Technical Paper

Separating school and family:

Evaluating the effects of school and family background on student performance in NCEA

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Abstract

Much of what we think we know about the drivers of quality education in New Zealand is too often based on anecdote or retrospective assessment rather than objective, data-driven information. Misconceptions and ideology tend to guide school choice. Consequently, decile drift and socioeconomic segregation have plagued our schools.

Fortunately, recent developments in integrated data have allowed The New Zealand Initiative to develop a solution to education evaluation in New Zealand. Using linked administrative data in Statistics New Zealand's Integrated Data Infrastructure (IDI), we developed New Zealand's first contextualised value-added model (CVAM).

Like other value-added models (VAMs) implemented around the world, the purpose of our CVAM was to determine the distribution of secondary school performance in New Zealand, holding family socioeconomic background constant. The results from our CVAM have several implications for education in New Zealand.

First, it provides empirical evidence that "decile is *not* a proxy for school quality". Results show almost identical average school performance across all 10 deciles once differences in family background have been controlled for. Second, among the family background variables included in our CVAM, parent's educational attainment was the strongest predictor of student academic achievement. Third, holding family background constant, approximately 80% of schools perform almost identically when evaluated on a wide range of NCEA-derived metrics. Finally, while most schools perform similarly, there are outliers. In particular, 42 decile 1 and 2 schools outperform 75% of every other secondary school in the country when evaluated on University Entrance attainment.

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Introduction

Problem definition

It is well known in the economics literature that family socioeconomic background matters a great deal in student academic success at school.[1] It is also well established in the education literature that good teachers and schools contribute to a student's academic success.[2] On their own, these findings are relatively unsurprising; put together, they make objective school evaluation an extremely difficult task.

When students enter college in year 9 (age 13), they bring with them different levels of human capital. This difference is a result of differences in parental influence, education, income and expectations in addition to differences in teacher and school quality at the primary and intermediate levels. As they progress through college, students are further influenced by these same factors. Throughout their time at college, they sit multiple assessments and exams to gain a qualification. The results, which are used to evaluate schools and create league tables, reflect a mix of family, teacher and school effects.

As a result of this entanglement of effects, ministries and departments of education all over the world have struggled to identify and separate the contribution of the school from that of the family. The synthesis of school and family effects is a key and ongoing issue in school evaluation.[3] Objective school evaluation through quantitative analysis is necessary to identify how schools are truly performing. Without it, schools do not get evaluated on an even playing field.[4]

Schools serving disadvantaged communities are more likely to receive poor reviews because of the cohort of students they serve.[5] As a result, some fantastic lower decile schools may not be recognised because their students may come from disadvantaged backgrounds; at the same time, some coasting higher decile schools might receive praise not because they are doing a great job but because their students may come from advantaged backgrounds.

Identifying high-performing and underperforming schools is necessary so we can learn lessons from the schools doing the best job;[6] the Ministry of Education (MoE) can provide additional support to underperforming schools; good schools can be rewarded and bad schools assisted; and, most importantly, students can get the most out of the education system. As outlined above, education attainment, particularly at the primary and secondary levels, is crucial for improving later life outcomes for those in the most disadvantaged communities – the same communities that are the most affected by an underperforming education system.

International solution

The solution to school evaluation that many countries have adopted is value-added models (VAMs) of assessment and evaluation. Since the first VAM (TVAAS) was developed and implemented in the state of Tennessee in 1992, VAMs have grown in popularity and use around the world. Compared with standard methods of assessment and evaluation, which only look at static performance at the end of the year, VAMs look at academic growth over time. By looking at growth instead of static performance, VAMs can (in theory) control for the different levels of human capital students bring with them to school. As a result, VAMs can objectively compare schools with different cohorts of students.

While VAMs are a significant improvement over standard methods of school evaluation, they have limitations. Basic VAMs rely on one key assumption: each student's prior performance captures the total effect of their family socioeconomic background, and there is no residual effect on student growth. Lu and Rickard, however, showed that this assumption is not always met.[7]

To overcome this problem, later iterations of VAMs included additional information on student socioeconomic background. These models are referred to as contextualised value-added models (CVAMs). Like standard VAMs, CVAMs also measure student progress but they use more complex statistical models to calculate value-added. Independent variables commonly used in these models include student ethnicity, gender, language, free-lunch status, and special education status.

In every VAM iteration, the exact model specification depends on its purpose, the political climate in which it was developed, and the data availability in that country. While every model differs in some shape or form, every model also seeks to answer one if not all of the following three questions.

1. What proportion of student achievement can be attributed to the school, the teacher, and the family?
2. How effective is an individual school compared with other schools?
3. Which characteristics or institutional practices are associated with effective schools?

New Zealand

Like education ministries in other comparable countries, the MoE in New Zealand struggles to identify and separate the contribution of the school from that of family background. The Ministry can rank schools based on average National Certificate of Educational Achievement (NCEA) performance within deciles; however, because of the significant number of students who attend schools out-of-zone, it is still not possible to get a clear picture of how schools are truly performing.[8] Existing measures of school performance, including Education Review Office (ERO) reports and NCEA and University Entrance (UE) achievement league tables – which only show absolute measures of student achievement – tell us as much about students and their parents as the quality of the school.

Additionally, like other countries, unadjusted league tables that rank schools based on raw academic outcomes often show higher decile schools at the top of the tables.[9] As a result, some parents use a school decile ranking to determine school quality and to choose the school to enrol their children in.

To find a way forward, The New Zealand Initiative developed New Zealand's first CVAM. Like in other countries, the purpose, political climate, and data availability determined the nature of our CVAM.

For example, unlike several other countries, New Zealand lacks the standardised testing required for a standard VAM. While NCEA – New Zealand's national secondary school qualification – has standardised tests and exams (through achievement and unit standards), the way students complete an NCEA qualification through various combinations of hundreds of different standards prevents anyone from reliably calculating a typical value-added score and comparing it across hundreds and thousands of students.[10]

To illustrate, one student's 80 level 1 credits (one of the main requirements for an NCEA level 1 qualification) is seldom comparable to another student's 80 level 1 credits. Additionally, one student's 80 level 1 credits are not comparable to that same student's 80 level 2 credits the following year. As a result, the Initiative's CVAM is not a standard "value-added" model because it does not measure progress from the beginning of one period to the end of that period.

It does, however, answer the same three key questions all VAMs seek to answer while still fitting the definition of what a "value-added" model measures. The OECD defines "value-added" as "the contribution of a school to a student's progress towards stated or prescribed education objectives over time."[11] The OECD also defines value-added modelling as "a category of statistical models that use student achievement data to measure students' learning gain."[12] Our model fits this definition.

A CVAM for New Zealand

While standard VAMs and CVAMs use prior performance and additional contextualised data to control for student family socioeconomic background, the Initiative's CVAM uses linked administrative data from Statistics New Zealand's Integrated Data Infrastructure (IDI) to do this. Using merged administrative data from several government departments, described in detail in the data section (see below), the Initiative constructed a student-parent dataset that covered an extensive range of family socioeconomic background characteristics.

The student-level dataset contained detailed information on student demographics, home abuse, school interventions, and school behaviour, in addition to information on parent's education, income, benefits history, relationship/divorce status, offences, and corrections history. Using this dataset in combination with a fixed-effects model with least squares dummy variable (LSDV) estimators, our CVAM was able to a separate the effect of family socioeconomic background and the effect of the school.

This model contributes several new findings to the literature, and the field of education economics. First, it provides empirical evidence that "decile is not a proxy for school quality". While many teachers, principals and education professionals have continually denied this, many parents still believe in this myth.[13] As a result, New Zealand has faced decile drift since the decile funding model was implemented in 1995.[14]

Results from our model show that once you control for the effects of family socioeconomic background, on average, schools in low-decile schools perform just as well as high-decile schools. This result is consistent across the 10 NCEA-derived outcomes on which we evaluated schools.

Second, our findings demonstrate the distribution of individual school performance in New Zealand. While most schools perform very similarly, there are outliers at both the top and the bottom distribution. This means there are high-performing schools and underperforming schools in New Zealand, where the highest-performing schools have the equivalent effect of a one-standard-deviation increase in the education outcome variables of interest (various NCEA-derived metrics). Importantly, low- and high-performing schools exist in both low- and high-decile schools.

Finally, our findings also provide insights into the main factors that predict student academic success in secondary school. Specifically, once we adjusted for a wide range of background characteristics, we found parent's education has the largest predicted effect on student academic success.

Data

The Initiative's IDI research project MAA2017-29 used linked administrative data in the IDI to create our student-parent dataset. The final dataset contained student/individual-level data from the MoE, Ministry for Children (previously Child, Youth and Family (CYF)), Ministry of Social Development (MSD), New Zealand Police, Department of Corrections, Inland Revenue Department (IRD), Department of Internal Affairs (DIA), and the 2013 Census. The dataset covered the years 2008 to 2017 and 398,961 students across 480 secondary schools in New Zealand.[15]

Student NCEA standards data was available from 2002, the year it was introduced; however, secondary school data was only available from 2007 onwards. For this reason, we restricted the sample to students who attempted NCEA level 1, 2 and 3 from 2008 to 2017. Home abuse data from CYF was available from 1991, while benefits dynamics data from the MSD was available from 1990. Convictions data from New Zealand Police was available only from 2009, while sentencing and remand data from the Department of Corrections was available from 1998. Income data from the IRD was available from 1999, while life event data linking children to their parents from the DIA was available all the way back from 1840.[16]

Tables 1–2 and 4–7 show summary statistics of our dataset. Note that all cell counts have been randomly rounded to base three (RR3) in compliance with rule 5.1.1 of Statistics New Zealand's *Microdata Output Guide*.[17]

Table 1: Distribution of students by decile

Decile	Number of students
1	16,581
2	27,102
3	24,786
4	37,371
5	46,284
6	54,786
7	39,987
8	56,367
9	44,298
10	51,030

In the 21 years since the decile funding model was implemented in 1995, there has been a dramatic shift in student enrolment to high-decile schools. This trend is reflected in the distribution of students across deciles in our dataset.[18]

Table 2: Dependent variables summary statistics

	Variable	Mean	Standard deviation
1.	WRPI score NCEA level 1	65.04	56.94
1.	WRPI score NCEA level 2	45.30	50.38
1.	WRPI score NCEA level 3	24.79	40.48
2.	Weighted NCEA score NCEA level 1	184.74	147.61
2.	Weighted NCEA score NCEA level 2	151.29	126.02
2.	Weighted NCEA score NCEA level 3	141.06	118.19
3.	Expected percentile NCEA level 1	0.41	0.2
3.	Expected percentile NCEA level 2	0.39	0.21
3.	Expected percentile NCEA level 3	0.39	0.22
		Percentage achieved	
4.	University Entrance	29.0%	

Our analysis evaluated secondary schools based on the academic performance of their students in NCEA level 1, 2 and 3. We used four NCEA-derived metrics (see Table 2) considering the inherent issues with the NCEA qualification.

NCEA comprises three levels of certificates, usually achieved in the final three years of secondary school. Students must demonstrate competence in enough standards, usually worth 3–5 credits to gain the 80 credits required for an NCEA qualification. Credits can be gained from potentially hundreds of combinations of standards, from 'Prepare and serve tea' to 'Investigate a given multivariate dataset using the statistical enquiry cycle.' All the different ways of earning an NCEA qualification are deemed equally valuable – when in practice they are not.

A previous Initiative report on NCEA, *Spoiled by Choice*, argued that this principle makes the NCEA qualification unreliable in demonstrating student achievement.[19] Ultimately, this hurts students from disadvantaged communities, and makes the qualification of limited use to employers and education professionals looking to gain insights from the qualification.[20]

Given the issues with the NCEA qualification we used these four NCEA-derived metrics:

1. Weighted Relative Performance Index (WRPI),
2. Weighted NCEA (WNCEA) score,
3. Expected Percentile (EP), and
4. University Entrance (UE) as a proxy for student achievement.

All four metrics provide better measures of academic achievement to compare NCEA results across different students.

The WRPI and WNCEA scores were developed by the Initiative, while EP was developed by Michael Johnston at the New Zealand Qualifications Authority (NZQA). UE is the minimum requirement for students to enrol in a New Zealand university as set by the NZQA.

We chose these four metrics covering NCEA level 1, 2 and 3 to test the robustness and consistency of our results. In total, we evaluated schools on 10 different dependent variables.

A brief description of each metric is provided below; a full discussion of each variable is available in *Score! Transforming NCEA Data* and *How Does Achievement at School Affect Achievement in Tertiary Education?*[21]

Future Initiative reports will evaluate secondary schools on later life outcomes such as NEET status 1, 3 and 5 years after graduation (see the Future regressions section in the Appendix – p. 63).

Weighted Relative Performance Index (WRPI) and Expected Percentile (EP)

WRPI and EP are constructed by considering how a student performed in each standard, relative to all other students in each of those standards at each NCEA level.[22] Both do this to adjust for the varying difficulties of different subjects and the standards within them.

To illustrate, a student might receive an Excellence in the 'Perform a solo or duet dance' standard. This standard is taken by, let's say, 1,000 students in the country, and 800 receive an Excellence grade. On the other hand, 1,000 students take 'Apply the algebra of complex numbers in solving problems', and 350 receive an Excellence grade. A student earning an Excellence in the dance standard is in the top 80% of students for that standard, while the algebra Excellence puts a student in the top 35%. This means the second standard is likely the more challenging of the two.

Very simply, where the EP ranking takes an average of the percentile scores across all standards attempted, WRPI adds those percentile scores using a log weighting.

The WRPI index is:

$$WRPI_j = \sum_{i=1}^{n} \propto_i \ln_i x_{i,j}$$

where $WRPI_j$ gives the WRPI score for student j; $\propto_j$ gives the number of credits for standard i; and $x_{i,j}$ denotes the relative performance on that standard as shown by the inverse proportion of students who achieved the same result or better than student j.

$$x_{i,j} = \frac{(no. of\ students\ who\ sat\ standard\ i)}{(no. of\ students\ who\ received\ the\ same\ or\ better\ grade\ than\ student\ j\ on\ standard\ i)}$$

Weighted NCEA (WNCEA) score

The WNCEA score is closely related to the cumulative score metric that many secondary schools use to select *Dux* and what universities use to rank students for selective entry into competitive first-year programmes. The WNCEA score assigns point values to different grades for each standard and then multiplies it by the number of credits that standard is worth. This value is then summed across all the standards a student has attempted.

Compared to the more uniform point values applied in the cumulative score, the WNCEA score puts more value on Merit credits and less on Achieved credits. These weights are based on a recent analysis by Singh and Maloney, who show that the cumulative score undervalues Merit credits relative to Excellence, but that Achieved credits on their own do little to predict future success.[23]

Table 3: Weighted NCEA score and Cumulative score

Weighted NCEA Score	Cumulative Score
Excellence: 4	Excellence: 4
Merit: 3.7	Merit: 3
Achieved: 1.36	Achieved: 2
Not achieved: 0	Not achieved: 0

University Entrance (UE)

There are various pathways to a New Zealand university, the most common being through NCEA. The NZQA has set the following requirements:[24]

1. NCEA level 3;
2. Three subjects at level 3, made up of 14 credits each, in three approved subjects;
3. Literacy: 10 credits at Level 2 or above, made up of 5 credits in reading and 5 credits in writing;
4. Numeracy: 10 credits at Level 1 or above, made up of:
    - Achievement standards – specified achievement standards available through a range of subjects, or
    - Unit standards – package of three required numeracy unit standards (26623, 26626, and 26627).

Table 4: Distribution of students by NCEA year

Year	NCEA level 1	NCEA level 2	NCEA level 3
2008	35,811	2,481	840
2009	37,098	31,203	2,838
2010	38,433	34,173	25,257
2011	38,916	35,439	28,644
2012	38,853	38,037	31,878
2013	40,593	39,501	35,640
2014	42,450	44,895	37,800
2015	38,205	35,154	40,569
2016	36,672	32,979	42,177
2017	10,851	22,866	34,878

The number of students attempting NCEA level 2 and 3 in 2008 and NCEA level 3 in 2009 was significantly lower compared to later years due to restricting our sample to the years 2008–17. Students attempting NCEA level 1 in 2006 would have likely attempted NCEA level 3 in 2008; while students attempting NCEA level 1 in 2007 would have likely attempted NCEA level 2 and 3 in 2008 and 2009, respectively. As a result, this cohort of students was dropped in our dataset restriction.

Additionally, in the years 2015–17 the number of students attempting NCEA level 3 was higher than expected. NZQA statistics consistently show fewer students attempting NCEA level 3 than 2.[25] We are unable to explain these discrepancies.

Furthermore, the number of students sitting NCEA level 1 and 2 was lower than expected for 2017. We suspect this may be a result of when the NCEA standards data was extracted from the IDI server and when the NCEA 2017 standards data was updated; however, we were unable to verify our hypothesis.[26] Future work will check whether more complete NCEA level 1 results are available.

Considering these anomalies, we ran several robustness tests restricting our analysis to five two-year samples (2008–09, 2010–11, 2012–13, 2014–15, and 2016–17). The results from the restricted samples were consistent with the pooled cross-sectional results.

Table 5: Student demographics summary statistics

Variable	Percentage of sample
Female	49.5%
Māori	25.0%
Pasifika	7.7%
Australian	0.1%
Asian	5.1%
European	1.3%
Middle Eastern	0.2%
Latin American	0.1%
African	0.1%
CYF sexual abuse (1+)	2.2%
CYF physical abuse (1+)	3.0%
CYF emotional abuse (1+)	4.4%
CYF neglect abuse (1+)	3.5%
CYF self-harm abuse (1+)	0.0%
CYF behavioural abuse (1+)	3.9%
Refugee	0.2%
Disability	3.9%
ESOL	6.3%
Reading recovery	1.0%
Suspension (1+)	4.1%
Stand downs (1+)	13.4%
Expulsion (1+)	0.2%
School transfer (2+)	23.9%
Access to heat at home	89.4%
Access to internet at home	79.4%

The demographic distribution of our sample was as expected. Females made up nearly 50% of our sample, while Māori made up 25%, Pasifika 7.7%, and Asians 5.1%. Among other ethnicities, a low number of students identified as Australian, European, Middle Eastern, Latin American and African (MELAA). Note the omitted or base category for ethnicity was European New Zealander, while the base category for female was male.

Across all CYF confirmed abuse cases, we identified 68,172 cases that matched our 2008–17 sample. This was only a fraction of the total number of children known to CYF since only a small fraction of students are identified as confirmed cases. In 2014–15, 150,905 children were notified; 45,463 were investigated further; and 16,472 were confirmed cases.[27] Among our CYF sample, 26% was emotional abuse, 22.8% was behavioural abuse, 20.7% was neglect, 17.5% was physical abuse, 12.9% was sexual abuse, and 0.045% was self-harm.

Table 6: Parent demographics summary statistics

Variable	Percentage of sample	
Parent's homeownership	49.8%	
Parents divorced	10.5%	
Mother's education		
None	32.4%	
High school certificate	41.8%	
Diploma	9.6%	
Bachelor's degree	14.2%	
Postgraduate degree	4.5%	
Father's education		
None	44.0%	
High school certificate	36.4%	
Diploma	6.9%	
Bachelor's degree	8.4%	
Postgraduate degree	4.3%	
Mother with offence history	3.4%	
Father with offence history	6.3%	
Mother with prison history	3.4%	
Father with prison history	6.3%	
	Mean	**Standard deviation**
Mother's ln income	8.15	3.92
Mother's income	$22,882	$22,748
Father's ln income	7.46	4.91
Father's income	$39,197	$46,481
Mother's benefit spell (weeks)	171	300
Father's benefit spell (weeks)	67	182

Table 7: School characteristics summary statistics

Variable	Percentage of sample
Girls' school	13.8%
Boys' school	14.4%
Charter school	0.1%
State school	94.7%
Private school	5.2%

In our analysis, we only included dummy variables for girls-only, boys-only and state schools. Where co-ed schools were the base category for the girls-only and boys-only school dummies, state-integrated and private schools were the base category for the state school dummy.

Method

The exact steps and order in which our final student-parent dataset was constructed are outlined in Table A-1 in the Appendix. Table A-1 summarises the individual datasets we exported from the IDI, and the order in which they were imported, cleaned and then merged.[28]

Following an initial examination and brief analysis of the data available in the IDI, each dataset was exported directly to a CSV file using Microsoft SQL Server.

The CSV files were imported into STATA, where they were cleaned and merged. None of the CSV files were opened with Microsoft Excel to avoid any clipping of the data as a result of the large file sizes.

To create our student-parent dataset, we used the MoE student enrolment dataset as the spine on which every other dataset was merged, while the DIA child-parent link in the IDI was used to link students with their birth parents.

Imputation

When we merged datasets such as the CYF abuse dataset with the student enrolment dataset, students who did not have matches with the spine were imputed values of 0. This may result in attenuation bias in these independent variable estimates.

However, for datasets such as the NCEA results dataset, students who did not have matches with the spine, i.e. students who did not attempt NCEA level 1, 2 or 3, non-matches were imputed missing values. Importantly, students who had missing values for NCEA level 1, 2 or 3 were not included in the corresponding regressions for NCEA level 1, 2 and 3 outcomes. However, in later robustness testing, we evaluated each school on several modified NCEA dependent variables where missing students were imputed values of 0.

Tables A-2 to A-6 in the Appendix list all the independent and dependent variables used in our model, the IDI database they originated from, and the imputation process applied to them.

Model background and specification

Fixed effects vs. Random effects

The primary purpose of a VAM is to separate the contribution of family socioeconomic background from the contribution of the teacher and or school. In practice, most VAMs are specified as linear models, where they all typically include prior achievement as a key conditioning variable used to control for family socioeconomic background.[29]

In most cases, teacher and school effects are estimated as fixed effects (FE) rather than random effects (RE).[30] Fixed-effect models are chosen because of the large volume of evidence that students are almost never randomly assigned to teachers and schools.[31] School selection in New Zealand is like in many other countries, non-random.

In New Zealand, students are guaranteed a place in their local school under *Education Act 1983*.[32] While many students attend their local secondary school, a significant number of students attend secondary schools outside their school zone for several reasons.[33] Furthermore, families often buy houses based on school zones, self-selecting into higher decile schools.[34] When schools are oversubscribed, they can select students based on several different criteria.[35] Consequently, our school estimates are biased to highly selective schools to the extent that these schools may be selecting students on unobservable variables.

One reason for school oversubscription in New Zealand is the pervasive myth that “decile is a proxy for school quality”.[36] In these cases, students who live in lower socioeconomic areas enrol into schools in higher socioeconomic areas because of their parent’s belief that schools in higher socioeconomic areas are of higher quality.

For this reason, we used an FE model with LSDV estimators, alternatively defined as a CVAM. Results from Hausman tests reject the null hypothesis (RE estimator consistent and efficient) for the alternative hypothesis (FE estimator consistent) at the 5% level.[37]

Our model achieves two objectives. The first is estimating individual school fixed effects through LSDV estimators. The second is estimating the effects of individual socioeconomic background characteristics using the various independent variables.

Equation 1: Contextualised value-added model

$$Y_i = \beta_0 + \beta_1 T_i + \beta_2 X_i + \beta_3 W_i + \beta_4 Z_i + \beta_5 D_i + \epsilon_i$$

where Y_i is a vector of student NCEA outcomes, including the WRPI score, WNCEA score, EP score, and UE attainment. See Table A-6 in the Appendix for a list of all 10 NCEA-derived dependent variables. A brief description of each dependent variable is available in the data section (see p. 8).

For this report, we only evaluated schools on NCEA-derived variables. As a result, students who attempted the Cambridge International General Certificate of Education or the International Baccalaureate qualification instead of NCEA were not included in our model.[38] This may negatively bias school estimates for schools that had a large proportion of their students attempting the Cambridge or International Baccalaureate qualification rather than an NCEA qualification.

β_0 is a constant representing the number of NCEA credits (or equivalent NCEA-derived score) a student is predicted to earn independent of family background and school effects.

β_1 is a vector of estimated time effects, where T_i is a vector of time dummy variables indicating the year that a student attempted NCEA level 1, 2 or 3. In each regression, 2008 was the base year (see Table A-2 in the Appendix).

β_2 is a vector of estimated effects from various student socioeconomic background characteristics, including gender, ethnicity, behaviour at school, and abuse as identified by the CYF. The full list of student characteristics, X_i, is in Table A-3 in the Appendix.

β_3 is a vector of estimated effects from various parental background characteristics, including parental relationship status, benefits history, income, and highest level of educational attainment. The full list of parental characteristics, W_i, is in Table A-4 in the Appendix.

β_4 is a vector of estimated effects from various school characteristics, including whether the school was single-sex, co-ed, state, state-integrated, or private.[39] The full list of school characteristics, Z_i, is in Table A-5 in the Appendix.

One common VAM independent variable not included in our CVAM was school roll size. Retrospectively, we could have calculated and imputed this in STATA given existing school roll size information was not available. However, we do not believe the exclusion of this variable has significantly affected our results as research from the NSW Centre for Education Statistics and Evaluation has shown limited effects of school size once other common socioeconomic variables have been controlled for.[40]

β_5 is a vector of individual school fixed effects, where each secondary school in our dataset has been identified by individual school dummy variables denoted as D_i. The individual school fixed effects are the "value-added" scores for every secondary school[41] in New Zealand relative to one random base school across the 10-year evaluation period.[42]

Finally, ϵ_i is an idiosyncratic term that represents the contribution of factors not captured in this model. This component captures the 'raw ability' of students – the part of their performance that remains after controlling for family background and school effects.

