8%	11.5%	6.5%	2.2%	20.2%	0.0%	1.0%	7.7%	37.4%	10.9%	23.7%	11.1%
School located in small town (3000 to 5000)	15.2%	25.3%	33.3%	28.1%	14.0%	34.1%	5.1%	14.3%	16.7%	12.3%	22.5%	25.1%	22.4%
School located in town (15k to 100k)	24.6%	53.8%	34.8%	33.6%	37.6%	7.5%	29.9%	52.1%	40.4%	26.6%	49.2%	34.6%	30.3%
School located in city (100k to 1mil)	17.6%	10.9%	20.4%	17.4%	23.7%	9.7%	48.5%	29.7%	35.2%	18.3%	17.5%	12.3%	17.6%
School located in large city (1mil +)	33.7%	5.9%	0.0%	9.3%	20.2%	17.9%	15.9%	0.0%	0.0%	5.3%	0/0%	3.9%	5.8%
Location information is missing	0.3%	1.3%	0.0%	5.1%	2.2%	10.7%	0.7%	2.9%	0.0%	0.0%	0.0%	0.4%	12.8%
Very low educational resources in the home	3.9%	2.7%	3.4%	1.4%	4.2%	7.1%	8.1%	4.8%	5.9%	3.0%	4.6%	6.7%	7.3%
Low education resources in the home	8.3%	6.9%	7.4%	2.9%	6.9%	11.2%	14.7%	11.8%	10.4%	5.0%	7.3%	9.8%	10.5%
Normal education resources in the home	87.9%	90.4%	89.2%	95.7%	88.5%	81.6%	77.2%	83.4%	83.6%	92.0%	87.9%	83.5%	82.2%
Low cultural possessions in the home	32.5%	39.3%	25.2%	27.5%	16.8%	39.5%	45.4%	35.3%	33.6%	13.6%	15.9%	22.7%	30.6%
Normal cultural possessions in the home	42.8%	41.8%	42.6%	43.6%	50.0%	42.7%	42.3%	49.1%	49.2%	57.7%	46.0%	45.6%	40.9%
High cultural possessions in the home	24.7%	18.9%	32.1%	29.0%	32.8%	17.8%	12.3%	15.6%	17.2%	28.6%	38.0%	31.7%	28.5%
Less than 11 books in the home	3.5%	10.4%	4.9%	4.3%	3.9%	10.6%	9.6%	11.0%	4.6%	8.3%	5.0%	3.0%	10.3%
Between 11 and 100 books in the home	35.0%	45.6%	49.1%	39.1%	35.8%	48.5%	44.3%	43.0%	40.8%	49.6%	51.3%	33.5%	45.4%
Between 101 and 500 books in the home	45.7%	33.7%	38.5%	42.1%	42.5%	32.7%	36.1%	34.2%	40.9%	33.2%	37.8%	46.6%	34.2%
More than 500 books in the home	14.2%	8.9%	6.6%	13.4%	16.5%	7.3%	9.6%	10.9%	11.3%	8.1%	5.2%	14.7%	9.1%
Missing number of books in the home	1.7%	1.5%	1.0%	1.0%	1.3%	0.9%	0.5%	1.0%	2.4%	0.8%	0.8%	2.2%	1.1%
Is a computer available at home	94.3%	91.6%	90.8%	94.1%	70.2%	83.5%	70.0%	0.0%	88.7%	63.7%	59.7%	96.6%	89.9%
Computer availability missing	2.0%	3.7%	0.5%	2.8%	6.6%	4.6%	11.4%	100.0%	2.7%	0.5%	18.1%	1.6%	1.3%
In Grade 7	0.0%	0.1%	0.1%	1.0%	1.1%	0.0%	0.0%	0.0%	0.0%	0.7%	0.5%	0.0%	0.3%
In Grade 8	0.1%	1.6%	11.6%	11.1%	4.8%	2.3%	0.0%	2.9%	0.1%	3.0%	0.8%	1.7%	2.2%
In Grade 9	9.0%	24.5%	88.2%	61.8%	64.9%	61.5%	0.0%	42.7%	5.8%	95.7%	36.6%	95.2%	30.8%
In Grade 10	73.2%	72.9%	0.0%	26.1%	29.2%	16.8%	100.0%	53.8%	91.3%	0.5%	61.7%	3.1%	60.2%
In Grade 11	17.7%	0.9%	0.0%	0.1%	0.0%	19.5%	0.0%	0.5%	2.8%	0.0%	0.4%	0.0%	6.4%
In Grade 12	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