We must note that our model is the first run at building a CVAM in New Zealand. Future work to refine it must be done if the model is to be implemented by the MoE. Future research from the Initiative will focus on further development and extensions of our CVAM.

Results

Regressions

To demonstrate the distribution of individual school performance, we completed our analysis in three parts. Part 1 shows the results by decile, Part 2 by school, and Part 3 by school and decile. Parts 1, 2 and 3 all used student-level data in each of the following regressions.

Equation 2: Restricted – Unadjusted regression annotated

$$\underbrace{Y_i}_{\substack{NCEA\\outcome}} = \underbrace{\beta_0}_{\substack{Student\\constant}} + \underbrace{\beta_5 D_i}_{\substack{School\\value-added}} + \underbrace{\epsilon_i}_{\substack{Random\\error}}$$

Equation 3: Unrestricted – Adjusted regression annotated

$$\underbrace{Y_i}_{\substack{NCEA\\outcome}} = \underbrace{\beta_0}_{\substack{Student\\constant}} + \underbrace{\beta_1 T_i}_{\substack{Time\\effects}} + \underbrace{\beta_2 X_i}_{\substack{Student\\effects}} + \underbrace{\beta_3 W_i}_{\substack{Parent\\effects}} + \underbrace{\beta_4 Z_i}_{\substack{School\\type\\effects}} + \underbrace{\beta_5 D_i}_{\substack{School\\value-added}} + \underbrace{\epsilon_i}_{\substack{Random\\error}}$$

In Parts 1 and 2, we first evaluated schools using a restricted unadjusted regression (Equation 2). This was done to show the distribution of school (and decile) performance before controlling for family background, time and school characteristics. The restricted unadjusted results from equation 1 are similar to what we currently see in NCEA league tables, albeit averaged over 10 years. In Part 1, D_i was a vector of dummy variables for each decile, while in Part 2, D_i was a vector of dummy variables for each school.

Then we ran the unrestricted adjusted regressions (Equation 3) for both Parts 1 and 2. This was done to show the distribution of school (and decile) performance after controlling for family background, time and school characteristics.

All 40 regressions for Parts 1 and 2 are summarised in Table 8, while the full set of results are shown in Tables A-7 and A-8 in the Appendix. In each of the regressions shown in Table 8, we used our complete student-parent dataset, which contained 398,961 students and covered 2008–17.[43]

Table 8: Summary of regressions

Dependent variables	Part 1: Decile level $D_i = decile$		Part 2: School level $D_i = school$	
	Unadjusted regression	**Adjusted regression**	**Unadjusted regression**	**Adjusted regression**
WRPI score NCEA level 1	Eq. 2	Eq. 3	Eq. 2	Eq. 3
WRPI score NCEA level 2	Eq. 2	Eq. 3	Eq. 2	Eq. 3
WRPI score NCEA level 3	Eq. 2	Eq. 3	Eq. 2	Eq. 3
Weighted NCEA score NCEA level 1	Eq. 2	Eq. 3	Eq. 2	Eq. 3
Weighted NCEA score NCEA level 2	Eq. 2	Eq. 3	Eq. 2	Eq. 3
Weighted NCEA score NCEA level 3	Eq. 2	Eq. 3	Eq. 2	Eq. 3
Expected percentile NCEA level 1	Eq. 2	Eq. 3	Eq. 2	Eq. 3
Expected percentile NCEA level 2	Eq. 2	Eq. 3	Eq. 2	Eq. 3
Expected percentile NCEA level 3	Eq. 2	Eq. 3	Eq. 2	Eq. 3
University Entrance	Eq. 2	Eq. 3	Eq. 2	Eq. 3

Part 1: Average decile performance

Part 1 presents the results by decile. In Figures 1–10, we plotted both the unadjusted and adjusted dummy variable coefficients, D_i, in scatterplots. In each of these figures, each decile coefficient is represented by two points, one unadjusted (blue) and one adjusted (red).

The unadjusted scores show the average performance of schools within each decile, not adjusting for family background, time and school characteristics. In contrast, the adjusted scores show the average performance of schools within each decile after adjusting for family background, time and school characteristics.

In each of the figures in Part 1, the y-axis displays the relative performance of each decile compared to the average decile 1 school while the x-axis displays the regression coefficient results. Additionally, in each of these figures, a red line was inserted along the x-axis to indicate baseline performance.

For both unadjusted and adjusted points, the 95% confidence interval was also included; however, for many of the unadjusted and adjusted points, the confidence interval bands are too small to be seen – suggesting a high level of confidence.

The results are presented by NCEA year.

NCEA level 1

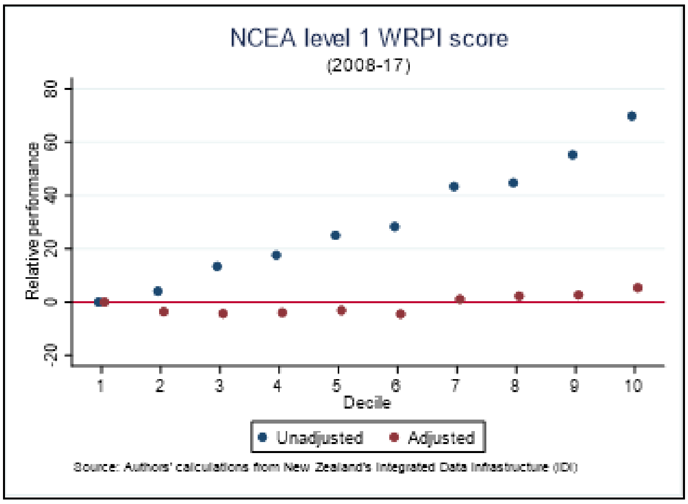


Figure 1: Unadjusted and adjusted average performance of secondary schools within each decile based on each student's NCEA level 1 WRPI score

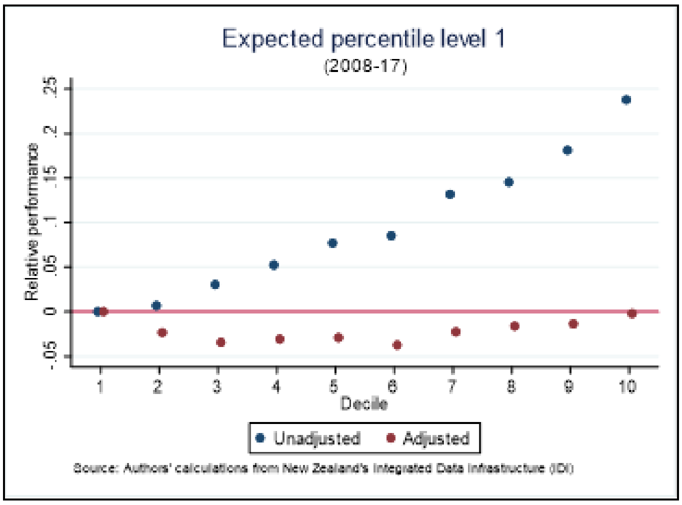


Figure 2: Unadjusted and adjusted average performance of schools within each decile based on each student's NCEA Level 1 expected percentile score

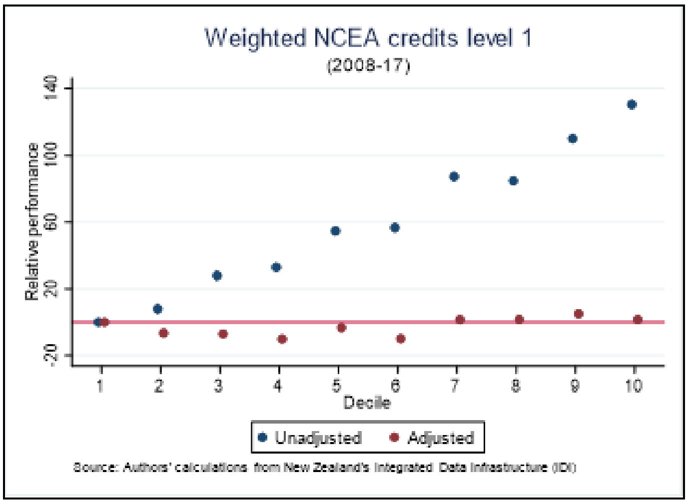


Figure 3: Unadjusted and adjusted average performance of secondary schools within each decile based on each student's NCEA Level 1 weighted score

Figures 1–3 and Figure 10 show the same results presented in an earlier Initiative research note, *Tomorrow's Schools: Data and Evidence*. The graphs clearly show that average school performance across deciles is similar once the model adjusts for differences in family background. As noted in *Tomorrow's Schools: Data and Evidence,* the results are consistent across NCEA level 1, 2 and 3.

NCEA level 2

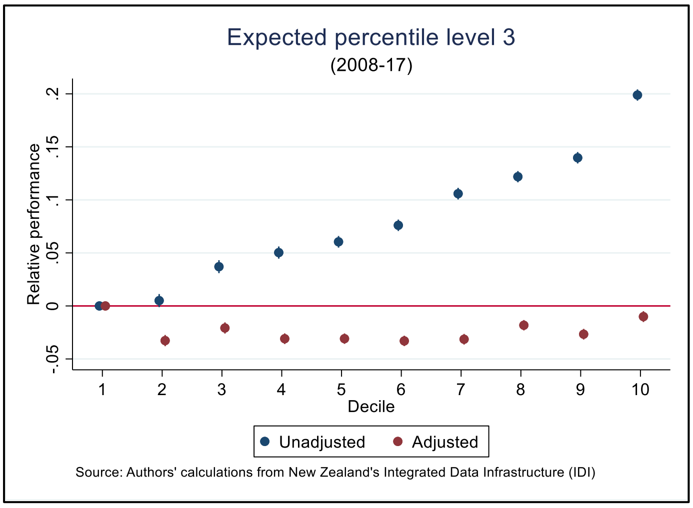


Figure 4: Unadjusted and adjusted average performance of secondary schools within each decile based on each student's NCEA level 2 WRPI score

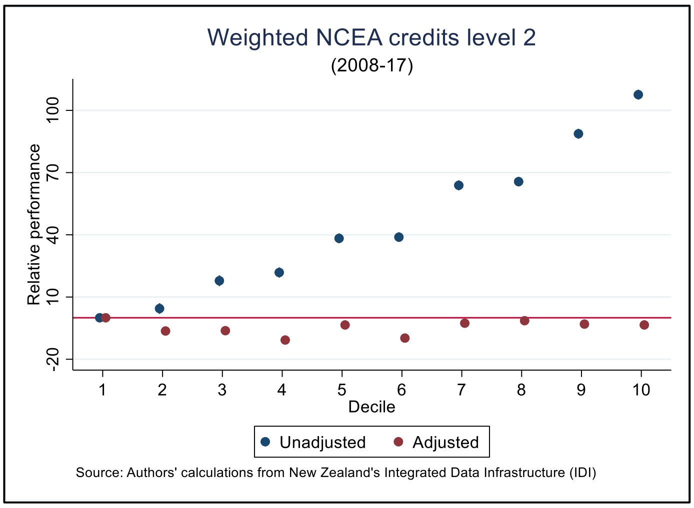


Figure 5: Unadjusted and adjusted average performance of schools within each decile based on each student's NCEA Level 2 expected percentile score

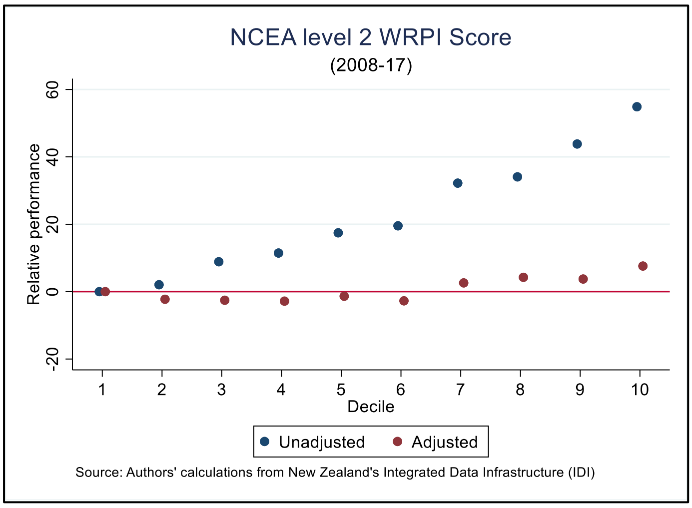


Figure 6: Unadjusted and adjusted average performance of secondary schools within each decile based on each student's NCEA Level 2 weighted score

NCEA level 3

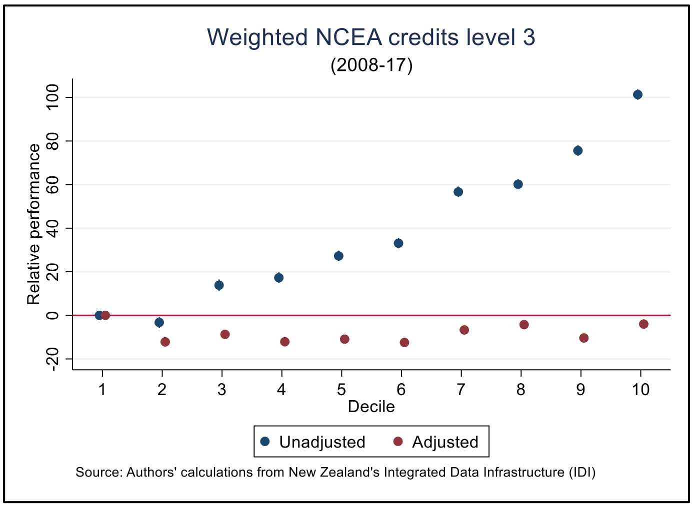


Figure 7: Unadjusted and adjusted average performance of secondary schools within each decile based on each student's NCEA level 3 WRPI score

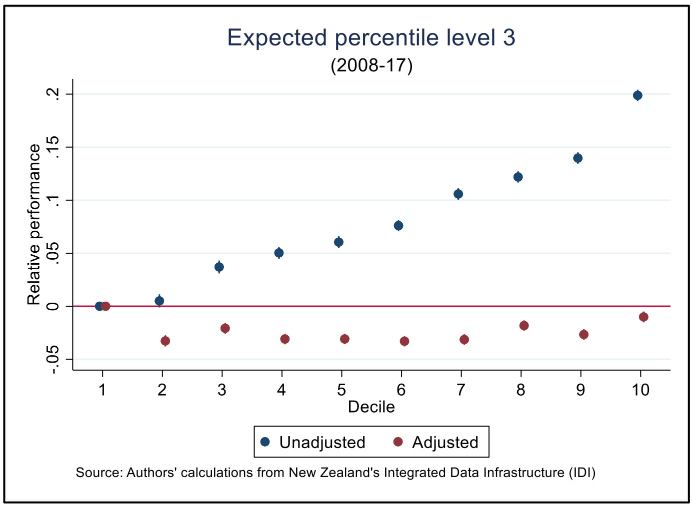


Figure 8: Unadjusted and adjusted average performance of schools within each decile based on each student's NCEA Level 3 expected percentile score

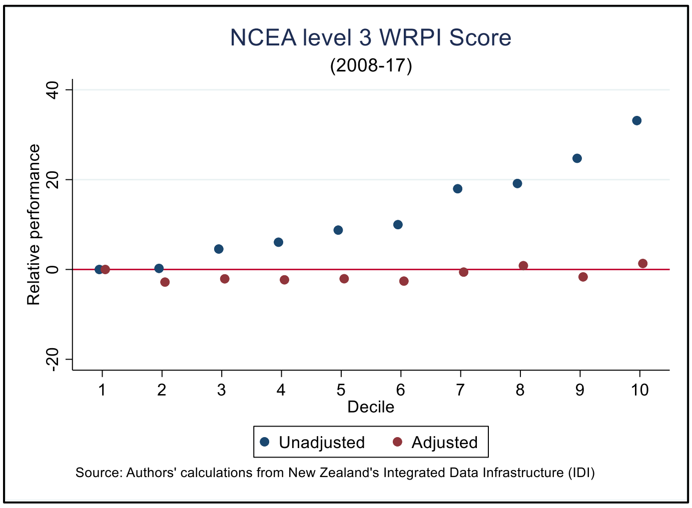


Figure 9: Unadjusted and adjusted average performance of secondary schools within each decile based on each student's NCEA Level 3 weighted score

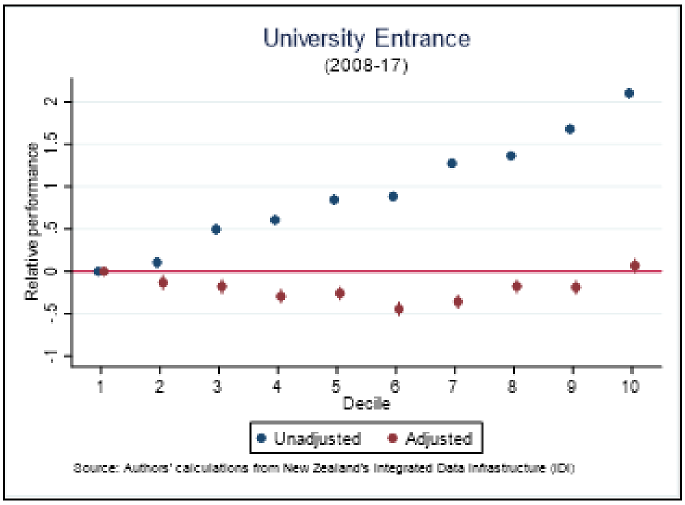


Figure 10: Unadjusted and adjusted average performance of secondary schools within each decile based on whether students achieved university entrance

Similar performance across deciles

Across all 10 outcomes, the blue (unadjusted) points in each figure trends up by decile. These unadjusted coefficients indicate that on average, high-decile schools outperform low-decile schools when differences in family background, time and school characteristics have not been controlled for.

However, once our model adjusts for differences in family background, time and school characteristics, performance differences across deciles are reduced – as indicated by the red (adjusted) points distributed around the red baseline in Figures 1–10. The results in these figures indicate that on average, decile 1 schools contribute similar "value-add" to their students as decile 10 schools, and that the differences seen across deciles are largely a result of the differences in family background, not differences in school quality.

Parts 2 and 3 go into more detail on the differences in school performance within deciles, while the Discussion (see p. 37) goes into detail on the specific background characteristics that are predictive of academic success in secondary school.

Table 9 summarises the adjusted (unrestricted) decile coefficient results as percentages of one standard deviation for each of the corresponding dependent variables.

Table 9: Summary of estimated effects: Decile

Decile	WRPI 1	WRPI 2	WRPI 3	EP 1	EP 2	EP 3	WNCEA 1	WNCEA 2	WNCEA 3
1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2	-6.2%	-4.5%	-6.9%	-11.7%	-11.9%	-14.9%	-4.4%	-5.1%	-10.3%
3	-7.5%	-5.1%	-5.1%	-17.2%	-13.1%	-9.5%	-4.7%	-4.9%	-7.4%
4	-6.8%	-5.6%	-5.7%	-15.3%	-15.4%	-14.0%	-6.8%	-8.5%	-10.2%
5	-5.4%	-2.7%	-5.1%	-14.5%	-13.9%	-14.0%	-2.2%	-2.7%	-9.2%
6	-7.8%	-5.4%	-6.4%	-18.7%	-17.9%	-15.0%	-6.7%	-7.8%	-10.5%
7	2.0%	5.2%	-1.4%	-11.3%	-10.5%	-14.3%	1.0%	-2.1%	-5.7%
8	4.0%	8.4%	2.1%	-8.1%	-5.1%	-8.3%	1.1%	-1.1%	-3.6%
9	4.7%	7.4%	-4.1%	-6.8%	-9.0%	-12.1%	3.4%	-2.4%	-8.8%
10	9.5%	15.1%	3.3%	-1.1%	3.0%	-4.6%	1.0%	-2.7%	-3.4%

Note: We have presented the results as percentages instead of regression coefficients because the coefficients shown in Tables A-7 and A-8 are relatively non-intuitive to interpret. Additionally, UE was excluded from Table 9 because schools (and deciles) were evaluated using a logit model, which produced odds-ratios rather than standard OLS coefficient results.

WRPI

The red (adjusted) points in Figures 1, 4 and 7 indicate that average school performance across deciles is similar when schools were evaluated on the performance of their students in WRPI. However, while performance is similar, it is not equal. Table 9 shows average school performance within decile 2–6 schools is slightly worse relative to decile 1 schools – on average, -5.72% of a standard deviation worse. In contrast, decile 7–10 schools perform slightly better relative to the average decile 1 school – on average, 4.68% of a standard deviation better. Table A-7 shows that all but three adjusted WRPI decile coefficients are statistically significant at the 5% level.

EP

The results are more polarised when schools are evaluated on the performance of students in EP. Figures 2, 5 and 8 show decile 2–10 schools all underperform relative to the average decile 1 school. Decile 2–7 schools perform, on average, -14.06% of a standard deviation worse, while decile 8–10 schools perform, on average, -5.79% of a standard deviation worse. Table A-7 shows that all but one adjusted expected percentile decile coefficient is statistically significant at the 5% level.

WCEA

The red (adjusted) points in Figures 3, 6 and 9 show similar but not equal performance across all deciles – comparable to the WRPI results. Decile 2–6 schools underperform relative to the average decile 1 school, while decile 7–10 schools overperform relative to the average decile 1 school. Table A-7 shows that all but five adjusted weighted NCEA score decile coefficients are statistically significant at the 5% level.

University Entrance

When evaluated on UE, decile 2–9 schools all underperform relative to decile 1 and 10 schools, where the red (unadjusted) points show decile 6 schools perform the worst with an odds ratio of 0.64 to 1 compared to decile 1 schools. All but one adjusted UE decile coefficient is statistically significant at the 5% level.

Part 2: Individual school performance

Part 2 presents our results by school. In Figures 11–20, the individual school coefficients from Equation 3 are presented in a LOWESS (locally weighted scatterplot smoothing) graph format. Unfortunately, because of rule 5.14.2 in Statistics New Zealand's *Microdata Output Guide*, we are not able to present the results as standard scatterplots (where each school is represented by two points – unadjusted and adjusted).[44] Rule 5.14.2 prevents researchers from presenting results in ways that could uniquely identify individual entities, including but not limited to individuals, businesses and schools. The confidentiality rules apply to both summary statistics and regression coefficient results.

To overcome this, we applied a LOWESS curve to the individual school coefficients, ordered from smallest to largest, so we could present the results in a way that would still show the distribution of individual school performance. We would very much like to have shown how many individual schools move between the two rankings, but that seems impossible with the way Statistics New Zealand currently interprets the confidentiality rules.

Like the figures shown in Part 1, Figures 11–20 in Part 2 show relative performance along the y-axis. However, in Part 2 the x-axis displays the unadjusted and adjusted school ranks of the 480 secondary schools in our dataset. For each regression (unadjusted and adjusted), the LOWESS curves have been applied to the corresponding ordered school coefficients. The result is two curves, one unadjusted (red) and one adjusted (blue).

The results are presented by NCEA year.

NCEA level 1

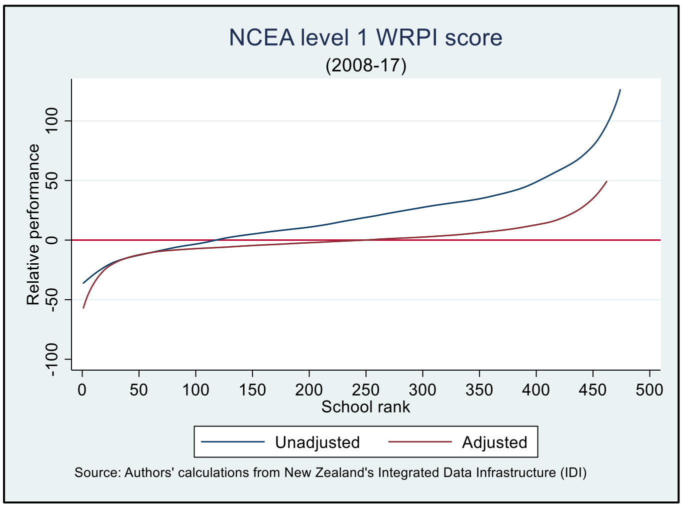


Figure 11: Unadjusted and adjusted performance of New Zealand secondary schools based on each student's NCEA level 1 WRPI score

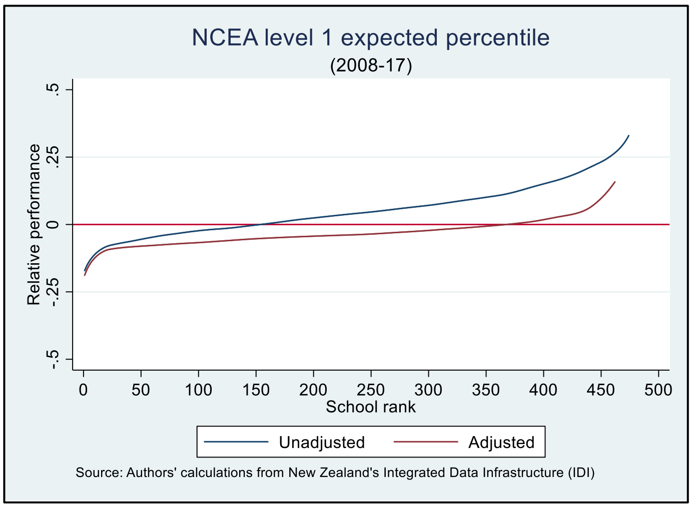


Figure 12: Unadjusted and adjusted performance of New Zealand secondary schools based on each student's NCEA level 1 expected percentile score

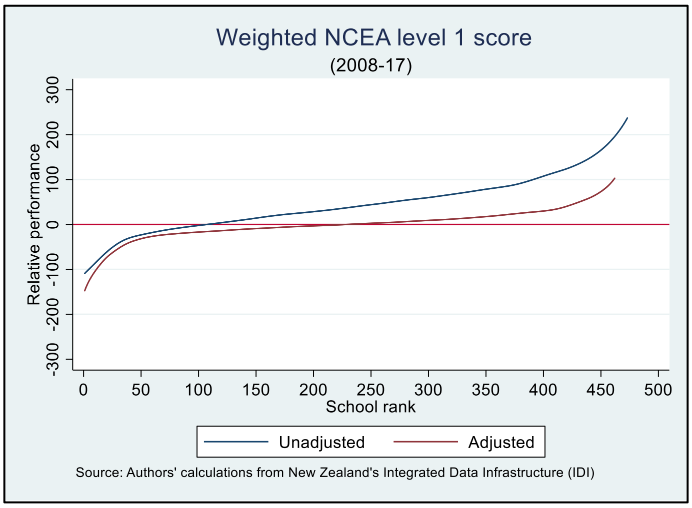


Figure 13: Unadjusted and adjusted performance of New Zealand secondary schools based on each student's NCEA level 1 weighted score

NCEA level 2

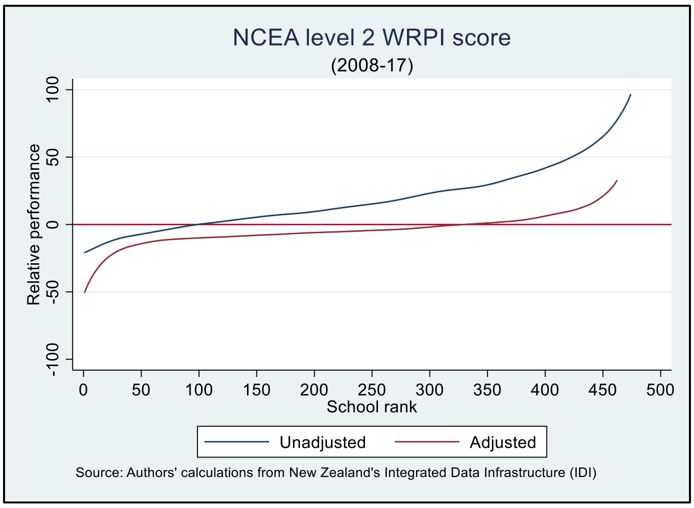


Figure 14: Unadjusted and adjusted performance of New Zealand secondary schools based on each student's NCEA level 2 WRPI score

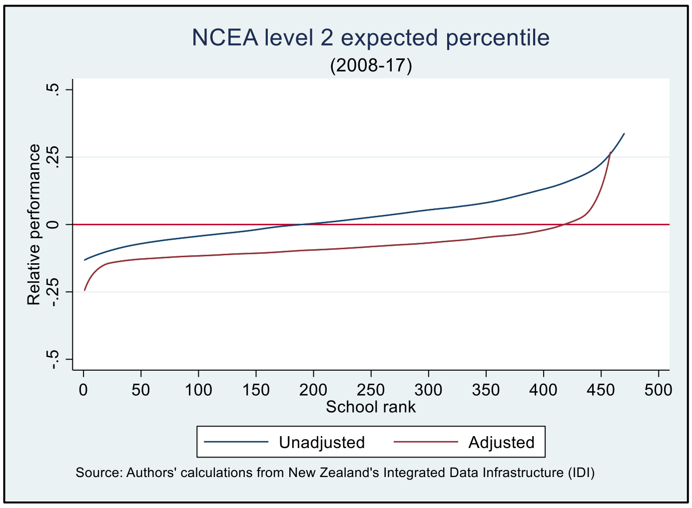


Figure 15: Unadjusted and adjusted performance of New Zealand secondary schools based on each student's NCEA level 2 expected percentile score

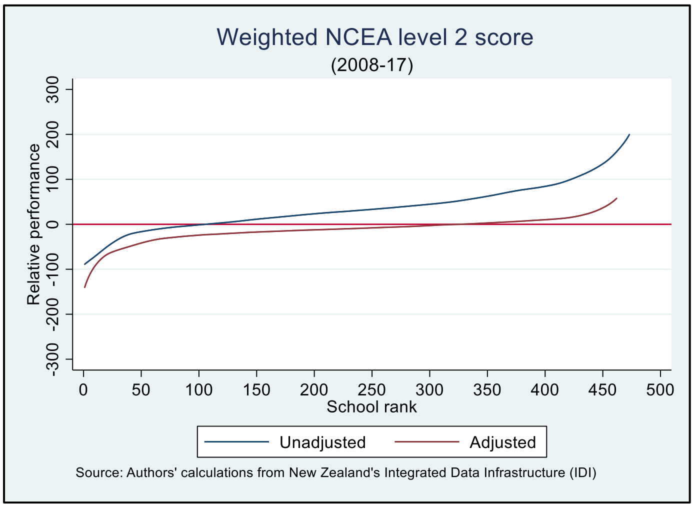


Figure 16: Unadjusted and adjusted performance of New Zealand secondary schools based on each student's NCEA level 2 weighted score

NCEA level 3

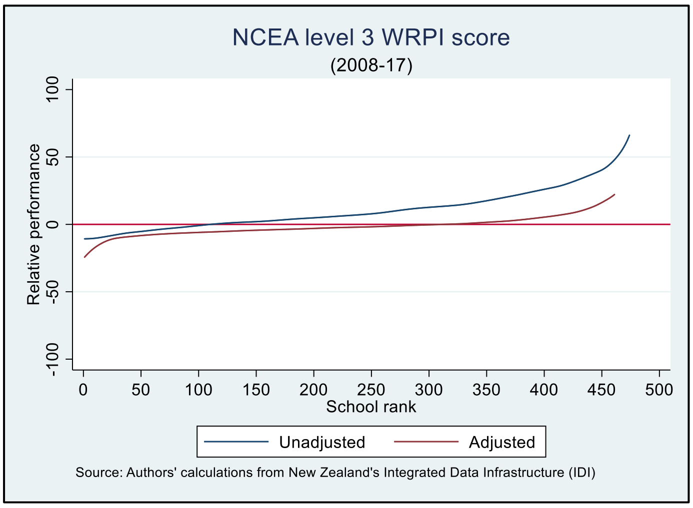


Figure 17: Unadjusted and adjusted performance of New Zealand secondary schools based on each student's NCEA level 3 WRPI score

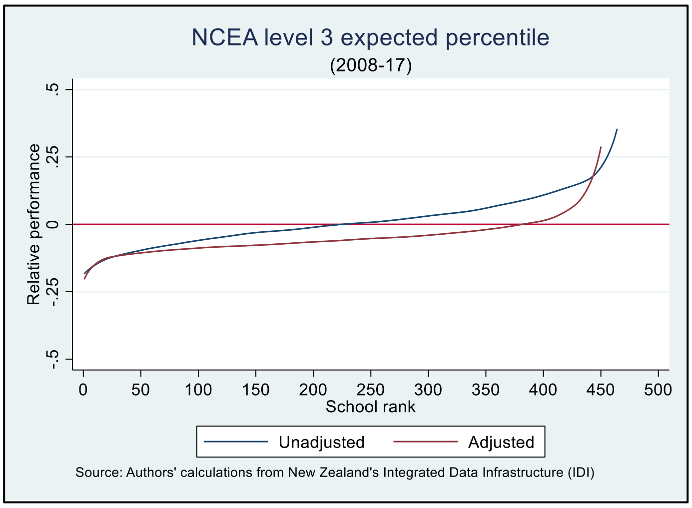


Figure 18: Unadjusted and adjusted performance of New Zealand secondary schools based on each student's NCEA level 3 expected percentile score

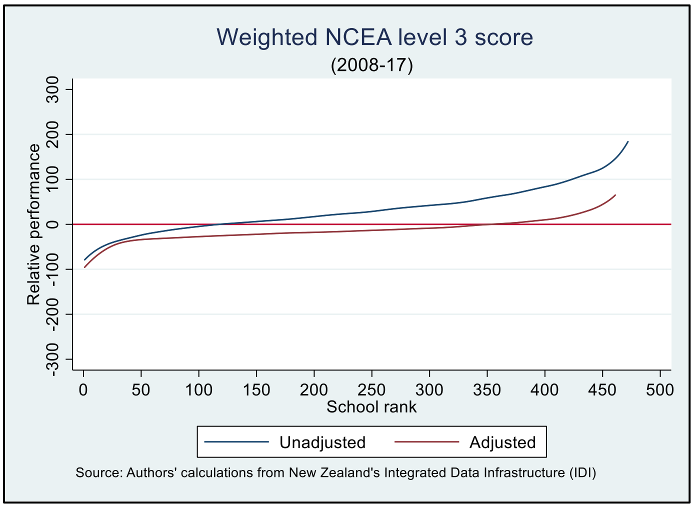


Figure 19: Unadjusted and adjusted performance of New Zealand secondary schools based on each student's NCEA level weighted score

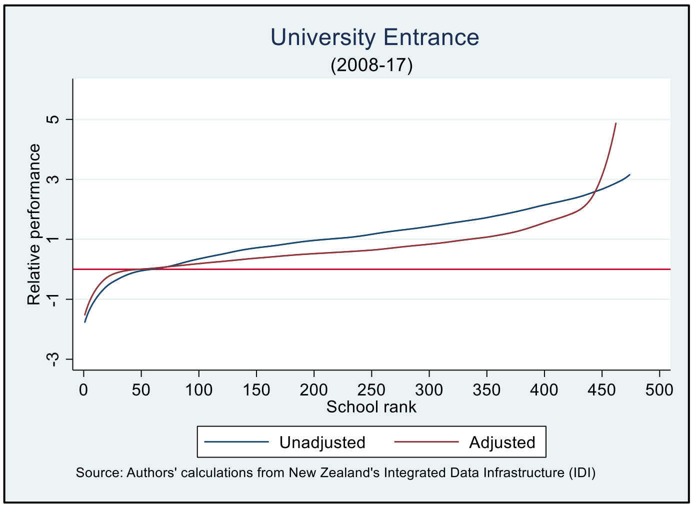


Figure 20: Unadjusted and adjusted performance of New Zealand secondary schools based on whether students achieved university entrance

80% of secondary schools perform very similarly

The general trend across all 10 outcome variables shown in Figures 11–20 is that 80% of schools – approximately 380 out of all 480 secondary schools in New Zealand – perform almost identically to each other. However, while most schools perform similarly, there are outliers in the bottom 10% and in the top 10% – approximately the bottom 50 and the top 50 secondary schools.

The exact percentage of schools that are statistically indifferent from each other varies based on the outcome the school was evaluated on. Unfortunately, given Statistics New Zealand's confidentially rules, we cannot present individual school coefficients.

Like the decile results, the unadjusted school results demonstrated by the blue LOWESS curves show large differences in school performance. However, once the model has adjusted for differences in family background, time and school characteristics, there is significantly less variation in school performance. Reiterating the decile results, this suggests that the large differences in school league tables are not primarily due to large differences in school quality but large differences in family socioeconomic background – in particular, differences in parental education rather than income.

WRPI, EP and WNCEA

However, in contrast to the decile results, the individual results are more consistent across 9 out of the 10 outcomes. In Figures 11–19, the middle 80% of schools perform almost identically to each other when evaluated on the performance of their students in the WRPI, EP and WNCEA scores. Additionally, in Figures 11–19 the outliers are in the bottom 10% and the top 10% of the school distribution, where the top-performing school(s) perform one standard deviation above the median school when evaluated on WRPI; slightly above one standard deviation when evaluated on EP; and slightly below one standard deviation when evaluated on the WNCEA score.

University Entrance

Finally, Figure 20 shows UE school results. Like the previous sections, approximately 80% of schools perform very similarly. However, in contrast to the previous results, there appear to be a select number of top-performing schools at the top end of the adjusted LOWESS curve, where the top-performing school(s) have an odds ratio of 5 to 1 of predicting UE achievement.

Differences across NCEA levels

It appears that the variance in school performance, specifically the difference between the top and the bottom schools, is decreasing in NCEA levels. The fall in individual school variance may be the result of underperforming students leaving after NCEA level 1 in each school – students who would have otherwise contributed to the lower performance of that school.

In later robustness tests, discussed further in the Appendix we reran our CVAM using a cohort of students, including students who dropped out of NCEA level 2 and 3. Briefly, early testing shows somewhat consistent results.

Part 3: Distribution of individual school performance across deciles

Part 3 shows the distribution of individual school performance across deciles. In constructing Figures 21–40, each school has been categorised as low-, average- and high-performing based on their school rank from both the unadjusted and adjusted regressions. As noted earlier, each school was ranked based on the size of its school coefficient from the unadjusted and adjusted regressions.

Schools in the bottom 25% were categorised as low performing, schools in the middle 50% as average performing, and schools in the top 25% as high performing. Note that this banding was chosen because it was the finest banding that could allow results out of IDI for most deciles.

Following this categorisation, the number of schools in each performance category was tallied in tables by decile and then randomly rounded to base 3. Importantly, for cell counts of 5 or less, the cell needed to be suppressed for release by the IDI.[45]

Table 10: Example of school counts by decile and category with suppressions

WRPI Score NCEA level 1 Unadjusted					
Decile	**1–2**	**3–4**	**5–6**	**7–8**	**9–10**
Low	63	24	9	s	12
Average	33	63	78	42	15
High	s	s	9	42	60

To present these results as stacked bar graphs, we have imputed values of 3 to indicate a possible suppression. As a result, several graphs from Figures 21–40 have yellow bars, indicating school counts of 3 that may be values of 0, 1, 2, 3, 4 or 5.

Table 11: Example of school counts by decile and category with imputation

WRPI Score NCEA level 1 Unadjusted					
Decile	**1–2**	**3–4**	**5–6**	**7–8**	**9–10**
Low	63	24	9	3	12
Average	33	63	78	42	15
High	3	3	9	42	60

Table 12: Relevant colours and categories for the figures below

	Low	Bottom 25% of schools
	Average	Middle 50% of schools
	High	Top 25% of schools
	Imputed	Cell count suppressed

Tables A-9 to A-12 in the Appendix show the school counts behind Figures 21–40.

Performance categories

When deciding the performance categories, we originally wanted to categorise low-performing schools as the bottom 10% and high-performing schools as the top 10% as per the results discussed in Part 2. However, because of Statistics New Zealand's suppression rules, we could not construct Figures 21–40 without heavy suppression of cell counts. As a result, we decided to use a 25% cut-off rather than the optimal 10%.

Additionally, we decided to combine the deciles into quintiles to prevent further cell suppression.

Low- and high-performing schools across all deciles

Figures 21–40 show that once differences in family socioeconomic background are adjusted for, the distribution of high- and low-performing schools is more evenly distributed across all 10 deciles. Looking at the adjusted figures, it is obvious there are lower-performing schools in both high-, middle- and low-decile schools; at the same time, there are high-performing schools, too.

WRPI score unadjusted

Figure 21: Distribution of school performance: WRPI score (NCEA level 1 unadjusted)

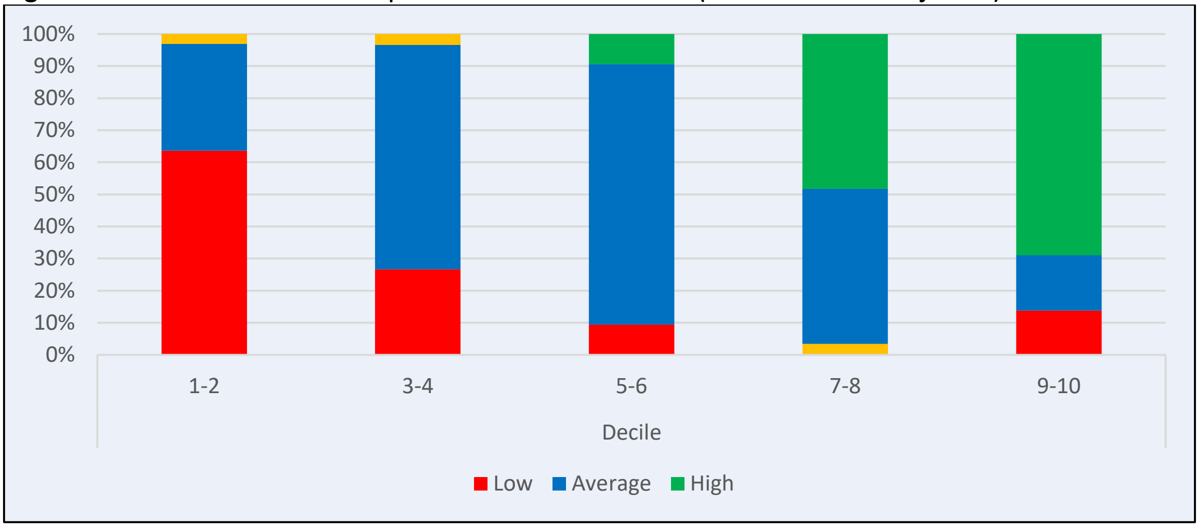


Figure 22: Distribution of school performance: WRPI NCEA score (NCEA level 2 unadjusted)

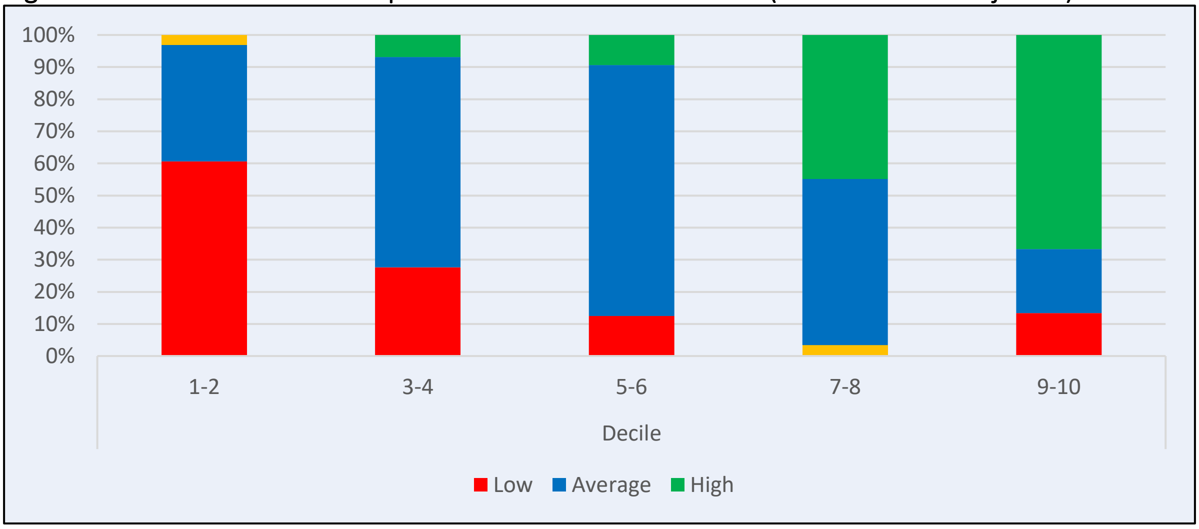
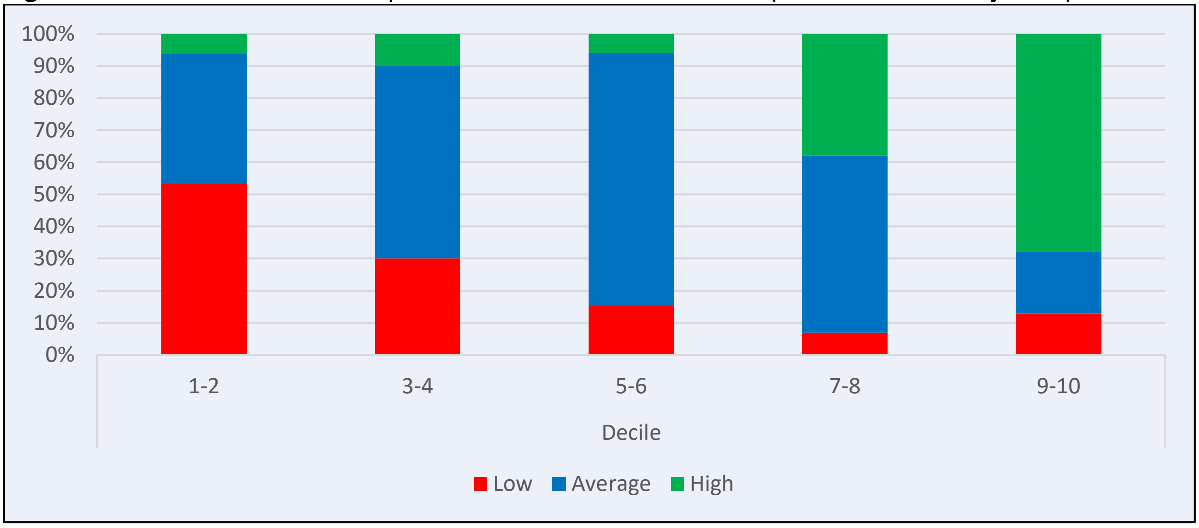


Figure 23: Distribution of school performance: WRPI NCEA score (NCEA level 3 unadjusted)



WRPI score adjusted

Figure 24: Distribution of school performance: WRPI NCEA score (NCEA level 1 adjusted)

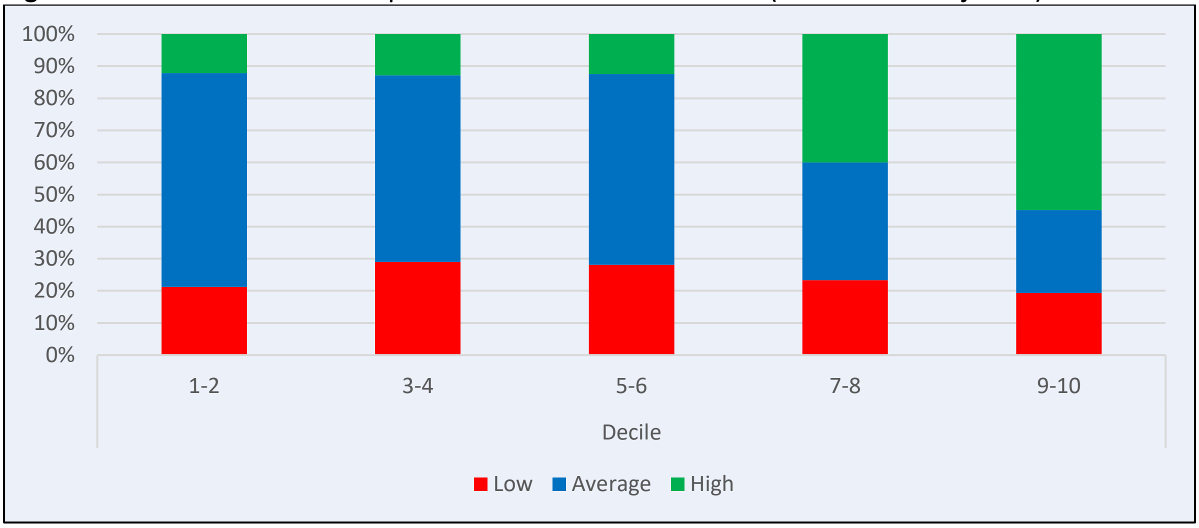


Figure 25: Distribution of school performance: WRPI NCEA score (NCEA level 2 adjusted)