	Australia	Belgium	Finland	Germany	Hungary	Ireland	Japan	Holland	NZ	Poland	Slovakia	Sweden	US
Grade is ISCED Level 2	82.3%	1.6	100.0%	99.7%	5.9%	63.8%	0.0%	71.6%	5.9%	99.5%	34.9%	96.9%	33.3%
Grade is ISCED Level 3	17.7%	98.4	0.0%	0.1%	94.1%	36.2%	100.0%	28.2%	94.1%	0.5%	65.1%	3.1%	66.7%
Missing Grade ISCED Level	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Number of students in class	22.7	19.1	18.3	24.0	23.9	22.9	35.2	22.9	23.3	23.7	25.9	19.5	22.7
Class is missing	4.0%	5.8%	1.9%	2.1%	3.1%	1.3%	7.1%	6.5%	5.2%	1.7%	1.7%	2.7%	4.2%
Student expects at most to finish intermediate	3.6%	5.3%	3.2%	40.9%	0.3%	4.6%	0.0%	30.5%	1.9%	6.9%	3.8%	4.6%	0.9%
Student expects at most to get National Certificate	4.2%	6.2%	0.0%	3.3%	9.8%	7.4%	12.8%	0.0%	14.1%	23.0%	8.3%	15.6%	0.0%
Student expects at most to finish high school	26.0%	26.7%	45.7%	33.7%	27.9%	21.6%	13.8%	28.9%	36.2%	25.9%	39.2%	24.1%	22.0%
Student expects at most to get post-school diploma	8.5%	23.6%	0.0%	1.9%	8.5%	14.3%	21.7%	0.0%	13.4%	14.1%	5.5%	24.6%	12.7%
Student expects at most to get university degree	57.6%	35.8%	51.0%	20.1%	53.0%	52.0%	50.2%	40.5%	33.1%	30.0%	42.5%	30.8%	64.1%
Missing student expectations	0.1%	2.3%	0.1%	0.1%	0.4%	0.1%	1.5%	0.1%	1.2%	0.1%	0.7%	0.3%	0.3%
Student has negative attitude to school	12.4%	22.1%	13.1%	22.6%	21.7%	15.0%	36.1%	17.0%	16.7%	24.0%	13.1%	17.8%	17.1%
Student has standard attitude to school	66.8%	70.1%	73.3%	67.3%	72.1%	68.3%	59.5%	77.8%	67.4%	64.6%	76.5%	68.4%	65.6%
Student has positive attitude to school	11.4%	4.9%	8.5%	6.9%	4.2%	10.1%	2.6%	4.0%	10.1%	6.1%	6.9%	9.9%	9.9%
Student has very positive attitude to school	9.1%	2.3%	5.1%	2.8%	1.5%	6.4%	1.6%	1.0%	5.1%	4.8%	3.2%	3.4%	6.9%
Missing student attitude to school	0.3%	0.7%	0.1%	0.5%	0.5%	0.2%	0.2%	0.2%	0.8%	0.4%	0.3%	0.5%	0.4%
Good student/teacher relationships	13.2%	8.7%	7.9%	15.9%	8.9%	10.9%	5.9%	5.0%	9.9%	6.3%	6.4%	15.0%	16.4%