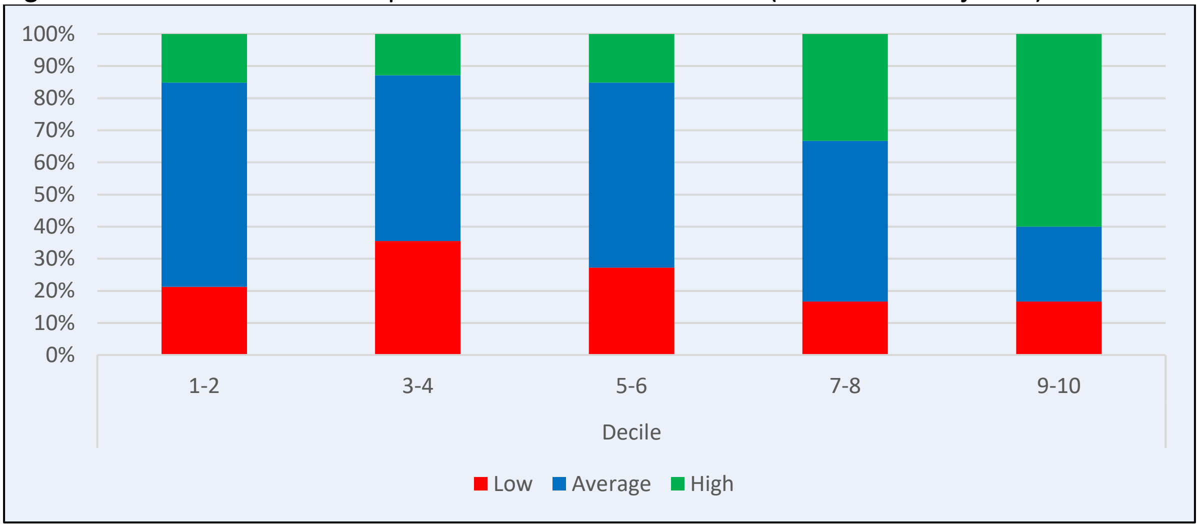
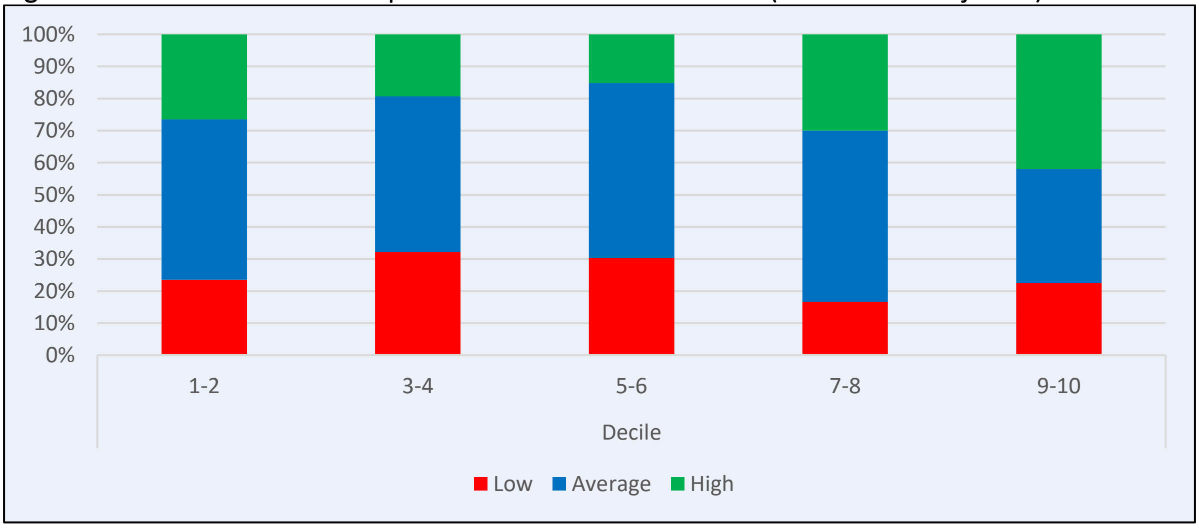


Figure 26: Distribution of school performance: WRPI NCEA score (NCEA level 3 adjusted)



Expected percentile score unadjusted

Figure 27: Distribution of school performance: Expected percentile score (NCEA level 1 unadjusted)

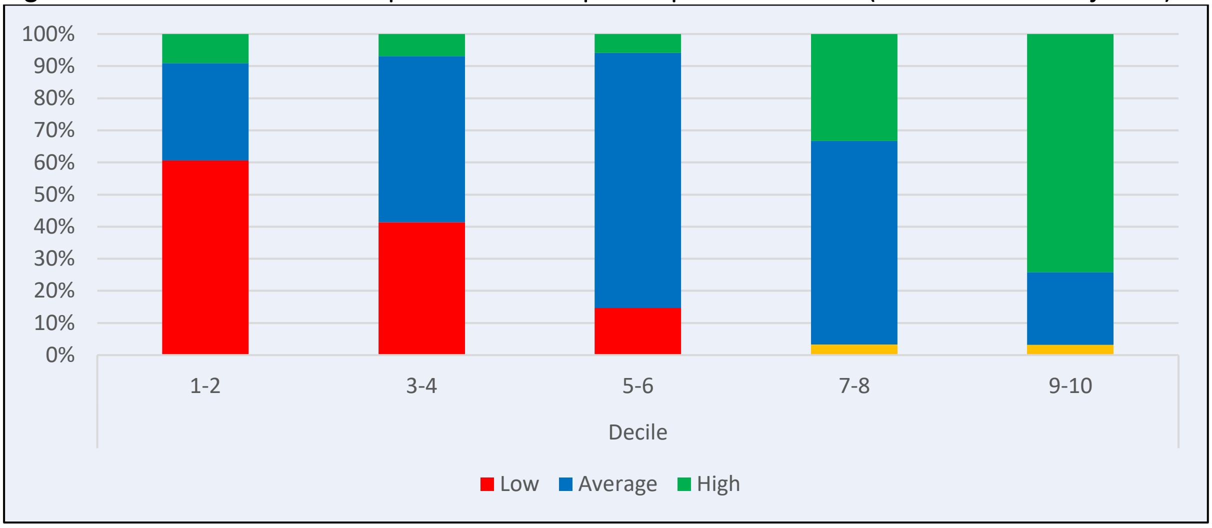


Figure 28: Distribution of school performance: Expected percentile score (NCEA level 2 unadjusted)

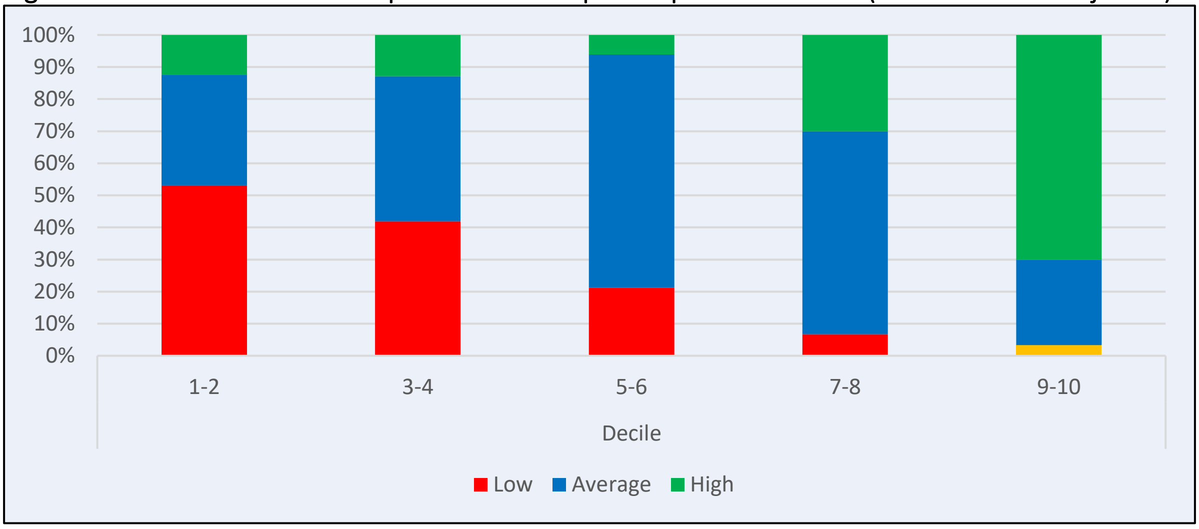
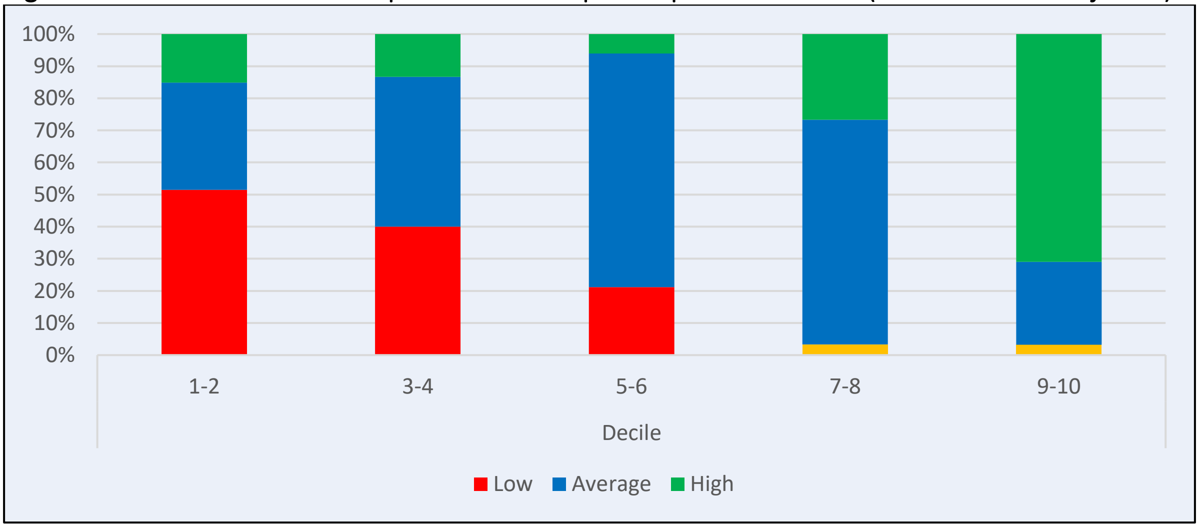


Figure 29: Distribution of school performance: Expected percentile score (NCEA level 3 unadjusted)



Expected percentile score adjusted

Figure 30: Distribution of school performance: Expected percentile score (NCEA level 1 adjusted)

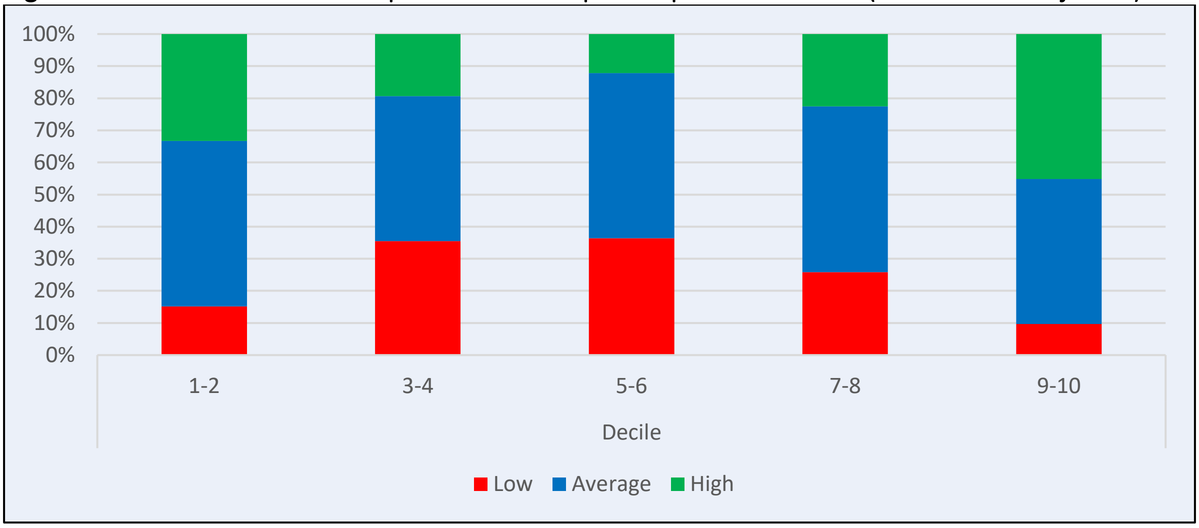


Figure 31: Distribution of school performance: Expected percentile score (NCEA level 2 adjusted)

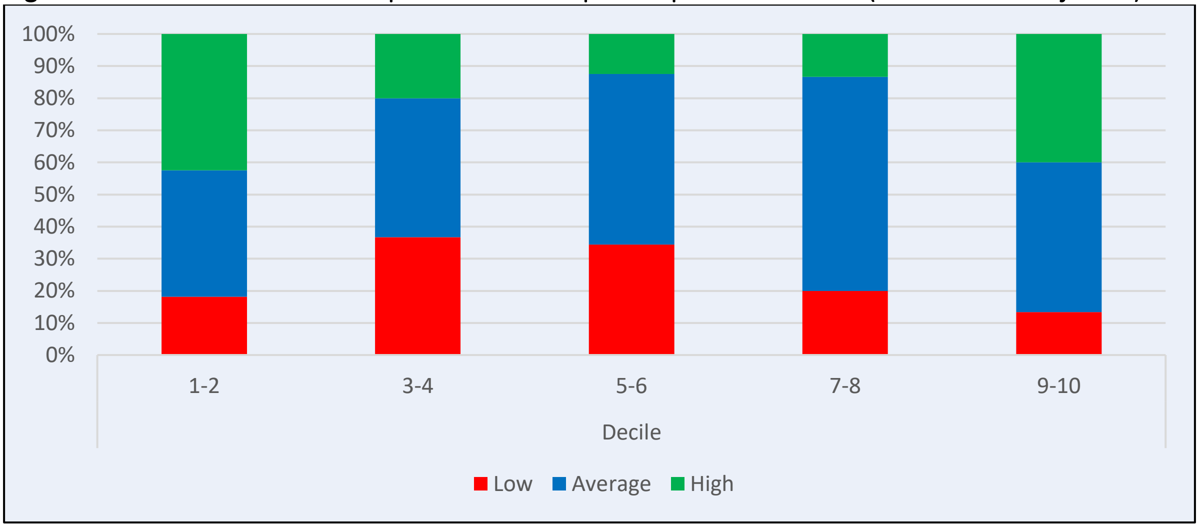
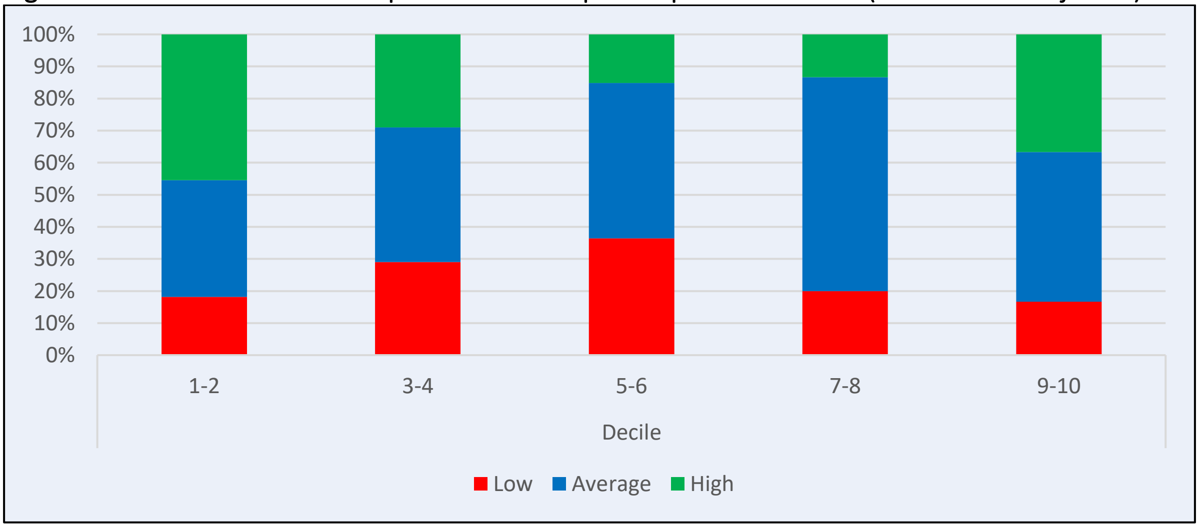


Figure 32: Distribution of school performance: Expected percentile score (NCEA level 3 adjusted)



Weighted NCEA score unadjusted

Figure 33: Distribution of school performance: Weighted NCEA score (NCEA level 1 unadjusted)

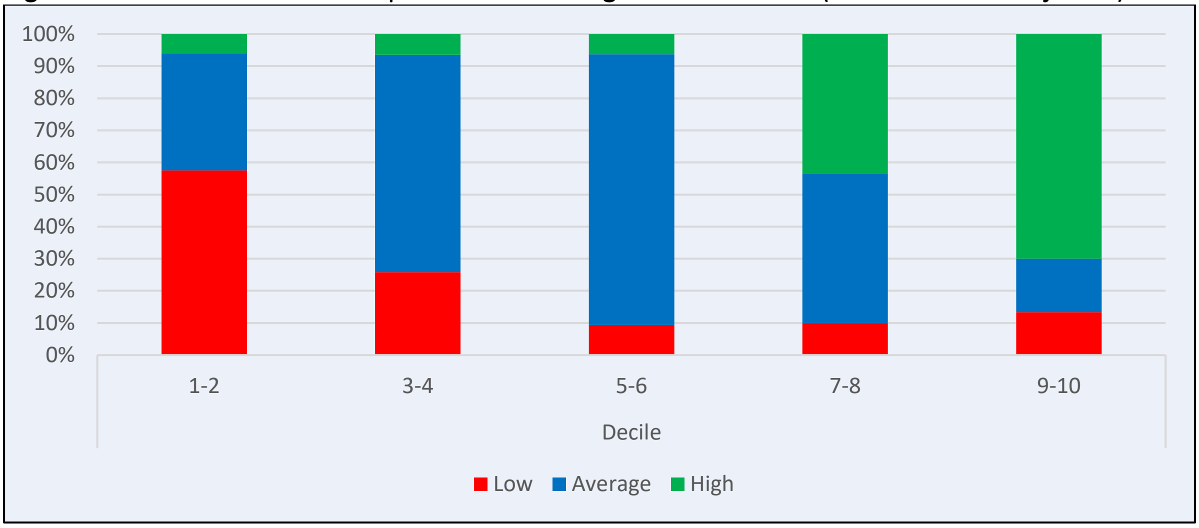


Figure 34: Distribution of school performance: Weighted NCEA score (NCEA level 2 unadjusted)

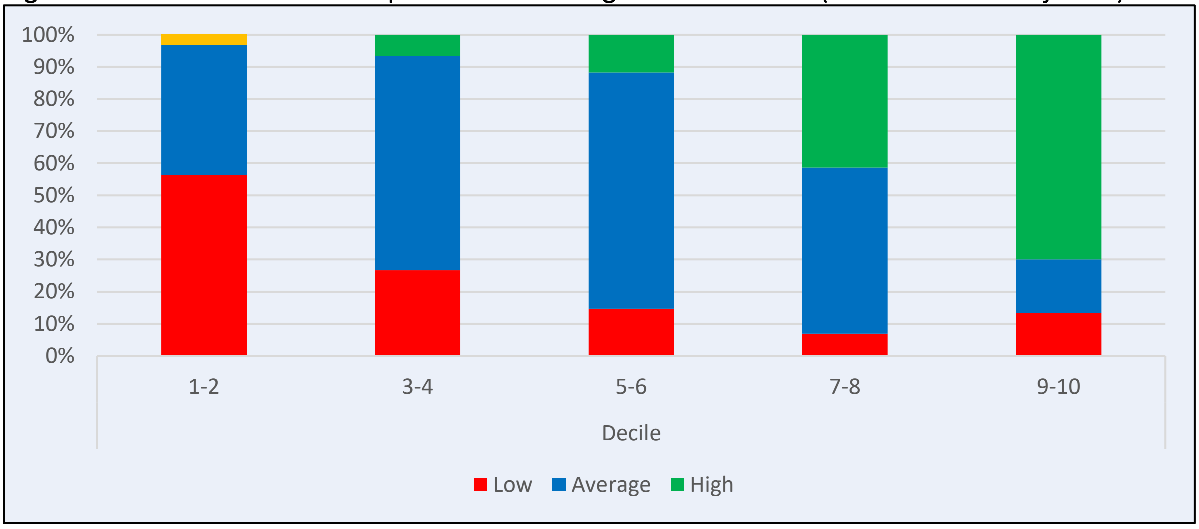
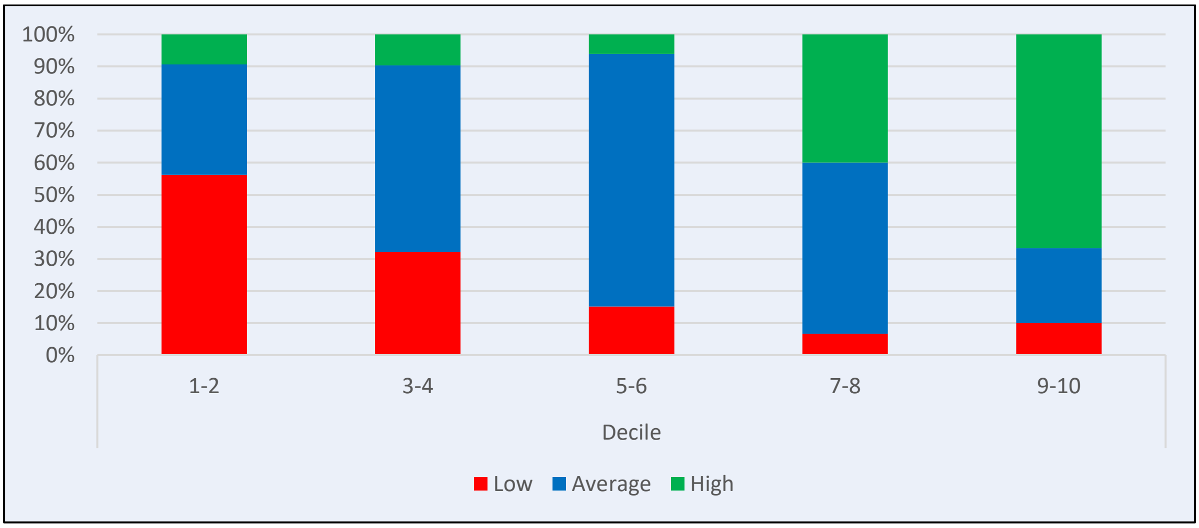


Figure 35: Distribution of school performance: Weighted NCEA score (NCEA level 3 unadjusted)



Weighted NCEA score adjusted

Figure 36: Distribution of school performance: Weighted NCEA score (NCEA level 1 adjusted)

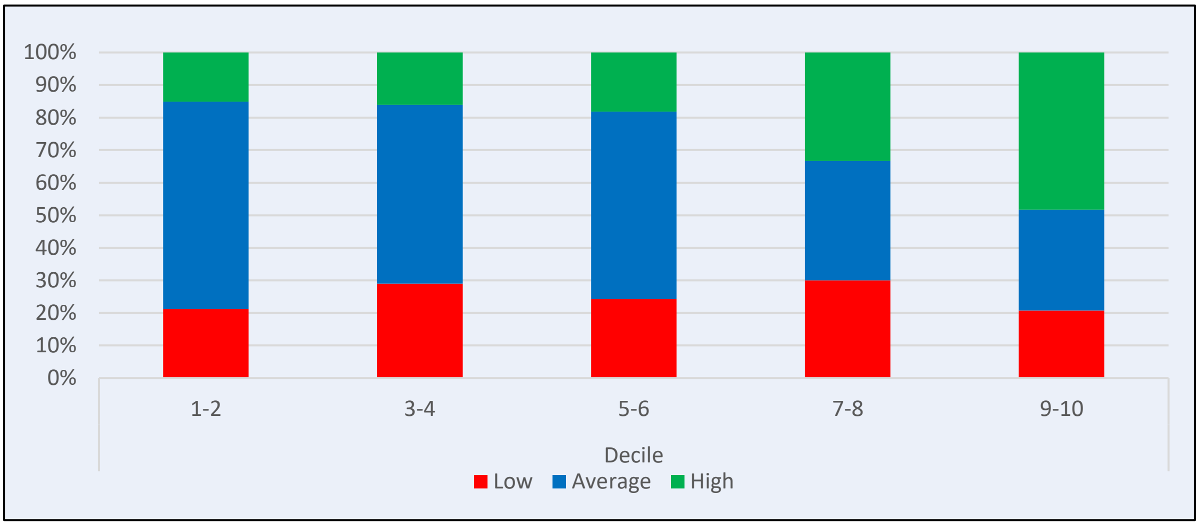


Figure 37: Distribution of school performance: Weighted NCEA score (NCEA level 2 adjusted)

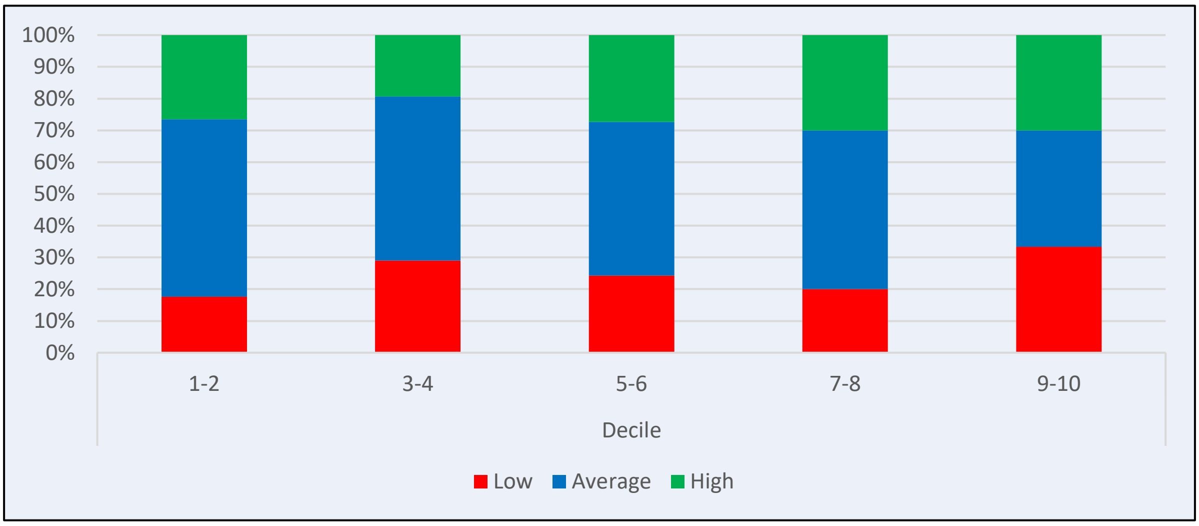
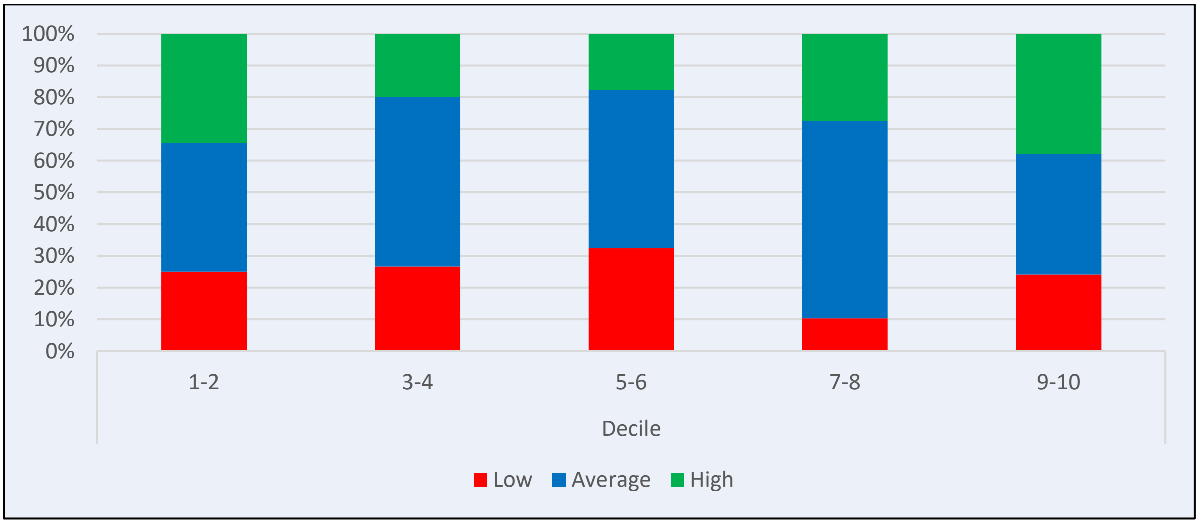
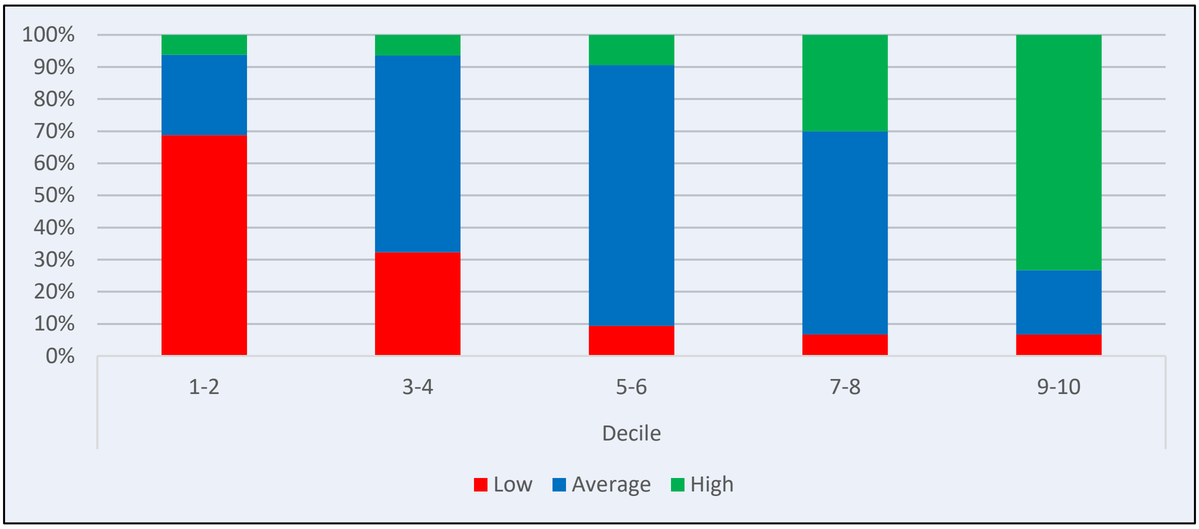


Figure 38: Distribution of school performance: Weighted NCEA score (NCEA level 3 adjusted)



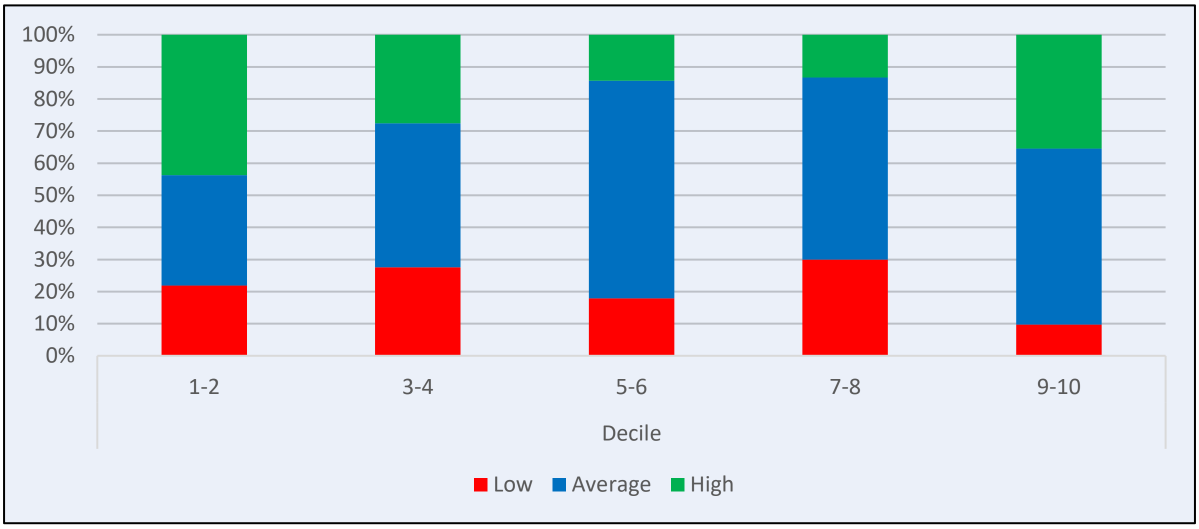
University Entrance unadjusted

Figure 39: Distribution of school performance: University Entrance (unadjusted)



University Entrance adjusted

Figure 40: Distribution of school performance: University Entrance (adjusted)



WRPI

When evaluated on WRPI, the concentration of high-performing schools is greatest in high-decile schools, both on unadjusted and adjusted measures (see Figures 24–25); however, on the adjusted measures (see Figures 24–26) the distribution is more uniform across all deciles. Figure 21 shows 69% of decile 9–10 schools classified as high-performing; however, this falls to 54.8% after adjusting for family background characteristics (see Figure 24).

By contrast, the distribution of low-performing schools is nearly equal across all deciles after adjusting for family background characteristics (see Figures 24–26). By comparison, Figure 21 shows that 63.6% of decile 1–2 schools are low performing; however, this falls to 21.2% on the unadjusted measure (see Figure 24).

EP and UE

Across the EP and UE results, the distribution of high-performing schools is mostly concentrated in decile 1–2 and 9–10 schools (see Figures 27–32 and 39–40). Figure 30 shows 33.3%, 12.1% and 45.2% of decile 1–2, 5–6 and 9–10 schools respectively as high performing.

In contrast, the concentration of low-performing schools is greatest in decile 5–6 schools when schools where evaluated on EP. Figures 30, 31 and 32 show 36.4%, 34.4% and 36.4% of decile 5–6 schools respectively as low performing. Conversely, when evaluated on UE, low-performing schools are more uniformly distributed across all deciles. Figure 40 shows 21.9%, 27.6%, 17.9%, 30.0% and 9.7% of decile 1–2, 3–4, 5–6, 7–8 and 9–10 schools respectively as low performing.

WNCEA

The distribution of high-performing and low-performing schools is most uniform when schools were evaluated on WNCEA (see Figures 33–38). Figure 37 shows 26.5%, 19.4%, 27.3%, 30.0% and 30.0% of decile 1–2, 3–4, 5–6, 7–8 and 9–10 schools respectively as high performing. By comparison, Figure 37 shows 17.6%, 29.0%, 24.2%, 20.0% and 33.3% of decile 1–2, 3–4, 5–6, 7–8 and 9–10 schools respectively as low-performing.

Hypothesis explaining the distribution of school performance

One hypothesis explaining low- and high-decile schools having a higher proportion of high performers is teacher quality. Better teachers may be more attracted to high-decile schools for a more ‘comfy’ and challenging teaching experience with more able students; in contrast, better teachers may also be attracted to low-decile schools because they believe in their potential to make a difference to a child’s life.

Crucially, we can only speculate on what drives the differences we observe across and within deciles. This reveals one major limitation of our model, that is, it is unable to distinguish between school-specific and teacher-specific effects. To be able to distinguish those differences, multilevel models using student- and teacher-level data are required.

Currently, the only way to determine the drivers of these differences in school performance is through MoE officials, who would need to study these high-performing schools via in-school visits – similar to ERO reviews.

Discussion

We should preface this discussion by acknowledging that the estimated effects presented here are all correlates. Our CVAM is a reduced form model (rather than a structural model) that uses observational data without the pretence of any natural experiment behind our analysis; therefore, our estimates cannot be interpreted as causal relationships.

Furthermore, we should highlight that the purpose of our research was not to explain the effects of parent's education or income on academic achievement; rather, the purpose was to determine or estimate the distribution of secondary school performance in New Zealand holding family background, time and school effects constant.

Regardless, there are interesting insights to be gained from the socioeconomic background coefficients presented and discussed here. As is always the case, the results shown here introduce more questions than answers. Nevertheless, where applicable we have discussed previous literature in relation to the consistency of our results in addition to potential mechanisms between our independent and dependent variables.

To aid the interpretation of our results we have presented our coefficients as percentages of one standard deviation for each of the corresponding dependent variables. By themselves, the coefficients shown in Tables A-7 and A-8 in the Appendix are relatively non-intuitive as a result of the NCEA-derived variables we used as our dependent variables.

Furthermore, stated as percentage of a standard deviation our results can be interpreted in relation to education researcher John Hattie's seminal paper "Measuring the Effects of Schooling" (1992). Hattie states: "Most innovations that are introduced in schools improve achievement by about 0.4 standard deviations [or 40% of one standard deviation]. This is the benchmark figure and provides a standard from which to judge effects."[46]

Parental education

Table 13: Summary of estimated effects: Parental education

	WRPI 1	WRPI 2	WRPI 3	EP 1	EP 2	EP 3	WNCEA 1	WNCEA 2	WNCEA 3	Average
Mother's education										
High school certificate***	10.5%	8.1%	4.4%	13.5%	11.0%	8.2%	8.4%	4.5%	6.6%	8.3%
Diploma***	23.1%	19.1%	10.9%	26.0%	21.9%	16.8%	16.7%	9.3%	12.4%	17.4%
Bachelor***	32.6%	28.2%	17.8%	34.0%	30.0%	22.7%	20.1%	10.1%	16.4%	23.6%
Postgraduate (master's/PhD)***	42.8%	37.9%	26.1%	43.0%	36.7%	30.0%	26.9%	14.2%	22.3%	31.1%
Father's education										
High school certificate***	11.1%	8.9%	4.8%	12.5%	10.5%	8.6%	8.3%	4.1%	6.6%	8.4%
Diploma***	23.7%	19.4%	10.3%	25.0%	21.4%	15.5%	16.1%	7.8%	11.8%	16.8%
Bachelor***	44.4%	39.4%	26.1%	41.5%	35.7%	26.8%	27.3%	13.5%	21.1%	30.7%
Postgraduate (master's/PhD)***	50.0%	45.5%	33.8%	46.0%	40.5%	30.9%	30.7%	16.0%	25.9%	35.5%

Note: The percentages shown here have been calculated from the decile regressions from Part 1 because the school regressions from Part 2 dropped the school characteristics coefficients due to co-linearity. Additionally, UE has been excluded from Tables 13–19 because UE attainment was evaluated using a logit model, which produced odds-ratios rather than standard OLS coefficient results.

Note: Variables with *** have statistically significant results at the 1% level across all WRPI, EP and WNCEA decile regressions.

We found that differences in parental education attainment is one of the most important predictors of a student's academic achievement, where the estimated effect of having both parents with postgraduate degrees increases a student's academic achievement by nearly one standard deviation (all else constant).[47] Table 13 shows a summary of the estimated effects of parental education as a percentage of one standard deviation for each of the corresponding dependent variables.

As expected, the estimated effect of parental education is increasing in attainment. Across WRPI, EP and WNCEA, the average estimated effect of parental education is approximately 8% for a high school certificate, 17% for a diploma, 23–30% for a bachelor's degree, and 31–35% for a postgraduate degree. Tables A-7 and A-8 show all the parental education estimates as statistically significant at the 1% level. Across all the independent variables we included, parental education had the largest predictive effect on student achievement.

This finding is consistent with the literature, which systematically finds that parental education is one of the most important (if not the strongest) predictors of children's academic achievement.[48] The exact mechanisms explaining this influence have not yet been well studied, however.[49]

This report cannot explain the mechanisms behind the influence of parental education, though previous research finds parental beliefs and behaviours have an influence.[50] Other research using family process models find the structure of the home environment and type of parenting (harsh versus nurturing) play a role, too.[51]

Student gender and ethnicity

Table 14: Summary of estimated effects: Student background characteristics

	WRPI 1	WRPI 2	WRPI 3	EP 1	EP 2	EP 3	WNCEA 1	WNCEA 2	WNCEA 3	Average
Female***	24.0%	19.8%	14.4%	24.5%	26.7%	25.0%	16.0%	4.2%	12.0%	18.5%
Māori***	-10.5%	-9.0%	-5.9%	-10.5%	-7.6%	-7.7%	-7.3%	-6.8%	-8.5%	-8.2%
Pasifika***	-9.7%	-7.2%	-8.0%	-12.5%	-12.9%	-18.6%	-5.4%	-8.1%	-7.6%	-10.0%
Australian	-1.9%	-0.9%	-4.3%	0.5%	-4.8%	-0.9%	-3.4%	-1.6%	-3.6%	-2.3%
Asian***	21.6%	17.5%	9.3%	23.5%	16.7%	7.3%	6.3%	-5.6%	4.8%	11.3%
European	3.5%	4.7%	0.7%	4.0%	4.3%	3.2%	0.9%	-1.0%	0.4%	2.3%
Middle Eastern	10.1%	10.5%	8.7%	11.0%	6.2%	9.5%	1.3%	-2.4%	0.0%	6.1%
Latin American	-4.1%	-0.5%	-9.0%	-4.0%	-3.8%	-10.9%	-1.2%	-1.8%	-1.6%	-4.1%
African	-3.4%	2.9%	-2.7%	0.0%	8.1%	-3.2%	-2.4%	-6.9%	-4.3%	-1.3%
CYF sexual abuse***	-6.8%	-6.1%	-4.4%	-7.5%	-5.7%	-5.5%	-6.1%	-4.0%	-4.3%	-5.6%
CYF physical abuse	-0.1%	-0.3%	0.5%	-2.0%	-2.4%	-2.7%	-0.5%	0.7%	-1.3%	-0.9%
CYF emotional abuse	-1.4%	-1.3%	0.4%	-1.5%	-1.9%	0.0%	0.9%	0.1%	-0.3%	-0.6%
CYF neglect abuse	0.0%	0.0%	0.2%	-2.0%	-1.4%	-1.8%	-0.4%	-0.2%	-0.5%	-0.7%
CYF self-harm abuse	7.5%	9.2%	-0.9%	17.0%	24.3%	-4.1%	-3.4%	8.5%	-0.3%	6.4%
CYF behavioural abuse	-2.4%	-2.5%	-0.5%	-2.0%	-2.9%	-1.4%	-2.3%	-1.6%	-2.7%	-2.0%
Refugee	0.4%	-3.4%	-2.3%	3.0%	-1.4%	1.4%	1.8%	1.2%	-1.2%	-0.1%
Disability***	-15.6%	-13.9%	-8.6%	-15.5%	-14.3%	-10.0%	-11.9%	-11.6%	-14.8%	-12.9%
ESOL***	-10.4%	-7.9%	-6.6%	-13.5%	-11.9%	-10.5%	-8.6%	-7.0%	-4.9%	-9.0%
Access to heat at home***	-11.5%	-8.7%	-7.2%	-11.0%	-9.5%	-7.7%	-10.3%	-5.1%	-7.2%	-8.7%
Access to internet at home	2.1%	2.2%	0.2%	4.5%	4.3%	2.7%	2.0%	-0.5%	2.0%	2.2%

Note: Variables with *** have statistically significant results at the 1% level across all WRPI, EP and WNCEA decile regressions.

In addition to parental education, a select number of student background variables are also strong predictors of achievement. Table 14 shows a summary of the estimated effects of various student background characteristics as percentages of one standard deviation for each corresponding dependent variable. Once again, it should be noted that all the marginal effects shown in Table 14 are the remaining estimated effects after parental education, income, etc. are held constant.

Among the 20 independent variables in Table 14, female students have the largest predicted effect – on average, 18.5% of one standard deviation across WRPI, EP and WNCEA. In addition to their economically significant effect, Tables A-7 and A-8 show all female coefficients as statistically significant at the 1% level.

The positive estimated effect of female students is consistent with the literature, wherein a recent meta-analysis consisting of 502 studies from more than 30 countries, including New Zealand, by Voyer and Voyer found female students had a small but significant advantage in elementary (primary), junior/middle school (intermediate), high school (college), and university.[52]

This report cannot explain the mechanism behind female academic advantage; however, Voyer and Voyer speculate that social and cultural factors could be among several explanations. Parents may assume boys are better at maths and science so they might encourage girls to put more effort into their studies, which could lead to the slight advantage girls have in all courses. Gender differences in learning styles is another possibility.

Previous research cited by the authors also shows that girls tend to study to understand the material, whereas boys emphasise performance, which indicates a focus on final grades. "Mastery of the subject matter generally produces better marks than performance emphasis, so this could account in part for males' lower marks than females," Voyer and Voyer suggest.

Among the other variables, the negative estimated effects for Māori and Pasifika students are unsurprising given the consistent finding that Māori and Pasifika students have, on average, worse education outcomes in New Zealand.[53] Across WRPI, EP and WNCEA, Māori and Pasifika students perform on average -8.2% and -10.0% of one standard deviation lower compared to European New Zealand students, respectively.

Interestingly, the magnitude of effects shown here is far less than that cited in PISA reports. New Zealand 2015 PISA data shows that Māori and Pasifika students perform on average -45% and -60% of one standard deviation below the New Zealand average, respectively.[54] This suggests that socioeconomic background is the main driver of most of the ethnic differences we observe elsewhere.

It also suggests there are still disparities in Māori and Pasifika educational outcomes that are not a result of socioeconomic background; whether this is due to cultural factors within the students' homes or other factors occurring in the classroom is beyond the scope of this report.

We find the opposite result for Asian students, who show a large positive estimated effect. On average, Asian students perform 11.3% of one standard deviation higher than European New Zealand students. Curiously, in contrast to our Māori and Pasifika coefficients, the magnitude of effect is similar to that observed in 2015 PISA data, where Asian students performed on average 12% of one standard deviation higher in science and reading and 20% of one standard deviation higher in maths. This suggests that socioeconomic background is not the main driver of differences in student performance among Asian cohorts.

We suspect the differences in Asian students' performance are a result of cultural factors outside the classroom, such as parent's academic expectations of their children. Our hypothesis is consistent with the literature that looks at parental expectations as one of the major factors in children's academic achievement. In general, studies find students whose parents hold higher expectations receive higher grades, achieve higher scores on standardised tests, and persist longer in school.[55] Within this literature, studies find Asian American parents have on average higher academic expectations of their children than other racial groups. We hypothesise a similar mechanism for Asian New Zealand parents.

Our findings are somewhat unsurprising given the national NCEA level 2 attainment figures, which show Asian students have the highest percentage of attainment at 91.1%, compared to 83.7% for European New Zealand students, 74.7% for Pasifika students, and 66.5% for Māori students.[56]

Tables A-7 and A-8 show that all Māori, Pasifika and Asian coefficients are statistically significant at the 1% level.

In contrast to the female, Māori, Pasifika and Asian student results, the coefficients for Australian, European, Middle Eastern, Latin American and African students (MELAA) are all largely economically and statistically insignificant. The only exceptions are the three WRPI and EP results for Middle Eastern students, where there is an average estimated effect of 10.5% of one standard deviation among the coefficients, all of which are statistically significant at the 1% level.

Student historical abuse identified by CYF

Among the historical abuse variables, only sexual abuse has both economic and statistically significant results. Across all WRPI, EP and WNCEA results, sexual abuse (as identified and confirmed by CYF) has an estimated average effect of -5.6% of one standard deviation.

Alternative measures that might better capture child maltreatment could be whether the child was only known to CYF rather than being identified as a case of abuse. Between 2003 and 2015, CYF received 914,125 notifications nationally, indicating the students were known to CYF; of these, 312,744 were investigated further, of which 146,769 were confirmed cases of abuse.[57] In comparison, our sample contained 68,172 identified cases of abuse.

Curiously, across both the national data and our sample, sexual abuse is often the least identified abuse finding. Nationally, data shows that 6.9% of confirmed cases involved sexual harm while our sample shows 12.9%.

Previous research has found negative effects of child maltreatment on academic achievement; however, the evidence is mixed on any causal relationship – though many psychological explanations have been theorised.[58] Previous studies often struggled with small sample sizes or a lack of adequate controls to determine any conclusive findings.[59]

One study from the University of Michigan, which analysed a sample of 732,828 students, found early childhood maltreatment was associated with significantly lower academic outcomes, even after controlling for school, neighbourhood, and other key demographics.[60] However, the Michigan study controlled for far fewer background characteristics than our study; in particular, it excluded parent's education as a control. Certainly, further research is needed.

Disability, ESOL and other student background characteristics

Among the other variables, disability, English as a Second or Other Language (ESOL), and access to heat at home all have economically and statistically significant results.

On average, the estimated effect of having a disability on academic achievement is -12.9% of one standard deviation. Our findings are consistent with the growing research that shows students with disabilities generally lag in educational outcomes.[61] Unfortunately, because our disability variable was derived from the 2013 Census, we did not have information on whether the disability was physical or learning related.

However, we can conjecture what proportion of students have learning disabilities from the 2013 Disability survey, which states 52% of disabled children had a learning disability.[62]

The ESOL variable is derived from the ESOL support variable in the MoE intervention dataset. Only students who received ESOL support are captured by this variable rather than all students who have ESOL. Regardless, we found an average estimated effect of -9.0% of one standard deviation.

Strangely, we also found a negative effect for access to heat at home – which has an average effect of -8.7% of one standard deviation.

Both refugee status and access to the internet at home variables are statistically insignificant across decile and school regressions.

Parental background characteristics

Table 15: Summary of estimated effects: Parental background characteristics

	WRPI 1	WRPI 2	WRPI 3	EP 1	EP 2	EP 3	WNCEA 1	WNCEA 2	WNCEA 3	Average
Parent's homeownership (**)	2.00%	1.65%	0.53%	2.50%	1.43%	0.91%	1.93%	1.19%	1.92%	1.56%
Parents' divorce status***	-7.31%	-5.53%	-4.19%	-5.50%	-4.29%	-1.82%	-4.95%	-3.32%	-3.02%	-4.44%
Mother's ln income***	-0.68%	-0.49%	-0.42%	-1.00%	-0.95%	-0.91%	-0.44%	-0.27%	-0.49%	-0.63%
Father's ln income***	-0.49%	-0.33%	-0.28%	-0.50%	-0.48%	-0.45%	-0.34%	-0.12%	-0.24%	-0.36%
Mother's benefit spell***	-0.02%	-0.01%	-0.01%	0.00%	0.00%	0.00%	-0.01%	-0.01%	-0.01%	-0.01%
Father's benefit spell***	-0.01%	-0.01%	0.00%	0.00%	0.00%	0.00%	-0.01%	-0.01%	-0.01%	-0.01%
Mother's offence history	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Father's offence history	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Mother's prison history	2.91%	1.78%	2.54%	2.00%	2.86%	2.73%	2.56%	1.50%	0.91%	2.20%
Father's prison history	-3.93%	-4.05%	-0.75%	-5.50%	-5.24%	-4.09%	-1.81%	-0.87%	-2.79%	-3.23%

Note: Variables with *** have statistically significant results at the 1% level across all WRPI, EP and WNCEA decile regressions.
Note: Variables with (**) have statistically significant results at the 1% level across all WRPI, EP and WNCEA decile regressions with the exception of two coefficients.

Table 15 shows a summary of the estimated effects of various parental background characteristics as percentages of one standard deviation for each of the corresponding dependent variables.

Out of the 10 variables in Table 15, parents' divorce has the largest economically significant effect in addition to consistent statistically significant results at the 1% level. On average, parents' divorce has an estimated negative effect of -4.4% of one standard deviation.

This negative effect is consistent with the literature, which finds that children who experience divorce achieve significantly lower academic outcomes.[63] Among the existing research, various mechanisms have been studied, including the drop in financial wellbeing, stress and strain associated with single parenthood, loss of spousal support, ongoing conflict regarding co-parenting, and changes in the quality of mother-child and father-child relations.[64]

One of the more interesting results is parent's natural log income, which has statistically significant (at the 1% level) but economically insignificant results. Using the average estimated effects in Table 15, we found a one standard deviation increase in mother's and father's income is predicted to *lower* a student's academic performance by -2.7% and -0.9% of one standard deviation, respectively – where one standard deviation is $22,748 and $46,481, respectively. Additionally, our sample mean income for mother's and father's income is $22,882 and $39,197, respectively.