Fair student/teacher relationships	77.3%	78.3%	79.1%	65.0%	72.7%	74.0%	64.6%	83.4%	77.8%	71.4%	73.4%	75.1%	72.1%
Bad student/teacher relationships	9.3%	12.7%	12.8%	18.6%	18.0%	15.0%	29.4%	11.4%	11.4%	22.0%	19.9%	9.3%	11.2%
Missing student/teacher relationships	0.3%	0.3%	0.2%	0.6%	0.4%	0.2%	0.1%	0.2%	0.8%	0.3%	0.2%	0.5%	0.4%
Whether private pchool	NA	72.3	6.2%	9.0%	10.9%	61.4%	27.4%	77.2%	4.3%	0.7%	12.3%	3.6%	5.4%
Whether private school missing	100.0%	0.7%	0.0%	4.4%	1.7%	0.0%	0.0%	3.6%	0.0%	0.0%	3.4%	0.0%	13.5%
Number of students in school	879.8	691.0	384.0	644.5	491.3	583.4	852.0	961.4	1011.2	437.3	496.4	522.9	1181.5
School size missing	0.3%	3.2%	1.4%	6.7%	3.3%	15.1%	0.0%	9.7%	0.0%	1.8%	3.4%	4.8%	16.4%
Proportion of students female	49.2%	47.6%	49.7%	52.0%	48.7%	51.5%	51.1%	48.7%	49.9%	48.9%	48.5%	49.0%	49.9%
All girls' school	7.4%	0.3%	0.0%	3.5%	0.0%	22.3%	7.8%	0.0%	15.9%	0.0%	0.3%	0.0%	0.8%
All boys' school	6.9%	1.5%	0.0%	0.0%	2.3%	16.3%	2.1%	0.0%	11.0%	0.0%	0.8%	0.0%	0.4%
Missing proportion of students female	0.3%	3.2%	1.4%	6.7%	3.3%	15.1%	0.0%	9.7%	0.0%	1.8%	3.4%	4.8%	16.4%
Student to teacher ratio	13.0	9.3	10.3	16.5	10.0	13.5	13.5	14.9	15.4	12.8	14.3	12.1	14.4
Missing student to teacher ratio	1.4%	5.5%	3.4%	11.4%	5.6%	29.2%	1.4%	15.1%	6.1%	2.7%	5.9%	6.6%	19.1%
Proportion of teachers certified	98.7%	95.2%	93.9%	97.6%	95.9%	98.1%	97.9%	88.0%	94.2%	98.0%	62.8%	87.6%	95.5%
Missing info on teachers certified	6.6%	18.1%	8.1%	27.0%	8.3%	26.1%	0.7%	14.5%	21.4%	2.2%	14.9%	3.7%	32.4%
Computer to student ratio	27.8%	15.0%	16.8%	8.6%	22.6%	11.8%	18.8%	14.1%	22.5%	6.9%	7.2%	15.3%	26.6%
Missing computer to student ratio	0.7%	7.7%	2.4%	10.5%	4.7%	16.4%	1.4%	13.7%	6.3%	3.5%	5.1%	7.1%	21.3%
Weeks in school year	39.3%	36.4%	38.1%	39.4%	36.7%	33.6%	38.9%	38.1%	36.2%	38.3%	38.9%	36.6%	36.3%
Missing weeks in school year	6.3%	12.9%	0.0%	18.9%	6.2%	10.4%	0.5%	7.0%	7.7%	5.3%	9.3%	2.7%	15.3%