Contrary to anecdotes about how deprivation and income drive outcomes, our results show that after correcting for parental education, increases in income reduced NCEA performance.

There is a wide body of research that finds parent's income is highly correlated with higher student academic achievement. However, whether this identified relationship is causal or purely related to other co-linear socioeconomic factors is still inconclusive.[65]

Despite this, studies simulating changes in family income find relatively small associated changes in children's education attainment. In one of the most careful explorations of this relationship, Hill and Duncan found that a 10% increase in family income (all else constant) was associated with a less than 1% increase in educational attainment.[66]

While parent's benefits history is statistically significant at the 1% level, the estimated effect is economically insignificant. Increasing mother's benefit spell by one standard deviation, equal to 300 weeks, decreases her child's academic performance by only -3.0% of one standard deviation on average. The effect is even smaller for father's benefit spell, where a one standard deviation increase, equal to 182 weeks, decreases his child's academic performance by only -1.8% of one standard deviation on average.

Among the other parental background characteristic variables, parent's home ownership, offence history, and interaction with the Department of Corrections were all statistically insignificant across our wide range of NCEA outcomes.

School characteristics

Table 16: Summary of estimated effects: School characteristics type

	WRPI 1	WRPI 2	WRPI 3	EP 1	EP 2	EP 3	WNCEA 1	WNCEA 2	WNCEA 3	Average
Boys only school	0.5%	3.8%	2.4%	0.0%	1.9%	-1.4%	1.8%	0.3%	6.0%	1.7%
Girls only school (***)	14.2%	13.5%	5.3%	8.5%	4.3%	-1.4%	10.9%	9.4%	5.1%	7.8%
State school (***)	-15.7%	0.9%	-12.2%	-11.5%	-11.4%	-15.9%	-6.3%	13.1%	-7.0%	-7.3%
School isolation index	1.4%	-0.5%	-1.0%	-0.5%	-0.5%	-0.9%	1.9%	3.0%	0.6%	0.4%

Note: Variables with (***) have statistically significant results at the 1% level across all WRPI, EP and WNCEA decile regressions with the exception of one coefficient.

In contrast, state schools perform on average -7.3% of one standard deviation worse than state-integrated and private schools, where the results are statistically significant results at the 1% level, with the exception of one coefficient out of the 10.

Finally, we find small effects for the isolation index of the school, which vary in statistical significance across its coefficients.

Time fixed effects

Table 17 shows a summary of the estimated effects for each year that students sat NCEA in our pooled dataset. The years 2015, 2016 and 2017 have on average large positive estimated effects.

Across the wide set of time coefficients, many are statistically significant at the 1% level. However, only 2015 and 2017 have consistent statistical significance across the same 9 out of 10 outcomes.

Table 17 does show NCEA grades increasing over time, from 2008 to 2015. This suggests possible grade inflation within the NCEA curriculum – rhetoric that has been discussed previously.[67]

Table 17: Summary of estimated effects: NCEA year cohort

	WRPI 1	WRPI 2	WRPI 3	EP 1	EP 2	EP 3	WNCEA 1	WNCEA 2	WNCEA 3	Average
NCEA year										
2008	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2009	1.1%	9.9%	2.3%	0.0%	-10.0%	0.9%	1.4%	33.1%	4.9%	4.8%
2010	-0.9%	8.3%	12.9%	1.0%	-9.0%	-14.1%	3.5%	34.6%	34.6%	7.9%
2011	13.2%	4.1%	11.2%	9.5%	-9.0%	-12.3%	25.8%	36.3%	41.4%	13.4%
2012	12.5%	16.0%	11.3%	11.5%	-2.9%	-11.4%	28.7%	54.1%	45.9%	18.4%
2013	14.0%	15.4%	22.2%	16.5%	-1.9%	-3.6%	34.3%	53.8%	57.6%	23.1%
2014	16.5%	22.5%	23.0%	21.5%	7.6%	-1.4%	28.4%	47.3%	56.0%	24.6%
2015 (***)	46.1%	70.4%	24.3%	56.0%	61.4%	3.2%	-58.1%	13.4%	54.6%	30.1%
2016	37.7%	62.2%	19.6%	48.0%	54.3%	8.6%	-77.7%	0.4%	42.9%	21.8%
2017 (***)	51.8%	33.4%	-22.2%	78.5%	37.1%	19.1%	-62.7%	-13.0%	-20.6%	11.3%

Note: Variables with (***) have statistically significant results at the 1% level across all WRPI, EP and WNCEA decile regressions with the exception of one coefficient.

Student behaviour

Finally, among the student behaviour variables, we find consistent statistically significant effects for the number of times a student was stood down, the number of times a student transferred school, and the percentage of internal credits a student sat. Among these variables, school transfer count has the largest average estimated effect of -6.9% of one standard deviation; total stand downs has an average estimated effect of -3.9% of one standard deviation; while the percentage of internal credits has an average estimated effect of -2.7% of one standard deviation.

Table 18: Summary of estimated effects: Student interventions

	WRPI 1	WRPI 2	WRPI 3	EP 1	EP 2	EP 3	WNCEA 1	WNCEA 2	WNCEA 3	Average
Reading recovery	-22.8%	-23.1%	16.5%	-33.5%	-21.9%	-8.2%	10.8%	-4.6%	-4.6%	-10.2%
Suspension count	0.5%	0.2%	0.5%	1.5%	0.0%	0.0%	-2.4%	-1.3%	-1.8%	-0.3%
Stand down count***	-3.0%	-3.1%	-0.8%	-7.0%	-7.1%	-5.5%	-3.6%	-1.9%	-3.4%	-3.9%
Expulsion	-5.9%	-7.3%	-1.2%	-9.0%	-7.1%	-0.9%	-2.6%	-4.3%	-0.1%	-4.3%
School transfer count***	-10.2%	-8.4%	-5.9%	-7.5%	-4.8%	-2.7%	-8.7%	-6.1%	-7.3%	-6.9%
Percentage of internal credits***	-2.5%	-3.0%	-3.3%	-2.5%	-2.9%	-2.3%	-2.2%	-3.1%	-2.4%	-2.7%

Note: Variables with *** have statistically significant results at the 1% level across all WRPI, EP and WNCEA decile regressions.

Despite these findings, and given that these variables can be influenced by the school a student attended, we suggest further research be conducted to determine whether these variables should be included in future iterations of our CVAM.

Proportion of variance explained by school and socioeconomic factors

Considering the family background characteristics discussed previously, we explain what proportion of student academic achievement is explained by the school and by socioeconomic effects.

The average R^2 values in Table 19 show 14.5% of the variation in student academic achievement is explained by the school; in comparison, 38.2% is explained by socioeconomics factors. Our findings are somewhat difficult to compare with the literature because many studies use 'percent of variance explained (PV) or ω^2' calculated from partial least squares regressions rather than R^2 values from ordinary least squares regressions.[68]

Regardless, in a meta-analysis studying the effects of individual schools on student achievement, Robert J. Marzano attributed (on average) 20% of the variation in student achievement to schools.[69] Conversely, Marzano attributed (on average) 80% of the variation to student-level effects.[70] Crucially, however, care should be taken when comparing our results to that of the literature.

Table 19: Summary of R^2 values: Unadjusted and adjusted regressions

	R^2 unadjusted regressions									
	WRPI 1	WRPI 2	WRPI 3	EP 1	EP 2	EP 3	WNCEA 1	WNCEA 2	WNCEA 3	Average
R^2	0.212	0.177	0.112	0.180	0.147	0.119	0.121	0.114	0.123	0.145
	R^2 adjusted regressions									
	WRPI 1	WRPI 2	WRPI 3	EP 1	EP 2	EP 3	WNCEA 1	WNCEA 2	WNCEA 3	Average
R^2	0.524	0.554	0.586	0.498	0.428	0.392	0.629	0.637	0.496	0.527

Note: We have used the standard R^2 values rather than the adjusted R^2 values in this table; however, the values are identical up to the 3rd decimal point. Additionally, the R^2 values presented here are from the school regressions in Part 2.

Conclusion

This report has shown that the large differences in academic performance across deciles is not a result of large differences in school quality, but rather large differences in family socioeconomic background, in particular, parental education attainment. This finding has several implications for education in New Zealand.

First, it provides empirical evidence against the pervasive myth that "decile is a proxy for school quality". Results from our CVAM show that most schools, approximately 80%, perform very similarly once family socioeconomic background has been controlled for.

Second, while most schools perform similarly, there are outliers – high-performing and low-performing secondary schools exist in both low- and high-decile schools in New Zealand.

Confidentiality rules set and enforced by Statistics New Zealand prevent us from identifying which schools are high performers and which schools are low performers; however, we have been able to show the distribution of the schools across deciles.

Third, we have been able to identify several family socioeconomic background characteristics that are highly predictive of student academic success. The largest estimated effect from our CVAM on student performance in NCEA is parental educational attainment, where a student with two parents both with postgraduate degrees is estimated to score one standard deviation higher in NCEA level 1.

Fourth, like previous research in this area the findings in this report present more questions than they answer. Further research is needed – particularly from Statistics New Zealand's IDI.

Finally, this study has provided a guide (and the underlying code) for future quantitative research on secondary school performance in New Zealand and the background characteristics that predict children's academic achievement in these schools. All of our code is available in the IDI wiki for any approved IDI researcher to access and build on. We strongly recommend future economics graduate students to do so; we only ask that students share their results with us and inform us about any improvement they have made (see the Appendix for further discussion). Future work on school performance by The New Zealand Initiative will build on the research presented in this report.

Appendix

Table A-1: IDI workflow

<table>
<tr><th>SQL</th><th>Excel (.csv)</th><th>STATA (.do)</th><th>Data (.dta)</th><th>STATA (.do)</th><th>Data (.dta)</th><th>STATA (.do)</th><th>Data (.dta)</th><th>STATA (.do)</th><th>Data (.dta)</th><th>STATA (.do)</th></tr>
<tr><td>education_extract</td><td>education_extract</td><td>education_import

(imports and merges all education datasets)</td><td>education_RAW1_data</td><td rowspan="6">education_import

(merges all education datasets)</td><td rowspan="6">education_clean_data</td><td rowspan="12">student_merge</td><td rowspan="12">student_data</td><td rowspan="16">master_merge</td><td rowspan="17">master_data</td><td rowspan="17">master_regressions_decile
+
master_regressions_shools</td></tr>
<tr><td>education_WRPI_extract</td><td>education_WRPI_extract</td><td>education_WRPI_import</td><td>education_WRPI_data</td></tr>
<tr><td>education_NCEA_extract</td><td>education_NCEA_extract</td><td>education_NCEA_import</td><td>education_NCEA_data</td></tr>
<tr><td>education_qualifications_extract</td><td>education_qualifications_extract</td><td>education_qualifications_import</td><td>education_qualifications_data</td></tr>
<tr><td>education_intervention_extract</td><td>education_intervention_extract</td><td>education_intervention_import</td><td>education_intervention_data</td></tr>
<tr><td>education_exp_per_extract</td><td>education_exp_per_extract</td><td>education_exp_per_import</td><td>education_exp_per_data</td></tr>
<tr><td></td><td></td><td></td><td>education_clean_data</td><td>school_id_new</td><td>school_id_new_data</td></tr>
<tr><td>CYF_extract</td><td>CYF_extract</td><td>CYF_import</td><td>CYF_data</td><td>-</td><td>-</td></tr>
<tr><td>census_extract</td><td>census_extract</td><td>census_import</td><td>census_data</td><td>-</td><td>-</td></tr>
<tr><td>IRD_extract</td><td>IRD_extract</td><td>IRD_import</td><td>IRD_data</td><td>-</td><td>-</td></tr>
<tr><td>MSD_extract</td><td>MSD_extract</td><td>MSD_import</td><td>MSD_data</td><td>-</td><td>-</td></tr>
<tr><td>police_corrections_extract</td><td>police_corrections_extract</td><td>police_corrections_import</td><td>police_corrections_data</td><td>-</td><td>-</td></tr>
<tr><td>-</td><td>-</td><td rowspan="4">↓

master_import

(All the SQL extracts can be extracted using this do file)</td><td>-</td><td>-</td><td>census_data</td><td rowspan="4">parents_merge</td><td rowspan="4">parents_data</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>IRD_data</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>MSD_data</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>police_corrections_data</td></tr>
<tr><td>-</td><td>-</td><td colspan="7">↓

master_import_clean_merge

(All the SQL extracts can be imported, cleaned and merged using this .do file)</td></tr>
</table>

Table A-2: NCEA year

Variables	Source	Technical notes
Time: T_i		
NCEA level 1 year	MoE: Standards data	The base group for the dummy variables NCEA level 1, 2 and 3 year was 2008. While most students attempted NCEA level 1, 2 and 3 standards in three separate years, i.e. level 1 in 2008, level 2 in 2009, and level 3 in 2010, some students attempted multiple NCEA level standards in the same year, i.e. level 1 and level 2 standards in 2015. For these students, the NCEA year they were allocated is based on the year they attempted the greatest number of NCEA level 1, 2 and 3 standards, respectively.
2008		
2009		
2010		
2011		
2012		
2013		
2014		
2015		
2016		
2017		
NCEA level 2 year		
2008		
2009		
2010		
2011		
2012		
2013		
2014		
2015		
2016		
2017		
NCEA level 3 year		
2008		
2009		
2010		
2011		
2012		
2013		
2014		
2015		
2016		
2017		

Table A-3: Student characteristics

Variables	Source	Technical notes
Student Characteristics: X_i		
Female	MoE: Personal data	The base group for the female dummy was male. The base group for each ethnicity dummy was European New Zealander. The European dummy is an indicator variable for non-New Zealander Europeans. Ethnicity dummy variables are non-mutually exclusive. Students can be allocated to multiple ethnicities.
1		
0		
Māori		
1		
0		
Pasifika		
1		
0		
Australian		
1		
0		
Asian		
1		
0		
European		
1		
0		
Middle Eastern		
1		
0		
Latin American		
1		
0		
African		
1		
0		
# of sexual abuse events	CYF: Abuse events data	Students who were not present in the CYF abuse database were allocated a value of 0 post merging.
1+		
0		
# of physical abuse events		
1+		
0		
# of emotional abuse events		
1+		
0		
# of neglect abuse events		
1+		
0		
# of self-harm abuse events		
1+		

0		
# of behavioural abuse events		
1+		
0		
Refugee	MoE: Enrolment	Students were allocated a value of 1 if they were categorised as a refugee in the MoE enrolment data; 0 otherwise.
1		
0		
Disability	2013 Census	Students were allocated a value of 1 if they identified as having a disability in the 2013 Census; 0 otherwise (answered no or left the question blank). There is no additional information regarding the type of disability, or whether the disability was inherited or attained later in life.
1		
0		
ESOL	MoE: Intervention data	Students were allocated a value of 1 if they were recorded as receiving ESOL funding in the student intervention dataset; 0 otherwise. ESOL is a particular learning support programme with eligibility requirements and lasts for a specified time. Many students may identify as learners of English as an additional language but never receive ESOL.
1		
0		
Reading Recovery		Students were allocated a value of 1 if they were in the reading recovery programme at school; 0 otherwise. It should be noted that the intervention data in the IDI is not complete – different learning support programmes have different years of coverage in the data. However, we believe the reading recovery coverage for our sample is complete.
1		
0		
# of suspensions		Student suspension and stand down counts were based on MoE intervention data. Students missing in the dataset were allocated a value of 0.
1+		
0		
# of stand downs		
1+		
0		
Expulsion	MOE: School leavers	Students were allocated a value of 1 if the reason for leaving their previous school was labelled as expulsion; 0 otherwise.
1		
0		
# of secondary schools attended	MOE: Enrolment	The number of schools a student attended was based on the total number of unique secondary schools that student attended as stated in the MoE enrolment data.
1+		
0		
% of internal credits level 1	MOE: NCEA standards	The percentage of internal credits was calculated by dividing the total number of internal credits by the total number of credits sat by one student.
% of internal credits level 2		
% of internal credits level 3		
Access to heat at home	2013 Census	Students were allocated a value of 1 if they answered 1 or greater to how

1		many fuel sources were available in their household; 0 otherwise.
0		
Access to internet at home		Students were allocated a value of 1 if they answered yes to if they had access to the internet at home; 0 otherwise.
1		
0		

Table A-4: Parental characteristics

Variables	Source	Technical notes
	Parents Characteristics: W_i	
Parent's homeownership	2013 Census	Parents were allocated a value of 1 if they answered yes to whether they owned a home (mortgage included); 0 otherwise.
1		
0		
Parents divorced		Parents were allocated a value of 1 if they answered yes to having been divorced; 0 otherwise.
1		
0		
Mother's education		Parental education was based on the highest level of education as answered in the 2013 Census. Individuals who left the answer blank were allocated the categorical variable 'none'.
None		
High school certificate		
Diploma		
Bachelor's degree		
Postgraduate degree		
Father's education		
None		
High school certificate		
Diploma		
Bachelor's degree		
Postgraduate degree		
Mother's log income	IRD	Parent's income and log income were the average incomes for individuals between 2000 and 2017. Log income was the variables used in the fixed effects model.
Mother's average income		
Father's log income		
Father's average income		
Mother's benefit spell	MSD	Parent's benefits spell was calculated using the total number of weeks spent on any form of income support starting from 1 January 1993.
Father's benefit spell		
Mother's offence history	Police	Parent's offence history was calculated using the total number of offences identified in the New Zealand Police database.
Father's offence history		
Mother's corrections history	Corrections	Parents were allocated a value of 1 if they had had an interaction with the Department of Corrections; 0 otherwise.
1		
0		
Father's corrections history		
1		
0		

Table A-5: School characteristics

Variable	Source	Technical Note
School Indicator: D_i		
School ID	MoE: Enrolment data + MoE: School profile data	Students were allocated to the last school they attended. This could lead to selection bias among schools that exclude students that don't reach a particular level of behaviour or performance and another set of schools that are more inclined to take all students, regardless of their history/characteristics/behaviour. Later robustness tests re-ran a sample of regressions restricted to the cohorts of students who stayed in the same school for the entirety of their secondary school years.
Decile		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
School Characteristics: Z_i		
Girls-only school	MoE: Enrolment data + MoE: School profile data	The base group for the girls-only and boys-only school dummies are co-ed schools. The base group for the state school dummy was state-integrated and private schools (where the two types of schools were both allocated values of 0). We acknowledge that there is a clear distinction between state, state-integrated and private schools; however, when state-integrated and private schools were categorised as separate dummy variables (where state schools were set as the base group), they were dropped in the test regressions. It should be noted that the school characteristics dummy variables were all omitted in the school fixed effects regressions (Part 2) by STATA due to co-linearity; however, they were included in the decile fixed effects regressions (Part 1).
1		
0		
Boys-only school		
1		
0		
State school		
1		
0		
School isolation index		

Table A-6: NCEA-derived metrics – Dependent variables

Variables	Source	Technical notes
Student's NCEA results: Y_{it}		
WRPI level 1 score	MoE: NCEA standards	A brief explanation of WRPI is provided in the Data section, while a comprehensive discussion of WRPI is available in a previous Initiative report, *Score! Transforming NCEA Data*.
WRPI level 2 score		
WRPI level 3 score		
Expected Percentile level 1 score	MoE: Expected percentile	A brief explanation of expected percentile is provided in the Data section, while a comprehensive discussion of expected percentile is available in *How Does Achievement at School Affect Achievement in Tertiary Education?*
Expected Percentile level 2 score		
Expected Percentile level 3 score		
Weighted NCEA level 1 score	MoE: NCEA standards	Total credits achieved at level 1, 2 and 3, weighted by the formula NA credits x0, A credits x1.36, M credits x3.7 and E credits x4.
Weighted NCEA level 2 score		
Weighted NCEA level 3 score		
University Entrance	MoE: Enrolment	Dummy variable: 1 if achieved UE; 0 otherwise.
1		
0		

Table A-7: Regression results by decile

	score1_un	score1_adj	ep1_un	ep1_adj	wncea1_un	wncea1_adj	score2_un	score2_adj	ep2_un	ep2_adj	wncea2_un	wncea2_adj	score3_un	score3_adj	ep3_un	ep3_adj	wncea3_un	wncea3_adj	ue_un	ue_adj
Decile	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
2	4.117***	-3.559***	0.007***	-0.023***	7.953***	-6.511***	2.056***	-2.262***	0.002	-0.025***	4.445***	-6.384***	0.239	-2.812***	0.005	-0.033***	-3.243*	-12.169***	0.107***	-0.176***
	(0.54)	(0.44)	(0.00)	(0.00)	(1.48)	(1.01)	(0.48)	(0.39)	(0.00)	(0.00)	(1.31)	(0.88)	(0.40)	(0.36)	(0.00)	(0.00)	(1.34)	(1.06)	(0.03)	(0.04)
3	13.411***	-4.278***	0.030***	-0.034***	27.918***	-7.005***	8.878***	-2.553***	0.025***	-0.028***	17.859***	-6.221***	4.556***	-2.077***	0.037***	-0.021***	13.829***	-8.710***	0.498***	-0.081
	(0.55)	(0.45)	(0.00)	(0.00)	(1.50)	(1.03)	(0.49)	(0.40)	(0.00)	(0.00)	(1.33)	(0.90)	(0.40)	(0.36)	(0.00)	(0.00)	(1.35)	(1.07)	(0.03)	(0.04)
4	17.615***	-3.884***	0.053***	-0.031***	32.941***	-10.085***	11.456***	-2.824***	0.040***	-0.032***	21.836***	-10.734***	6.069***	-2.295***	0.050***	-0.031***	17.270***	-12.114***	0.608***	-0.189***
	(0.51)	(0.43)	(0.00)	(0.00)	(1.40)	(0.97)	(0.45)	(0.37)	(0.00)	(0.00)	(1.24)	(0.85)	(0.37)	(0.34)	(0.00)	(0.00)	(1.26)	(1.01)	(0.03)	(0.04)
5	25.056***	-3.062***	0.077***	-0.029***	54.746***	-3.283***	17.463***	-1.370***	0.058***	-0.029***	38.299***	-3.465***	8.762***	-2.059***	0.060***	-0.031***	27.271***	-10.925***	0.847***	-0.015
	(0.49)	(0.42)	(0.00)	(0.00)	(1.36)	(0.96)	(0.44)	(0.37)	(0.00)	(0.00)	(1.20)	(0.84)	(0.36)	(0.34)	(0.00)	(0.00)	(1.22)	(1.00)	(0.03)	(0.04)
6	28.313***	-4.442***	0.085***	-0.037***	56.733***	-9.891***	19.541***	-2.727***	0.065***	-0.038***	38.880***	-9.801***	9.980***	-2.587***	0.076***	-0.033***	33.081***	-12.439***	0.885***	-0.203***
	(0.48)	(0.42)	(0.00)	(0.00)	(1.33)	(0.96)	(0.43)	(0.37)	(0.00)	(0.00)	(1.18)	(0.83)	(0.36)	(0.34)	(0.00)	(0.00)	(1.19)	(1.00)	(0.03)	(0.04)
7	43.333***	1.108*	0.132***	-0.023***	87.274***	1.500	32.209***	2.596***	0.108***	-0.022***	63.856***	-2.617**	17.971***	-0.585	0.106***	-0.031***	56.664***	-6.698***	1.276***	-0.089*
	(0.50)	(0.44)	(0.00)	(0.00)	(1.38)	(1.00)	(0.45)	(0.38)	(0.00)	(0.00)	(1.23)	(0.87)	(0.37)	(0.35)	(0.00)	(0.00)	(1.24)	(1.03)	(0.03)	(0.04)
8	44.752***	2.266***	0.145***	-0.016***	84.812***	1.605	34.070***	4.252***	0.126***	-0.011***	65.646***	-1.415	19.142***	0.842*	0.122***	-0.018***	60.165***	-4.260***	1.365***	0.191***
	(0.48)	(0.42)	(0.00)	(0.00)	(1.32)	(0.97)	(0.43)	(0.37)	(0.00)	(0.00)	(1.18)	(0.84)	(0.35)	(0.34)	(0.00)	(0.00)	(1.19)	(1.00)	(0.03)	(0.04)
9	55.236***	2.682***	0.181***	-0.014***	110.103***	5.054***	43.831***	3.744***	0.151***	-0.019***	88.737***	-3.053***	24.740***	-1.650***	0.140***	-0.027***	75.605***	-10.386***	1.679***	0.088*
	(0.50)	(0.44)	(0.00)	(0.00)	(1.37)	(1.01)	(0.44)	(0.39)	(0.00)	(0.00)	(1.22)	(0.89)	(0.36)	(0.35)	(0.00)	(0.00)	(1.22)	(1.05)	(0.03)	(0.04)
10	69.749***	5.374***	0.238***	-0.002	130.550***	1.514	54.882***	7.597***	0.216***	0.006**	107.584***	-3.458***	33.145***	1.338***	0.199***	-0.010***	101.308***	-4.008***	2.102***	0.379***
NCEA year	(0.49)	(0.46)	(0.00)	(0.00)	(1.36)	(1.05)	(0.44)	(0.41)	(0.00)	(0.00)	(1.22)	(0.92)	(0.36)	(0.37)	(0.00)	(0.00)	(1.21)	(1.08)	(0.03)	(0.04)
2008		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000
		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)
2009		0.628*		0.000		2.021**		5.003***		-0.021***		41.760***		0.922		0.002		5.818		0.547*
		(0.30)		(0.00)		(0.69)		(0.72)		(0.01)		(1.64)		(1.15)		(0.02)		(3.38)		(0.28)
2010		-0.522		0.002		5.208***		4.182***		-0.019***		43.597***		5.210***		-0.031		40.931***		2.289***
		(0.30)		(0.00)		(0.69)		(0.72)		(0.01)		(1.64)		(1.03)		(0.02)		(3.03)		(0.25)
2011		7.513***		0.019***		38.091***		2.057**		-0.019**		45.787***		4.546***		-0.027		48.872***		2.266***
		(0.30)		(0.00)		(0.68)		(0.72)		(0.01)		(1.63)		(1.02)		(0.02)		(3.02)		(0.25)
2012		7.141***		0.023***		42.335***		8.067***		-0.006		68.183***		4.590***		-0.025		54.293***		2.368***
		(0.30)		(0.00)		(0.69)		(0.72)		(0.01)		(1.63)		(1.02)		(0.02)		(3.01)		(0.25)
2013		7.965***		0.033***		50.654***		7.737***		-0.004		67.858***		8.996***		-0.008		68.087***		2.641***
		(0.30)		(0.00)		(0.68)		(0.72)		(0.01)		(1.63)		(1.02)		(0.02)		(3.01)		(0.25)
2014		9.423***		0.043***		41.862***		11.334***		0.016**		59.629***		9.320***		-0.003		66.225***		2.145***
		(0.30)		(0.00)		(0.67)		(0.72)		(0.01)		(1.62)		(1.02)		(0.02)		(3.01)		(0.25)
2015		26.276***		0.112***		-85.742***		35.458***		0.129***		16.866***		9.817***		0.007		64.586***		2.276***
		(0.32)		(0.00)		(0.73)		(0.72)		(0.01)		(1.63)		(1.02)		(0.02)		(3.00)		(0.25)
2016		21.458***		0.096***		-114.626***		31.359***		0.114***		0.495		7.948***		0.019		50.673***		1.985***
		(0.33)		(0.00)		(0.76)		(0.72)		(0.01)		(1.64)		(1.02)		(0.02)		(3.00)		(0.25)
2017		29.508***		0.157***		-92.510***		16.813***		0.078***		-16.323***		-8.994***		0.042*		-24.406***		-4.403***
		(0.49)		(0.00)		(1.11)		(0.73)		(0.01)		(1.66)		(1.02)		(0.02)		(3.01)		(0.27)
Girls-only school		0.308		0.000		2.680***		1.933***		0.004***		0.406		0.974***		-0.003*		7.114***		0.313***

		(0.23)		(0.00)		(0.52)		(0.20)		(0.00)		(0.45)		(0.18)		(0.00)		(0.53)		(0.02)
Boys-only school		8.086***		0.017***		16.163***		6.802***		0.009***		11.815***		2.156***		-0.003*		6.058***		0.224***
		(0.23)		(0.00)		(0.52)		(0.20)		(0.00)		(0.46)		(0.18)		(0.00)		(0.52)		(0.02)
State school		-8.953***		-0.023***		-9.323***		0.459		-0.024***		16.503***		-4.947***		-0.035***		-8.318***		-0.517***
		(0.40)		(0.00)		(0.91)		(0.37)		(0.00)		(0.83)		(0.31)		(0.00)		(0.90)		(0.04)
School isolation index		0.814***		-0.001*		2.782***		-0.265**		-0.001*		3.721***		-0.392***		-0.002**		0.696**		-0.005
		(0.10)		(0.00)		(0.23)		(0.09)		(0.00)		(0.20)		(0.08)		(0.00)		(0.24)		(0.01)
Female		13.664***		0.049***		23.576***		9.970***		0.056***		5.247***		5.829***		0.055***		14.185***		0.687***
		(0.17)		(0.00)		(0.38)		(0.15)		(0.00)		(0.33)		(0.13)		(0.00)		(0.39)		(0.02)
Māori		-5.985***		-0.021***		-10.804***		-4.530***		-0.016***		-8.518***		-2.388***		-0.017***		-10.105***		-0.337***
		(0.19)		(0.00)		(0.42)		(0.16)		(0.00)		(0.37)		(0.15)		(0.00)		(0.44)		(0.02)
Pasifika		-5.525***		-0.025***		-7.942***		-3.647***		-0.027***		-10.181***		-3.246***		-0.041***		-9.021***		-0.139***
		(0.31)		(0.00)		(0.72)		(0.28)		(0.00)		(0.63)		(0.25)		(0.00)		(0.74)		(0.03)
Australian		-1.072		0.001		-4.998		-0.465		-0.010		-2.000		-1.760		-0.002		-4.258		0.213
		(2.37)		(0.01)		(5.42)		(2.09)		(0.01)		(4.74)		(1.83)		(0.01)		(5.41)		(0.21)
Asian		12.323***		0.047***		9.373***		8.822***		0.035***		-7.098***		3.748***		0.016***		5.707***		0.039
		(0.37)		(0.00)		(0.83)		(0.33)		(0.00)		(0.75)		(0.29)		(0.00)		(0.85)		(0.03)
European		2.004**		0.008***		1.383		2.382***		0.009**		-1.259		0.270		0.007*		0.463		0.126*
		(0.62)		(0.00)		(1.43)		(0.56)		(0.00)		(1.28)		(0.49)		(0.00)		(1.46)		(0.06)
Middle Eastern		5.767***		0.022***		1.902		5.305***		0.013		-3.009		3.530*		0.021*		8.441*		0.248
		(1.72)		(0.01)		(3.93)		(1.61)		(0.01)		(3.65)		(1.39)		(0.01)		(4.11)		(0.17)
Latin American		-2.326		-0.008		-1.801		-0.233		-0.008		-2.278		-3.655		-0.024		-1.832		0.310
		(2.93)		(0.01)		(6.70)		(2.65)		(0.01)		(6.02)		(2.37)		(0.01)		(7.01)		(0.26)
African		-1.924		0.000		-3.556		1.469		0.017		-8.746		-1.106		-0.007		-5.139		0.553**
		(2.19)		(0.01)		(5.00)		(2.08)		(0.01)		(4.74)		(1.81)		(0.01)		(5.37)		(0.20)
CYF sexual abuse		-3.857***		-0.015***		-9.057***		-3.079***		-0.012***		-5.015***		-1.767***		-0.012***		-5.111***		-0.293***
		(0.39)		(0.00)		(0.89)		(0.34)		(0.00)		(0.77)		(0.33)		(0.00)		(0.98)		(0.05)
CYF physical abuse		-0.034		-0.004**		-0.755		-0.164		-0.005**		0.847		0.204		-0.006*		-1.505*		-0.210***
		(0.30)		(0.00)		(0.68)		(0.26)		(0.00)		(0.59)		(0.26)		(0.00)		(0.76)		(0.05)
CYF emotional abuse		-0.790***		-0.003***		1.264***		-0.663***		-0.004***		0.178		0.153		-0.000		-0.378		-0.031
		(0.15)		(0.00)		(0.34)		(0.13)		(0.00)		(0.30)		(0.13)		(0.00)		(0.39)		(0.02)
CYF neglect abuse		-0.010		-0.004***		-0.528		-0.011		-0.003**		-0.218		0.078		-0.004*		-0.559		-0.076*
		(0.20)		(0.00)		(0.45)		(0.18)		(0.00)		(0.40)		(0.18)		(0.00)		(0.53)		(0.03)
CYF self-harm abuse		4.297		0.034		-5.025		4.625		0.051		10.719		-0.372		-0.009		-0.390		-0.349
		(8.14)		(0.03)		(18.25)		(6.74)		(0.04)		(15.03)		(6.81)		(0.06)		(20.16)		(0.92)
CYF behavioural abuse		-1.361***		-0.004***		-3.433***		-1.253***		-0.006***		-2.023***		-0.201		-0.003		-3.184***		-0.243***
		(0.20)		(0.00)		(0.45)		(0.18)		(0.00)		(0.40)		(0.18)		(0.00)		(0.53)		(0.04)
Refugee		0.222		0.006		2.586		-1.730		-0.003		1.483		-0.923		0.003		-1.420		-0.247*
		(1.41)		(0.01)		(3.22)		(1.21)		(0.01)		(2.75)		(1.06)		(0.01)		(3.12)		(0.12)
Disability		-8.885***		-0.031***		-17.589***		-7.024***		-0.030***		-14.560***		-3.462***		-0.022***		-17.440***		-0.495***
		(0.38)		(0.00)		(0.86)		(0.34)		(0.00)		(0.77)		(0.33)		(0.00)		(0.96)		(0.04)
ESOL		-5.946***		-0.027***		-12.654***		-3.955***		-0.025***		-8.883***		-2.665***		-0.023***		-5.744***		-0.224***
		(0.37)		(0.00)		(0.85)		(0.33)		(0.00)		(0.75)		(0.29)		(0.00)		(0.87)		(0.03)
Reading recovery		-12.978***		-0.067***		15.877***		-11.634***		-0.046***		-5.836*		6.661***		-0.018		-5.410		-1.055*
		(0.98)		(0.00)		(2.25)		(1.00)		(0.01)		(2.28)		(1.70)		(0.02)		(5.02)		(0.47)

Suspension count	0.296	0.003*	-3.566***	0.085	-0.000	-1.631**	0.195	-0.000	-2.161**	-0.387***
	(0.28)	(0.00)	(0.63)	(0.24)	(0.00)	(0.55)	(0.25)	(0.00)	(0.71)	(0.05)
Stand down count	-1.715***	-0.014***	-5.335***	-1.584***	-0.015***	-2.450***	-0.304***	-0.012***	-4.057***	-0.435***
	(0.09)	(0.00)	(0.22)	(0.08)	(0.00)	(0.19)	(0.08)	(0.00)	(0.24)	(0.02)
Expulsion	-3.361*	-0.018**	-3.892	-3.681**	-0.015	-5.374	-0.492	-0.002	-0.148	-0.151
	(1.49)	(0.01)	(3.38)	(1.32)	(0.01)	(2.99)	(1.30)	(0.01)	(3.81)	(0.23)
School transfer count	-5.813***	-0.015***	-12.882***	-4.251***	-0.010***	-7.688***	-2.404***	-0.006***	-8.621***	-0.207***
	(0.12)	(0.00)	(0.28)	(0.11)	(0.00)	(0.24)	(0.10)	(0.00)	(0.30)	(0.01)
Percentage of internal credits	-1.441***	-0.005***	-3.276***	-1.523***	-0.006***	-3.936***	-1.319***	-0.005***	-2.811***	-0.093***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
Access to heat at home	-6.528***	-0.022***	-15.219***	-4.406***	-0.020***	-6.435***	-2.923***	-0.017***	-8.484***	-0.486***
	(0.26)	(0.00)	(0.59)	(0.23)	(0.00)	(0.51)	(0.20)	(0.00)	(0.60)	(0.02)
Access to the internet at home	1.189***	0.009***	2.885***	1.091***	0.009***	-0.668	0.082	0.006***	2.330***	0.223***
	(0.21)	(0.00)	(0.48)	(0.18)	(0.00)	(0.42)	(0.17)	(0.00)	(0.50)	(0.02)
Parent's homeownership	1.141***	0.005***	2.851***	0.830***	0.003***	1.500***	0.214	0.002*	2.273***	0.071***
	(0.15)	(0.00)	(0.35)	(0.14)	(0.00)	(0.31)	(0.12)	(0.00)	(0.36)	(0.01)
Parents' divorce status	-4.163***	-0.011***	-7.305***	-2.784***	-0.009***	-4.180***	-1.697***	-0.004***	-3.571***	-0.091***
	(0.23)	(0.00)	(0.52)	(0.20)	(0.00)	(0.45)	(0.18)	(0.00)	(0.53)	(0.02)
Mother's education	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
High school certificate	5.978***	0.027***	12.367***	4.075***	0.023***	5.667***	1.762***	0.018***	7.825***	0.242***
	(0.20)	(0.00)	(0.45)	(0.17)	(0.00)	(0.39)	(0.16)	(0.00)	(0.47)	(0.02)
Diploma	13.173***	0.052***	24.634***	9.625***	0.046***	11.723***	4.401***	0.037***	14.686***	0.446***
	(0.29)	(0.00)	(0.65)	(0.25)	(0.00)	(0.57)	(0.23)	(0.00)	(0.67)	(0.03)
Bachelor's degree	18.582***	0.068***	29.630***	14.223***	0.063***	12.765***	7.207***	0.050***	19.420***	0.517***
	(0.28)	(0.00)	(0.64)	(0.25)	(0.00)	(0.57)	(0.22)	(0.00)	(0.66)	(0.03)
Postgraduate (master's/PhD)	24.372***	0.086***	39.693***	19.100***	0.077***	17.943***	10.574***	0.066***	26.316***	0.618***
	(0.40)	(0.00)	(0.90)	(0.35)	(0.00)	(0.80)	(0.31)	(0.00)	(0.91)	(0.04)
Father's education	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
High school certificate	6.295***	0.025***	12.289***	4.464***	0.022***	5.146***	1.925***	0.019***	7.812***	0.275***
	(0.20)	(0.00)	(0.45)	(0.17)	(0.00)	(0.40)	(0.16)	(0.00)	(0.47)	(0.02)
Diploma	13.493***	0.050***	23.763***	9.763***	0.045***	9.816***	4.182***	0.034***	14.004***	0.380***
	(0.32)	(0.00)	(0.72)	(0.28)	(0.00)	(0.64)	(0.25)	(0.00)	(0.73)	(0.03)
Bachelor's degree	25.303***	0.083***	40.352***	19.833***	0.075***	17.053***	10.583***	0.059***	24.884***	0.590***
	(0.31)	(0.00)	(0.72)	(0.28)	(0.00)	(0.64)	(0.25)	(0.00)	(0.72)	(0.03)
Postgraduate (master's/PhD) degree	28.489***	0.092***	45.387***	22.915***	0.085***	20.201***	13.665***	0.068***	30.617***	0.610***
	(0.41)	(0.00)	(0.93)	(0.37)	(0.00)	(0.83)	(0.32)	(0.00)	(0.93)	(0.04)
Mother's ln income	-0.388***	-0.002***	-0.643***	-0.245***	-0.002***	-0.342***	-0.170***	-0.002***	-0.583***	-0.008***
	(0.02)	(0.00)	(0.05)	(0.02)	(0.00)	(0.05)	(0.02)	(0.00)	(0.05)	(0.00)
Father's ln income	-0.280***	-0.001***	-0.503***	-0.165***	-0.001***	-0.145***	-0.113***	-0.001***	-0.287***	-0.012***
	(0.02)	(0.00)	(0.05)	(0.02)	(0.00)	(0.04)	(0.02)	(0.00)	(0.05)	(0.00)
Mother's benefit history (weeks)	-0.009***	-0.000***	-0.018***	-0.007***	-0.000***	-0.010***	-0.003***	-0.000***	-0.015***	-0.001***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Father's benefit history (weeks)		-0.005***		-0.000***		-0.012***		-0.004***		-0.000***		-0.009***		-0.002***		-0.000***		-0.013***		-0.000***
		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)
Mother's offence history (number)		0.001		0.000		0.006		0.002		0.000		0.003		0.001		0.000		0.003		0.000
		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)
Father's offence history (number)		0.003***		0.000***		0.005**		0.002**		0.000		0.002		0.001		0.000		0.004*		0.000*
		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)
Mother's prison (dummy)		1.658***		0.004**		3.775***		0.896*		0.006**		1.895*		1.028**		0.006		1.080		-0.151*
		(0.44)		(0.00)		(1.00)		(0.39)		(0.00)		(0.88)		(0.38)		(0.00)		(1.11)		(0.06)
Father's prison (dummy)		-2.240***		-0.011***		-2.669***		-2.040***		-0.011***		-1.092		-0.305		-0.009***		-3.293***		-0.129***
		(0.33)		(0.00)		(0.76)		(0.30)		(0.00)		(0.67)		(0.28)		(0.00)		(0.82)		(0.04)
Constant	29.981***	173.256***	0.298***	0.787***	116.283***	453.853***	19.080***	160.053***	0.288***	0.830***	100.517***	442.758***	10.171***	141.718***	0.289***	0.798***	95.727***	346.045***	-2.057***	5.436***
	(0.42)	(0.74)	(0.00)	(0.00)	(1.17)	(1.68)	(0.38)	(0.96)	(0.00)	(0.01)	(1.03)	(2.17)	(0.31)	(1.15)	(0.00)	(0.02)	(1.05)	(3.39)	(0.02)	(0.26)
R^2	0.124	0.492	0.118	0.477	0.066	0.598	0.105	0.534	0.089	0.407	0.063	0.618	0.061	0.572	0.067	0.367	0.069	0.479		
N	384336	345849	367263	333534	361740	347259	384336	313839	308202	269571	323568	315657	384339	277734	215628	204450	289455	279342	398586	279339
Model	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	logit	logit

Note: Standard error in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A-8: Regression results by school

	score1_un	score1_adj	ep1_un	ep1_adj	wncea1_un	wncea1_adj	score2_un	score2_adj	ep2_un	ep2_adj	wncea2_un	wncea2_adj	score3_un	score3_adj	ep3_un	ep3_adj	wncea3_un	wncea3_adj	ue_un	ue_adj
NCEA year	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
2008		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000
		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)
2009		0.449		0.000		1.481*		3.388***		-0.021***		37.242***		0.554		0.000		4.913		0.651*
		(0.29)		(0.00)		(0.66)		(0.71)		(0.01)		(1.61)		(1.13)		(0.02)		(3.33)		(0.28)
2010		-0.614*		0.002		4.909***		2.459***		-0.019***		38.663***		3.838***		-0.029		37.048***		2.477***
		(0.29)		(0.00)		(0.66)		(0.71)		(0.01)		(1.60)		(1.01)		(0.02)		(2.98)		(0.26)
2011		7.370***		0.019***		37.904***		0.345		-0.019***		40.926***		3.130**		-0.025		44.847***		2.455***
		(0.29)		(0.00)		(0.66)		(0.71)		(0.01)		(1.60)		(1.01)		(0.02)		(2.98)		(0.26)
2012		6.945***		0.023***		41.913***		6.330***		-0.006		63.401***		3.233**		-0.023		50.557***		2.566***
		(0.29)		(0.00)		(0.66)		(0.71)		(0.01)		(1.59)		(1.01)		(0.02)		(2.97)		(0.26)
2013		7.690***		0.033***		50.025***		5.981***		-0.004		63.108***		7.634***		-0.006		64.278***		2.848***
		(0.29)		(0.00)		(0.65)		(0.70)		(0.01)		(1.59)		(1.01)		(0.02)		(2.97)		(0.26)
2014		9.009***		0.043***		41.017***		9.505***		0.015**		54.870***		8.047***		-0.001		62.674***		2.341***
		(0.29)		(0.00)		(0.65)		(0.70)		(0.01)		(1.59)		(1.01)		(0.02)		(2.97)		(0.26)
2015		26.254***		0.114***		-85.351***		33.230***		0.127***		12.081***		8.568***		0.008		61.103***		2.479***
		(0.31)		(0.00)		(0.71)		(0.71)		(0.01)		(1.60)		(1.01)		(0.02)		(2.96)		(0.26)
2016		20.899***		0.096***		-115.935***		28.981***		0.113***		-4.828**		6.616***		0.020		47.098***		2.176***
		(0.32)		(0.00)		(0.73)		(0.71)		(0.01)		(1.60)		(1.01)		(0.02)		(2.96)		(0.26)
2017		29.966***		0.161***		-90.496***		15.253***		0.079***		-20.138***		-10.398***		0.044**		-28.286***		-4.371***
		(0.48)		(0.00)		(1.07)		(0.72)		(0.01)		(1.63)		(1.01)		(0.02)		(2.97)		(0.27)
Girls-only school		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000
		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)
Boys-only school		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000
		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)
State school		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000
		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)
School isolation index		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000
		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)
Female		13.305***		0.048***		22.660***		9.960***		0.056***		5.056***		5.780***		0.055***		14.116***		0.716***
		(0.16)		(0.00)		(0.37)		(0.14)		(0.00)		(0.33)		(0.13)		(0.00)		(0.39)		(0.02)
Māori		-5.538***		-0.021***		-9.883***		-4.690***		-0.018***		-8.888***		-2.671***		-0.021***		-11.247***		-0.355***
		(0.19)		(0.00)		(0.42)		(0.17)		(0.00)		(0.37)		(0.15)		(0.00)		(0.45)		(0.02)
Pasifika		-5.538***		-0.022***		-7.652***		-4.461***		-0.022***		-8.789***		-3.869***		-0.033***		-11.666***		-0.219***
		(0.32)		(0.00)		(0.72)		(0.29)		(0.00)		(0.65)		(0.26)		(0.00)		(0.76)		(0.03)
Australian		-0.672		0.001		-3.463		-0.400		-0.013		-0.277		-1.789		-0.001		-3.747		0.169
		(2.30)		(0.01)		(5.21)		(2.05)		(0.01)		(4.63)		(1.80)		(0.01)		(5.33)		(0.21)
Asian		14.194***		0.049***		14.614***		9.334***		0.037***		-4.241***		3.972***		0.018***		6.747***		0.056
		(0.36)		(0.00)		(0.82)		(0.33)		(0.00)		(0.75)		(0.29)		(0.00)		(0.85)		(0.04)
European		1.982**		0.005*		1.877		1.909***		0.006*		-1.096		-0.227		0.005		-0.587		0.052
		(0.61)		(0.00)		(1.38)		(0.55)		(0.00)		(1.25)		(0.49)		(0.00)		(1.44)		(0.06)
Middle Eastern		4.852**		0.017**		-0.145		3.935*		0.009		-3.966		1.995		0.018*		4.027		0.155
		(1.67)		(0.01)		(3.80)		(1.58)		(0.01)		(3.58)		(1.37)		(0.01)		(4.06)		(0.17)

Latin American	-2.536	-0.012	-3.337	-1.073	-0.009	-3.704	-4.800*	-0.021	-5.412	0.338
	(2.84)	(0.01)	(6.44)	(2.59)	(0.01)	(5.88)	(2.33)	(0.01)	(6.88)	(0.27)
African	-1.806	-0.004	-2.410	0.807	0.009	-5.652	-1.769	-0.010	-6.206	0.502*
	(2.12)	(0.01)	(4.81)	(2.04)	(0.01)	(4.63)	(1.79)	(0.01)	(5.29)	(0.21)
CYF sexual abuse	-3.577***	-0.015***	-8.174***	-2.961***	-0.011***	-4.753***	-1.687***	-0.011***	-4.763***	-0.276***
	(0.38)	(0.00)	(0.86)	(0.34)	(0.00)	(0.76)	(0.33)	(0.00)	(0.96)	(0.05)
CYF physical abuse	0.031	-0.003*	-0.555	-0.165	-0.005**	0.698	0.197	-0.004	-1.461	-0.213***
	(0.29)	(0.00)	(0.65)	(0.26)	(0.00)	(0.58)	(0.26)	(0.00)	(0.75)	(0.05)
CYF emotional abuse	-0.730***	-0.002***	1.466***	-0.619***	-0.004***	0.392	0.146	-0.000	-0.367	-0.017
	(0.15)	(0.00)	(0.33)	(0.13)	(0.00)	(0.29)	(0.13)	(0.00)	(0.39)	(0.02)
CYF neglect abuse	0.011	-0.004***	-0.562	-0.014	-0.003**	-0.423	0.101	-0.004*	-0.523	-0.078*
	(0.19)	(0.00)	(0.44)	(0.18)	(0.00)	(0.39)	(0.18)	(0.00)	(0.52)	(0.03)
CYF self-harm abuse	3.795	0.034	-3.047	4.644	0.052	15.652	-0.864	-0.001	0.271	-0.275
	(7.89)	(0.03)	(17.56)	(6.60)	(0.04)	(14.68)	(6.70)	(0.06)	(19.84)	(0.91)
CYF behavioural abuse	-1.279***	-0.004***	-3.218***	-1.214***	-0.006***	-1.910***	-0.175	-0.004	-2.936***	-0.239***
	(0.19)	(0.00)	(0.44)	(0.17)	(0.00)	(0.39)	(0.18)	(0.00)	(0.52)	(0.04)
Refugee	0.351	0.005	2.342	-1.752	-0.004	0.031	-0.985	0.003	-1.342	-0.260*
	(1.37)	(0.00)	(3.10)	(1.19)	(0.01)	(2.69)	(1.04)	(0.01)	(3.07)	(0.12)
Disability	-8.541***	-0.031***	-16.767***	-6.853***	-0.030***	-14.349***	-3.323***	-0.023***	-17.025***	-0.491***
	(0.37)	(0.00)	(0.83)	(0.34)	(0.00)	(0.75)	(0.32)	(0.00)	(0.95)	(0.04)
ESOL	-5.329***	-0.024***	-9.981***	-3.961***	-0.022***	-6.205***	-2.722***	-0.020***	-6.475***	-0.228***
	(0.37)	(0.00)	(0.83)	(0.33)	(0.00)	(0.75)	(0.30)	(0.00)	(0.88)	(0.04)
Reading recovery	-12.814***	-0.067***	15.894***	-11.685***	-0.046***	-7.601***	7.118***	-0.018	-3.834	-0.869
	(0.95)	(0.00)	(2.16)	(0.98)	(0.01)	(2.23)	(1.67)	(0.02)	(4.95)	(0.47)
Suspension count	0.170	0.002	-3.914***	-0.102	-0.003	-2.304***	0.033	-0.004	-2.695***	-0.389***
	(0.27)	(0.00)	(0.61)	(0.24)	(0.00)	(0.54)	(0.24)	(0.00)	(0.71)	(0.06)
Stand down count	-1.523***	-0.012***	-4.753***	-1.487***	-0.014***	-2.187***	-0.226**	-0.010***	-3.743***	-0.438***
	(0.09)	(0.00)	(0.21)	(0.08)	(0.00)	(0.19)	(0.08)	(0.00)	(0.24)	(0.02)
Expulsion	-3.228*	-0.018**	-2.785	-3.921**	-0.011	-4.351	-0.855	0.010	-0.601	-0.145
	(1.44)	(0.01)	(3.26)	(1.30)	(0.01)	(2.92)	(1.28)	(0.01)	(3.76)	(0.24)
School transfer count	-5.221***	-0.016***	-11.685***	-3.846***	-0.013***	-6.818***	-1.995***	-0.009***	-7.563***	-0.214***
	(0.12)	(0.00)	(0.28)	(0.11)	(0.00)	(0.25)	(0.10)	(0.00)	(0.30)	(0.01)
Percentage of internal credits	-1.492***	-0.005***	-3.429***	-1.513***	-0.006***	-3.983***	-1.323***	-0.005***	-2.821***	-0.098***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
Access to heat at home	-5.982***	-0.022***	-13.962***	-4.208***	-0.020***	-6.702***	-2.949***	-0.018***	-7.990***	-0.469***
	(0.25)	(0.00)	(0.57)	(0.22)	(0.00)	(0.50)	(0.20)	(0.00)	(0.60)	(0.02)
Access to the internet at home	1.112***	0.009***	2.903***	1.057***	0.009***	-0.140	-0.122	0.006***	2.010***	0.218***
	(0.20)	(0.00)	(0.46)	(0.18)	(0.00)	(0.41)	(0.17)	(0.00)	(0.50)	(0.02)
Parent's homeownership	1.158***	0.006***	2.488***	1.031***	0.004***	1.374***	0.312**	0.003**	2.439***	0.081***
	(0.15)	(0.00)	(0.34)	(0.13)	(0.00)	(0.30)	(0.12)	(0.00)	(0.35)	(0.01)
Parents' divorce status	-3.868***	-0.010***	-6.670***	-2.579***	-0.009***	-3.709***	-1.497***	-0.004**	-2.772***	-0.085***
	(0.22)	(0.00)	(0.50)	(0.20)	(0.00)	(0.44)	(0.18)	(0.00)	(0.52)	(0.02)
Mother's education	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
High school certificate	5.552***	0.025***	11.434***	3.759***	0.022***	5.140***	1.500***	0.016***	7.048***	0.238***