	Australia	Belgium	Finland	Germany	Hungry	Ireland	Japan	Holland	NZ	Poland	Slovakia	Sweden	US
Percent of funding from government	71.9%	78.0%	99.6%	90.5%	87.9%	81.4%	73.2%	87.2%	74.9%	94.1%	91.4%	99.7%	70.1%
Percent of funding from student fees	23.1%	6.9%	0.1%	0.8%	0.2%	4.1%	20.5%	3.1%	11.4%	2.3%	0.6%	0.0%	6.2%
Percent of funding from benefactors	2.4%	1.0%	0.0%	1.6%	3.1%	1.5%	2.9%	0.2%	3.3%	1.1%	2.1	0.1%	2.1%
Percent of Funding from other sources	2.0%	2.7%	0.0%	1.7%	5.1%	0.5%	2.1%	0.7%	5.5%	0.6%	4.8%	0.1%	3.0%
Funding sources missing	0.3%	11.2%	0.2%	5.4%	3.6%	12.5%	1.0%	8.6%	4.7%	1.9%	1.1%	0.1%	19.6%
School is not selective	30.1%	31.1%	76.5%	20.0%	4.8%	47.9%	0.7%	2.9%	48.8%	45.3%	18.6%	75.8%	45.6%
School has low level of selectivity	51.0%	37.0%	16.5%	24.0%	18.4%	34.3%	10.0%	10.4%	29.4%	26.2%	28.9%	17.3%	19.4%
School has medium level of selectivity	16.4%	18.1%	3.4%	20.6%	19.2%	7.5%	19.8%	28.8%	14.6%	22.3%	9.3%	2.5%	12.8%
School is highly selective	2.3%	12.5%	3.6%	30.0%	55.8%	1.3%	69.2%	55.0%	2.7%	6.2%	40.3%	3.0%	8.2%
School selectivity is missing	0.3%	1.3%	0.0%	5.4%	1.9%	9.0%	0.2%	2.9%	4.6%	0.0%	2.9%	1.4%	13.9%
School does not stream students	2.4%	27.6%	48.0%	51.8%	39.9%	2.9%	54.6%	7.6%	0.7%	18.9%	25.5%	5.1%	2.4%
School streams students in some slasses	49.7%	52.0%	41.0%	19.5%	37.5%	30.2%	31.9%	27.7%	52.2%	38.4%	24.5%	38.0%	48.0%
School streams students in all classes	47.5%	19.1%	11.0%	23.6%	20.0%	55.3%	13.5%	61.1%	44.3%	42.0%	47.3%	55.9%	34.3%
School streaming is missing	0.3%	1.3%	0.0%	5.1%	2.5%	11.6%	0.0%	3.6%	2.8%	0.6%	2.7%	1.0%	15.3%
Good teacher/student relationships	19.2%	46.2%	16.5%	19.6%	28.4%	29.2%	11.4%	16.4%	14.3%	30.3%	42.9%	14.5%	16.0%
Fair teacher/student relationships	66.1%	43.8%	69.1%	63.3%	51.0%	45.9%	65.1%	62.4%	65.5%	59.5%	50.1%	75.5%	57.1%
Bad teacher/student relationships	14.4%	7.9%	13.8%	11.5%	16.1%	13.9%	22.9%	18.3%	18.0%	10.2%	7.0%	9.3%	12.5%
Missing teacher/student relationships	0.3%	2.1%	0.6%	5.5%	4.5%	11.1%	0.7%	2.9%	2.3%	0.0%	0.0%	0.7%	14.4%
Teacher shortages	12.0%	15.8%	0.6%	14.2%	0.2%	1.5%	16.9%	10.4%	19.5%	9.8%	3.3%	9.6%	8.1%
Missing Info on teacher shortages	0.3%	2.1%	0.0%	4.5%	1.7%	9.0%	0.0%	2.9%	2.3%	0.0%	0.0%	0.0%	14.1%
Quality of material resources [-3,3]	0.065	0.059	-0.148	0.179	-0.185	-0.185	-0.078	0.149	0.123	0.099	-0.165	0.027	0.161
Missing quality of material resources	0.3%	2.5%	0.0%	5.2%	1.9%	9.0%	0.0%	2.9%	2.9%	0.0%	0.9%	0.0%	14.1%
Quality of educational resources [-3,3]	0.401	0.203	-0.020	0.170	0.059	0.035	0.049	0.322	0.214	-0.385	-0.386	0.086	0.398
Missing quality of educational resources	0.3%	2.0%	0.0%	4.5%	1.7%	9.0%	0.0%	2.9%	2.9%	0.0%	0.1%	0.0%	14.1%
Teacher morale [-3,3]	0.195	-0.111	0.167	0.088	0.031	0.200	-0.181	0.041	0.113	0.060	-0.043	0.310	0.129
Missing teacher morale	0.3%	2.1%	0.0%	5.0%	2.3%	10.5%	0.0%	3.5%	2.3%	0.0%	0.0%	0.0%	15.4%
Student behaviours [-3,3]	0.002	0.315	-0.078	0.051	0.204	-0.137	0.269	-0.085	-0.235	-0.010	0.111	0.015	-0.108
Missing student behaviours	0.3%	2.1%	0.0%	5.0%	3.3%	9.7%	0.0%	2.9%	2.3%	0.0%	0.0%	0.7%	14.4%
Teacher behaviours [-3,3]	-0.043	0.193	0.006	-0.018	0.150	-0.080	-0.062	-0.318	-0.068	0.195	0.228	0.067	-0.008
Missing teacher behaviours	0.3%	2.1%	0.0%	5.0%	3.3%	9.7%	0.0%	2.9%	2.3%	0.0%	0.0%	0.7%	14.4%
School antonomy [-3,3]	0.128	-0.045	0.055	-0.158	0.315	0.012	0.264	0.682	0.145	0.064	0.361	0.387	0.397
Missing school antonomy	0.3%	1.7%	0.0%	4.5%	1.7%	9.7%	0.2%	2.9%	2.3%	0.0%	0.0%	0.7%	13.6%
Teacher participation [-3,3]	-0.014	0.111	0.171	0.026	0.045	0.085	-0.492	-0.137	-0.316	-0.117	-0.025	0.039	0.060
Missing teacher participation	0.3%	1.7%	0.0%	4.5%	1.7%	9.7%	0.2%	2.9%	2.3%	0.0%	0.0%	0.7%	13.6%
Number of students	7,156	6,453	5,349	3,259	4,376	3,109	4,532	3,114	2,694	4,280	6,676	3,574	4,063

Note: See the text, in particular the glossary, as well as Table 10 and Appendix 1 for information about the derivation of each variable.

APPENDIX TABLE 2: The relationship between test scores and parental education in New Zealand controlling for all measured characteristics

	Maths (1)	Reading (2)	Science (3)	Problem-solving (4)
Age in months	-0.004	0.000	-0.007	0.003
	(0.005)	(0.005)	(0.006)	(0.005)
Female	-0.225***	0.228***	-0.218***	-0.006
	(0.039)	0.037)	(0.039)	(0.039)
Highest parent did not finish intermediate school	-0.251***	-0.212***	-0.239***	-0.275***
ISCED 0/1	(0.082)	(0.075)	(0.082)	(0.088)
Highest parent finished intermediate school	-0.094	-0.029	-0.067	-0.022
ISCED 2	(0.067)	(0.064)	(0.068)	(0.065)
Highest parent has National Cert Levels 1-2	0.0959***	0.127***	0.0961**	0.122***
ISCED 3B/C	(0.036)	(0.037)	(0.039)	(0.035)
Highest parent finished secondary school	-0.021	-0.012	0.007	0.003
ISCED 3A	(0.050)	(0.046)	(0.047)	(0.047)
Highest parent has National Cert Levels 3-5	0.002	0.045	0.023	0.051
ISCED 4B/C	(0.032)	(0.031)	(0.034)	(0.031)
Highest parent has post-school diploma	0.001	-0.010	-0.015	-0.007
ISCED 5B	(0.029)	(0.029)	(0.030)	(0.029)
Highest parent has university degree	0.0802**	0.014	0.0843**	-0.011
ISCED 5A/6	(0.035)	(0.032)	(0.034)	(0.034)
Difference between parents with ISCED 5A/6 and 2	0.174**	0.044	0.151*	0.011
	(0.079)	(0.075)	(0.077)	(0.078)
Lives with one biological parent and step-parent	-0.087	0.048	-0.054	-0.057
	(0.057)	(0.057)	(0.058)	(0.058)
Lives with mother and no father	-0.0918**	-0.166***	-0.153***	-0.0897**
	(0.044)	(0.043)	(0.046)	(0.045)
Lives with father and no mother	-0.121	-0.246***	-0.200***	-0.202***
	(0.075)	(0.070)	(0.075)	(0.072)
Lives with no parents	-0.464***	-0.276***	-0.394***	-0.384***
	(0.074)	(0.066)	(0.075)	(0.071)
Very low index of home possessions	-0.321**	-0.125	-0.265	-0.091
	(0.153)	(0.183)	(0.173)	(0.159)
Low index of home possessions	-0.175**	-0.084	-0.153*	-0.164**
	(0.080)	(0.076)	(0.084)	(0.077)
High index of home possessions	0.020	-0.020	0.003	0.005
	(0.057)	(0.052)	(0.057)	(0.052)
Very high index of home possessions	-0.072	-0.121*	-0.080	-0.063
	(0.078)	(0.065)	(0.076)	(0.073)
Father is employed part-time	0.024	-0.161***	-0.074	0.043
	(0.066)	(0.060)	(0.069)	(0.062)
Father is unemployed	-0.077	-0.243***	0.013	-0.034
	(0.094)	(0.085)	(0.104)	(0.103)
Father is not in the labour force (NILF)	0.124	0.159**	0.098	0.029
	(0.075)	(0.069)	(0.075)	(0.073)
Mother is employed part-time	0.112***	0.0941**	0.142***	0.110***
	(0.038)	(0.039)	(0.040)	(0.037)
Mother is unemployed	0.050	-0.002	0.063	-0.041
	(0.083)	(0.078)	(0.087)	(0.082)
Mother is not in the labour force (NILF)	0.073	0.116*	0.124***	0.136***
	(0.048)	(0.045)	(0.047)	(0.048)

Status index of highest parental occupation	-0.001	-0.001	-0.001	0.000
	(0.002)	(0.002)	(0.002)	(0.003)
Status index of father's occupation	0.00305*	0.00511***	0.00409**	0.00328*
	(0.002)	(0.002)	(0.002)	(0.002)
Status index of mother's occupation	0.00306*	0.00721***	0.00422**	0.00493***
	(0.002)	(0.002)	(0.002)	(0.002)
School located in small town (3000 to 15000)	-0.123	-0.121	-0.119	-0.087
	(0.116)	(0.109)	(0.108)	(0.108)
School located in town (15k to 100k)	-0.149	-0.084	-0.119	-0.109
	(0.101)	(0.094)	(0.096)	(0.097)
School located in city (100k to 1mil)	-0.274*	-0.180*	-0.229**	-0.206**
	(0.107)	(0.104)	(0.103)	(0.103)
Very low educational resources in the home	0.086	0.017	0.037	0.023
	(0.085)	(0.084)	(0.092)	(0.079)
Low educational resources in the home	0.042	0.019	0.017	0.039
	(0.053)	(0.056)	(0.058)	(0.052)
Low cultural possessions in the home	0.019	0.019	-0.002	0.013
	(0.034)	(0.034)	(0.036)	(0.035)
High cultural possessions in the home	0.148**	0.199***	0.174***	0.151**
	(0.066)	(0.058)	(0.061)	(0.064)
Between 11 to 100 books in the home	0.063	0.148*	0.038	0.251***
	(0.078)	(0.076)	(0.086)	(0.076)
Between 101 to 500 books in the home	0.191**	0.317***	0.188***	0.370***
	(0.079)	(0.081)	(0.090)	(0.080)
More than 500 books in the home	0.353***	0.450***	0.245**	0.599***
	(0.093)	(0.092)	(0.102)	(0.093)
A computer is available at home	0.114**	0.032	0.165***	0.069
	(0.052)	(0.053)	(0.059)	(0.054)
In Grade 10	0.565***	0.492***	0.533***	0.519***
	(0.077)	(0.075)	(0.079)	(0.075)
In Grade 11	1.051***	0.961***	1.098***	0.988***
	(0.131)	(0.120)	(0.134)	(0.122)
Number of students in class	0.0373***	0.0317***	0.0350***	0.0431***
	(0.004)	(0.004)	(0.003)	(0.003)
Student expects to at most get National Cert Levels 1-2	-0.079	-0.097	-0.186	-0.049
	(0.126)	(0.142)	(0.159)	(0.126)
Student expects to at most finish high school	0.316***	0.359***	0.139	0.354***
	(0.118)	(0.129)	(0.147)	(0.118)
Student expects to at most get a post-school diploma	0.546***	0.659***	0.313**	0.635***
	(0.125)	(0.129)	(0.147)	(0.127)
Student expects to get a university degree	0.711**	0.759***	0.512***	0.723***
	(0.123)	(0.133)	(0.151)	(0.122)
Student has standard attitude towards school	0.022	0.0858*	-0.010	-0.025
	(0.045)	(0.045)	(0.047)	(0.044)
Student has positive attitude towards school	0.176***	0.262***	0.090	0.092
	(0.059)	(0.056)	(0.064)	(0.062)
Student has very positive attitude towards school	-0.053	0.210*	-0.028	-0.091
	(0.076)	(0.084)	(0.086)	(0.070)
Fair student/teacher personal relationships	-0.006	-0.029	0.019	0.024
	(0.057)	(0.061)	(0.064)	(0.066)
Bad student/teacher personal relationships	-0.151**	-0.149**	-0.097	-0.074
	(0.069)	(0.073)	(0.076)	(0.076)

Whether Private school	0.170	0.126	0.082	0.152
	(0.192)	(0.193)	(0.205)	(0.184)
Number of students in school (hundreds)	0.009**	0.007	0.0124**	0.007
	(0.004)	(0.004)	(0.005)	(0.005)
Proportion of students female	-0.311*	-0.127	-0.387*	-0.291*
	(0.165)	(0.207)	(0.201)	(0.176)
All girls 'school	0.250**	0.120	0.250**	0.241**
	(0.107)	(0.125)	(0.120)	(0.110)
All boys' school	-0.094	-0.078	-0.172	-0.079
	(0.096)	(0.114)	(0.108)	(0.099)
Student to teacher ratio	0.0159*	0.012	0.013	0.0159*
	(0.009)	(0.011)	(0.009)	(0.009)
Proportion of teachers certified	0.053	-0.031	0.062	0.028
	(0.149)	(0.177)	(0.138)	(0.149)
Computer to student ratio	0.170	-0.020	0.244	0.137
	(0.306)	(0.313)	(0.334)	(0.289)
Weeks in school year	-0.012	-0.011	-0.007	-0.006
	(0.012)	(0.012)	(0.012)	(0.011)
Percent of funding from student fees	0.143	0.184	0.216	0.163
	(0.203)	(0.204)	(0.218)	(0.192)
Percent of funding from benefactors	-0.229	0.093	-0.084	-0.091
	(0.353)	(0.328)	(0.357)	(0.347)
Percent of funding from other sources	0.135	0.306	0.105	0.391
	(0.241)	(0.245)	(0.238)	(0.255)
Low school selectivity	0.008	-0.040	-0.010	0.014
	(0.052)	(0.053)	(0.053)	(0.051)
Medium school selectivity	-0.007	-0.085	-0.080	-0.017
	(0.062)	(0.060)	(0.061)	(0.058)
High school selectivity	0.014	-0.014	-0.045	0.036
	(0.108)	(0.119)	(0.120)	(0.109)
Some student streaming	-0.209**	-0.059	-0.015	-0.125
	(0.089)	(0.086)	(0.092)	(0.090)
All students streamed	-0.255***	-0.098	-0.043	-0.166*
	(0.086)	(0.084)	(0.092)	(0.089)
Fair teacher/student school relationships	0.150***	0.145***	0.172***	0.148*
	(0.064)	(0.068)	(0.062)	(0.064)
Bad teacher/student school relationships	0.080	0.115	0.106	0.074
	(0.093)	(0.097)	(0.095)	(0.094)
Teacher shortages	-0.062	-0.064	-0.016	-0.049
	(0.051)	(0.049)	(0.050)	(0.066)
Quality of material resources [-3,3]	0.047	0.068	0.028	0.076
	(0.052)	(0.049)	(0.049)	(0.050)
Quality of educational resources [-3,3]	0.033	0.027	0.049	0.018
	(0.032)	(0.031)	(0.033)	(0.033)

Teacher morale [-3,3]	-0.042	-0.012	-0.018	-0.016
	(0.041)	(0.039)	(0.044)	(0.040)
Student behaviours [-3,3]	0.047	0.079	0.105**	0.043
	(0.053)	(0.048)	(0.046)	(0.052)
Teacher behaviours [-3,3]	-0.007	0.001	-0.031	-0.022
	(0.045)	(0.050)	(0.049)	(0.046)
School autonomy [-3,3]	-0.045	-0.041	-0.037	-0.039
	(0.061)	(0.061)	(0.056)	(0.061)
Teacher participation [-3,3]	0.037	0.067	0.045	0.041
	(0.41)	(0.043)	(0.041)	(0.041)
R-squared	0.47	0.523	0.448	0.488
Observations	2694	2694	2694	2694

Note: This tables presents the full set of regression coefficients for the specifications in Table 12. Parental education variables are defined as relative to the parental education for the mean student. Student weights which are provided with the data are used to ensure the representativeness of the sample of students. Robust standard errors, which account for the fact that students in clusters of schools are surveyed, are in parentheses. Additional covariates are included for whether particular variables are missing, but these results are not presented. *** significant p<0.01, ** p<0.05, * p<0.1.

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Families Commission
PO Box 2839
Wellington 6140
Telephone: 04 917 7040
Email: enquiries@nzfamilies.org.nz

families commission
kōmihana ā ***whānau***

Giving New Zealand families a voice *Te reo o te whānau*

Wellington office
Public Trust Building, Level 6
117–125 Lambton Quay
PO Box 2839, Wellington 6140
Phone 04 917 7040
Fax 04 917 7059

Auckland office
Level 5, AMI House
63 Albert Street, Auckland 1010
Phone 09 985 4106

Email
enquiries@nzfamilies.org.nz

Commission website
www.nzfamilies.org.nz

The Couch website
www.thecouch.org.nz