		(0.19)		(0.00)		(0.43)		(0.17)		(0.00)		(0.38)		(0.16)		(0.00)		(0.46)		(0.02)
Diploma		12.266***		0.048***		22.737***		8.886***		0.043***		10.472***		3.973***		0.033***		13.277***		0.419***
		(0.28)		(0.00)		(0.63)		(0.25)		(0.00)		(0.56)		(0.22)		(0.00)		(0.66)		(0.03)
Bachelor's degree		17.676***		0.064***		27.477***		13.450***		0.060***		11.479***		6.706***		0.046***		17.886***		0.485***
		(0.27)		(0.00)		(0.62)		(0.25)		(0.00)		(0.56)		(0.22)		(0.00)		(0.65)		(0.03)
Postgraduate (master's/PhD) degree		23.433***		0.081***		37.167***		18.215***		0.073***		16.495***		10.030***		0.062***		24.956***		0.576***
		(0.38)		(0.00)		(0.87)		(0.35)		(0.00)		(0.79)		(0.30)		(0.00)		(0.90)		(0.04)
Father's education		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000
		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)		(.)
High school certificate		5.845***		0.023***		11.256***		4.190***		0.021***		4.833***		1.728***		0.017***		7.310***		0.263***
		(0.19)		(0.00)		(0.44)		(0.17)		(0.00)		(0.39)		(0.16)		(0.00)		(0.46)		(0.02)
Diploma		12.900***		0.047***		22.429***		9.376***		0.043***		9.388***		3.972***		0.032***		13.476***		0.365***
		(0.31)		(0.00)		(0.70)		(0.28)		(0.00)		(0.62)		(0.24)		(0.00)		(0.72)		(0.03)
Bachelor's degree		24.045***		0.078***		37.604***		18.909***		0.071***		15.831***		10.107***		0.056***		23.749***		0.547***
		(0.31)		(0.00)		(0.69)		(0.28)		(0.00)		(0.63)		(0.24)		(0.00)		(0.72)		(0.03)
Postgraduate (master's/PhD) degree		27.409***		0.087***		42.504***		21.906***		0.081***		18.474***		13.195***		0.064***		29.599***		0.578***
		(0.40)		(0.00)		(0.90)		(0.36)		(0.00)		(0.82)		(0.31)		(0.00)		(0.92)		(0.04)
Mother's ln income		-0.373***		-0.002***		-0.641***		-0.228***		-0.001***		-0.338***		-0.156***		-0.001***		-0.557***		-0.009***
		(0.02)		(0.00)		(0.05)		(0.02)		(0.00)		(0.04)		(0.02)		(0.00)		(0.05)		(0.00)
Father's ln income		-0.258***		-0.001***		-0.470***		-0.141***		-0.001***		-0.140***		-0.100***		-0.001***		-0.258***		-0.010***
		(0.02)		(0.00)		(0.04)		(0.02)		(0.00)		(0.04)		(0.02)		(0.00)		(0.05)		(0.00)
Mother's benefit history (weeks)		-0.008***		-0.000***		-0.016***		-0.007***		-0.000***		-0.009***		-0.002***		-0.000***		-0.014***		-0.001***
		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)
Father's benefit history (weeks)		-0.005***		-0.000***		-0.011***		-0.004***		-0.000***		-0.009***		-0.002***		-0.000***		-0.013***		-0.000***
		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)
Mother's offence history (number)		0.001		0.000		0.004		0.002		0.000		0.002		0.001		0.000		0.002		0.000
		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)
Father's offence history (number)		0.003***		0.000***		0.005**		0.002**		0.000*		0.002		0.001		0.000		0.004*		0.000
		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)
Mother's prison (dummy)		1.603***		0.004*		3.511***		0.853*		0.006**		1.263		0.964**		0.006		0.871		-0.139*
		(0.43)		(0.00)		(0.96)		(0.38)		(0.00)		(0.86)		(0.37)		(0.00)		(1.10)		(0.06)
Father's prison (dummy)		-2.209***		-0.010***		-2.566***		-2.066***		-0.010***		-1.048		-0.332		-0.008***		-3.331***		-0.119***
		(0.32)		(0.00)		(0.73)		(0.29)		(0.00)		(0.65)		(0.27)		(0.00)		(0.81)		(0.04)
Constant	36.102***	167.043***	0.348***	0.804***	122.186***	452.918***	20.380***	165.557***	0.346***	0.886***	102.855***	475.554***	10.652***	138.501***	0.371***	0.809***	96.988***	348.829***	-2.330***	4.874***
	(3.09)	(2.54)	(0.01)	(0.01)	(8.66)	(5.76)	(2.79)	(2.33)	(0.01)	(0.01)	(7.49)	(5.26)	(2.33)	(2.34)	(0.02)	(0.02)	(7.82)	(6.92)	(0.21)	(0.41)
R^2	0.212	0.524	0.180	0.498	0.121	0.629	0.177	0.554	0.147	0.428	0.114	0.637	0.112	0.586	0.119	0.392	0.123	0.496		
N	384648	345861	367557	333537	362028	347280	384651	313851	308457	269574	323859	315684	384651	277746	215793	204450	289671	279363	398010	279054
Model	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	ols	logit	logit

Note: Standard error in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A-9: School counts by decile and performance categories – WRPI score

WRPI score NCEA level 1 unadjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	63	24	9	s	12
Average	33	63	78	42	15
High	s	s	9	42	60
WRPI score NCEA level 1 adjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	21	27	27	21	18
Average	66	54	57	33	24
High	12	12	12	36	51
WRPI score NCEA level 2 unadjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	60	24	12	s	12
Average	36	57	75	45	18
High	s	6	9	39	60
WRPI score NCEA level 2 adjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	21	33	27	15	15
Average	63	48	57	45	21
High	15	12	15	30	54
WRPI score NCEA level 3 unadjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	51	27	15	6	12
Average	39	54	78	48	18
High	6	9	6	33	63
WRPI score NCEA level 3 adjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	24	30	30	15	21
Average	51	45	54	48	33
High	27	18	15	27	39

Table A-10: School counts by decile and performance categories – EP score

Expected percentile NCEA level 1 unadjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	60	36	15	s	s
Average	30	45	81	57	21
High	9	6	6	30	69
Expected percentile NCEA level 1 adjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	15	33	36	24	9
Average	51	42	51	48	42
High	33	18	12	21	42
Expected percentile NCEA level 2 unadjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	51	39	21	6	s
Average	33	42	72	57	24
High	12	12	6	27	63
Expected percentile NCEA level 2 adjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	18	33	33	18	12
Average	39	39	51	60	42
High	42	18	12	12	36
Expected percentile NCEA level 3 unadjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	51	36	21	s	s
Average	33	42	72	63	24
High	15	12	6	24	66
Expected percentile NCEA level 3 adjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	18	27	36	18	15
Average	36	39	48	60	42
High	45	27	15	12	33

Table A-11: School counts by decile and performance categories – Weighted NCEA score

Weighted NCEA score level 1 unadjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	57	24	9	9	12
Average	36	63	81	42	15
High	6	6	6	39	63
Weighted NCEA score level 1 adjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	21	27	24	27	18
Average	63	51	57	33	27
High	15	15	18	30	42
Weighted NCEA score level 2 unadjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	54	24	15	6	12
Average	39	60	75	45	15
High	s	6	12	36	63
Weighted NCEA score level 2 adjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	18	27	24	18	30
Average	57	48	48	45	33
High	27	18	27	27	27
Weighted NCEA score level 3 unadjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	54	30	15	6	9
Average	33	54	78	48	21
High	9	9	6	36	60
Weighted NCEA score level 3 adjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	24	24	33	9	21
Average	39	48	51	54	33
High	33	18	18	24	33

Table A-12: School counts by decile and performance categories – UE

University Entrance unadjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	66	30	9	6	6
Average	24	57	78	57	18
High	6	6	9	27	66
University Entrance adjusted					
Performance	**Decile**				
	1–2	**3–4**	**5–6**	**7–8**	**9–10**
Low	21	24	15	27	9
Average	33	39	57	51	51
High	42	24	12	12	33

Robustness tests

As part of our analysis of secondary school performance, we performed a range of robustness tests.

The first test evaluated the consistency of our results over time. As part of this test, we restricted our analysis to five two-year samples covering 2008–09, 2010–11, 2012–13, 2014–15 and 2016–17.

The second test evaluated the consistency of our results using a modified model excluding student characteristics that could be influenced by the school. In this test, we excluded these student behaviour variables: percentage of internal credits, reading recovery, number of suspensions, number of stand downs, and number of expulsions. In the literature, most VAMs only control for variables outside the control of the school.

The third test evaluated the consistency of our results using two restricted risky cohorts. The first restricted the sample to students with low education parents, while the second restricted the sample to Māori and Pasifika students. We classified students with low education parents as risky given that parental education was the greatest predictor of success in NCEA, while Māori and Pasifika students were classified as risky because of their consistent negative regression coefficients and the consistent finding that Māori and Pasifika have on average worse academic outcomes in New Zealand.

These robustness tests classified low education attainment as parents with a total education attainment of value 3 or less, where the education attainment rank was:

1. None
2. High school certificate
3. Diploma
4. Bachelor’s degree
5. Postgraduate degree

The fourth test evaluated the consistency of our results using data where students who did not attempt NCEA level 2 and 3 (post NCEA level 1) were imputed a value of 0. This robustness test evaluated the performance of schools that might be pushing students out of school if they were at risk of failing NCEA level 2 and 3. There are conceptual problems with assigning grades of 0 to students who drop out given the counterfactual to dropping out is unlikely scoring a 0 grade in NCEA. Further work is being undertaken to develop better robustness tests.

The fifth and final test evaluated the consistency of our results using data restricted to students who only attended one school. This was done because our analysis of schools had allocated students to the last school they were enrolled in. This could bias schools that were more likely to push students to other schools and schools that were more likely to take students from other schools.

The results from our robustness tests supported our initial findings.

Future regressions and research

VAMs around the world commonly evaluate schools on only academic outcomes. However, because of the rich datasets available in the IDI, future work by the Initiative will evaluate schools on later life outcomes, including progression and completion of tertiary education and progression to benefit and or NEET (Not in Employment, Education or Training) status 1, 3 and 5 years after college.

Interesting master's theses

Typically, the laborious and time-consuming task of data matching students with parents, and the high risk of insignificant results, inhibits one-year master's students from undertaking this type of work. However, we have already done all the data matching so all a student needs to do is run the Initiative's IDI code and start building on it. Example master's theses include:

1. Investigating the probability of enrolling into a high-performing school based on the location of a student's residence using meshblock data. As discussed in detail in the Introduction, many students attend high-decile schools out-of-zone. What is the probability that a student would be better served by his or her local low-decile school versus the out-of-zone high-decile school? This is a quantitatively difficult project and beyond the scope of our current research programme, but it would be an interesting research question worth investigating by a master's student.

2. Many of the family background covariates (control variables) used in our project are the simplest version of that variable because of the 80/20 rule we applied to our school performance model – our project is very much a proof of concept. Future master's theses could significantly improve upon the covariates we have used. For example, we have only used dummy variables for mother's and father's prison history; in other words, students were allocated values of 'yes' (1) or 'no' (0) based on their parent's presence in the corrections database. It would be more insightful for a future version of our model to include parent's length of stay in prison in addition to severity of offence. There are more than 40 covariates in our model – all of which could be refined and improved upon.

3. Finally, because no standardised national testing is performed and results collected in primary and intermediate schools in New Zealand, it is impossible to evaluate feeder schools using our school performance tool. This is important as many secondary schools often argue that they make up for the academic weaknesses caused by feeder primary and intermediate schools. Using linked primary and intermediate school data in the IDI, a master's student could study feeder school quality using a modified version of our school performance model. Again, this project is quantitatively difficult and beyond the scope of our current research programme, but it would be an interesting project for a master's student.

Endnotes

[1] Yugo Nakamura, "A Primer on Value-Added Models: Towards a Better Understanding of the Quantitative Analysis of Student Achievement," Dissertation in fulfilment for Doctor of Philosophy (University of Washington, 2014).
[2] Thomas Dee and James Wyckoff, "Incentives, Selection, and Teacher Performance: Evidence from IMPACT," NBER Working Paper 19529 (Cambridge: United States, 2013).
[3] Yugo Nakamura, "A Primer on Value-Added Models: Towards a Better Understanding of the Quantitative Analysis of Student Achievement," op. cit.
[4] HoonHo Kim and Diane Lalancette, "Literature Review on the Value-Added Measurement in Higher Education" (Paris: OECD Publishing, 2013).
[5] ERO disproportionately categorises low-decile schools in the one- to two-year review cycle (ERO's poor performing category). ERO evaluates schools on various aspects of performance; the reason(s) low-decile schools are disproportionately represented in the poor-performing category is beyond the scope of this report. Tomorrow's Schools Independent Taskforce, "Our Schooling Futures: Stronger Together" (Wellington: Ministry of Education, 2018); Education Review Office, "Our approach to school evaluations," Website (17 July 2019). However, a previous Initiative report, "Tomorrow's Schools: Data and Evidence," found no difference between low- and high-decile schools when evaluated on academic performance, after separating the effect of family background from average school performance across deciles. Chapter 3 of this report discusses this further. Joel Hernandez, "Tomorrow's Schools: Data and Evidence" (Wellington: The New Zealand Initiative, 2019), 3.
[6] Two reports used the NSW VAM to identify high-performing schools and best practice. Natalie Johnston-Anderson, "Sustaining Success: A Case Study of Effective Practices in Fairfield High-Value-Add Schools" (Sydney: Centre for Education Statistics and Evaluation, 2017), and Blaise Joseph, "Overcoming the Odds: A Study of Australia's Top-Performing Disadvantaged Schools" (Sydney: The Centre for Independent Studies, 2019).
[7] Lucy Lu and Karen Rickard, "Value Added Models for NSW Government Schools" (NSW: Centre for Education Statistics and Evaluation, 2014), 5–6.
[8] For example, out of the 220,000 students who attended school in Auckland in 2018, approximately 127,000 attended a school within-zone, 38,000 attended a school out-of-zone, and 57,000 attended a school without an enrolment scheme. John Gerritsen, "Auckland schools overcrowded with out-of-zone students," Radio NZ (23 April 2019).
[9] Simon Collins, "Revealed: NZ's best schools – How co-ed schools rank against single-sex," *The New Zealand Herald* (15 April 2019).
[10] In a previous Initiative report, "Score! Transforming NCEA Data," we discussed this issue thoroughly. Eric Crampton and Martine Udahemuka, "Score! Transforming NCEA Data" (Wellington: The New Zealand Initiative, 2018).
[11] HoonHo Kim and Diane Lalancette, "Literature Review on the Value-Added Measurement in Higher Education," op. cit.
[12] Ibid.
[13] Tomorrow's Schools Independent Taskforce, "Our Schooling Futures: Stronger Together," op. cit.
[14] Harkanwal Singh, "The decile drift: How school roll ethnicities have changed," Educationcentral.co.nz (1 March 2018). We acknowledge that decile drift and the corresponding socioeconomic segregation are also influenced by personal biases and prejudices about certain cultures.
[15] Note that the number of students and schools in our dataset are not official statistics but numbers produced after randomly rounding the respective student and school counts to base 3 (RR3) in compliance with rule 5.1.1 in Statistics New Zealand's *Microdata Output Guide*. Statistics New Zealand, *Microdata Output Guide*, 4th edition (Wellington: New Zealand Government, 2016).
The official number of secondary and composite schools that teach years 11–13 in New Zealand is 517; however, some schools in our dataset were dropped because they had fewer than 30 students. Education Counts, "Number of schools," Website.
Additionally, key restrictions to our dataset include dropping students who died or emigrated during their time at secondary school and students who attended a school with fewer than 30 observations over the 10-year period. Excluding schools with low student counts is standard practice in VAMs to avoid volatility in school estimates over time. This volatility can occur from large variability in students from year to year.

[16] Note that the Department of Internal Affairs (DIA) data includes birth information dating back to the 1840s, with unique IDs for the child and both parents where they exist. Irene Wu and Barry Milne, "Intergenerational Analyses Using the IDI" (University of Auckland: COMPASS Research Centre, 2017).
[17] Statistics New Zealand, *Microdata Output Guide*, op. cit.
[18] In the 21 years since the decile funding model was implemented in 1995, the number of students in decile 8–10 schools has increased from 201,153 to 280,209 in 2016; in contrast, the number of students in decile 1–3 schools has decreased from 188,089 to 179,929. Tomorrow's Schools Independent Taskforce, "Our Schooling Futures: Stronger Together," op. cit.
[19] Briar Lipson, "Spoiled by Choice: How NCEA Hampers Education and What it Needs to Succeed" (Wellington: The New Zealand Initiative, 2017).
[20] Ibid.
[21] Eric Crampton and Martine Udahemuka, "Score! Transforming NCEA Data," op. cit.; David Scott, "How Does Achievement at School Affect Achievement in Tertiary Education?" (Wellington: Ministry of Education, 2008). Note there are existing deficiencies in both the WRPI and Expected Percentile scores in that both do not fully account for the difficulty of each standard and subject. Future research creating a difficulty-adjusted WRPI score should be done. Note that the University of Canterbury produced a Difficulty Index of its courses ranking a course's difficulty based on how well students performed in that course, on average, compared to their performance in other courses. So if everyone taking intermediate macroeconomics earned, on average, a letter grade lower score than in other courses, intermediate macroeconomics would be rated as relatively difficult. Producing that measure across the thousands of NCEA standards would be computationally intensive.
[22] A unit or achievement standard is the form of assessment used in NCEA.
[23] Kamakshi Singh and Tim Maloney, "Using Validated Measures of High School Academic Achievement to Predict University Success," *New Zealand Economic Papers* 53:1 (2019), 89–106.
[24] New Zealand Qualifications Authority, "University Entrance," Website.
[25] New Zealand Qualifications Authority, "Secondary school statistics," Website.
[26] Extracting NCEA standards data at a later data would confirm our hypothesis.
[27] Te Ara, "Child, Youth and Family notifications, investigations and confirmations, 2003–2015," Website.
[28] Note: Datasets were not exported out of the IDI; rather, they were exported to our project folder using Microsoft SQL Server.
[29] HoonHo Kim and Diane Lalancette, "Literature Review on the Value-Added Measurement in Higher Education," op. cit. 11.
[30] Cory Koedel, Kata Mihaly and Jonah E. Rockoff, "Value-Added Modelling: A Review," *Economics of Education Review* 47C (2015), 180–195.
[31] Lucy Lu and Karen Rickard, "Value Added Models for NSW Government Schools," op. cit. 6. Also see Cory Koedel, Kata Mihaly and Jonah E. Rockoff, "Value-Added Modelling: A Review," Ibid.
[32] Andrew Devonport, "The Impact of Secondary School Enrolment Schemes on School Desirability, Academic Achievement and Transport," Thesis in fulfilment of Master's of Geographic Information Science (University of Canterbury, 2017).
[33] Ibid.
[34] Susan Edmunds, "Data shows NZ school zoning makes huge difference to house prices," *Stuff* (4 August 2017).
[35] Ministry of Education, "Enrolment schemes (school zones)," Website.
[36] Tomorrow's Schools Independent Taskforce, "Our Schooling Futures: Stronger Together," op. cit.
[37] Hausman tests were run on the outcome variables, NCEA level 1 WRPI score, and expected percentile score. The p-value on the NCEA level 1 WRPI score was 0.0012.
[38] Both Cambridge and International Baccalaureate qualifications are not available in the IDI, and thus have not been included in our analysis. However, these students will be included in our analysis of schools using later-life outcomes (see the Future regressions section in the Appendix).
[39] In our analysis, state-integrated and private schools were combined. In our dummy variable for state schools, state schools were allocated a value of 1 while state-integrated and private schools were allocated a value of 0. Future research and later iterations of our model should distinguish between state-integrated and private schools.
[40] Lucy Lu and Karen Rickard, "Value Added Models for NSW Government Schools," op. cit. 15.
[41] In our final student-parent dataset, we evaluated 480 secondary schools. This figure is not an official statistic but a number produced after randomly rounding the school count to base 3 (RR3) in compliance with Statistics

New Zealand's confidentially rules and regulations. The official number of secondary and composite schools that teach year 11–13 students in New Zealand is 517; however, some schools in our dataset were dropped because they had fewer than 30 students allocated to them.
[42] Note: In future iterations of our model, the distribution of school performance presented in LOWESS graphs should re-normalise the schools to the median school.
[43] See endnote 15.
[44] Specifically, rule 5.14.2 of Statistics New Zealand's *Microdata Output Guide* prevents individual schools from being identified in any IDI research output, even in cases where a school's results are anonymised. Statistics New Zealand, *Microdata Output Guide*, op. cit.
[45] Ibid.
[46] Robert J. Marzano cites John Hattie's seminal work: John Hattie, "Measuring the Effects of Schooling," *Australian Journal of Education* 36:1 (1992), 5–13, in Robert J. Marzano, *A New Era of School Reform: Going Where the Research Takes Us* (Aurora, Colorado: Mid-continent Research for Education and Learning, 2000), 26. See John Hattie, "Influences of Student Learning," Inaugural Lecture: Professor of Education (University of Auckland, 1999) for a list of education innovations and their estimated average effects.
[47] The nearly one standard deviation increase in performance refers to the results from the NCEA level 1 WRPI evaluation where the predicted effect of being born with parents who both have postgraduate qualifications is 92.8% of one standard deviation.
[48] The following three papers have an extensive list of studies discussing the large positive effects of parent's education on children's academic achievement: 1) Eric Dubow, Paul Boxer and Rowell Huesmann, "Long-term Effects of Parents' Education on Children's Educational and Occupational Success: Mediation by Family Interactions, Child Aggression, and Teenage Aspirations," *National Institute of Health* 55:3 (2009), 224–249; 2) Pamela Davis-Kean, "The Influence of Parent Education and Family Income on Child Achievement: The Indirect Role of Parental Expectations and the Home Environment," *Journal of Family Psychology* 19:2 (2005), 294–304; and 3) Robert Haveman and Barbara Wolfe, "The Determinants of Children's Attainments: A Review of Methods and Findings," *Journal of Economic Literature* 33:4 (1995), 1829–1878.
[49] Pamela Davis-Kean, "The Influence of Parent Education and Family Income on Child Achievement," Ibid.
[50] Ibid.
[51] Ibid.
[52] Daniel Voyer and Susan Voyer, "Gender Differences in Scholastic Achievement: A Meta-Analysis," *Psychological Bulletin* 140:4 (2014), 1174–1204.
[53] Ministry of Education, "PISA 2015: New Zealand Summary Report" (Wellington, New Zealand Government, 2016); Tomorrow's Schools Independent Taskforce, "Our Schooling Futures: Stronger Together," op. cit.
[54] PISA is scaled to have a mean of 500 and a standard deviation of 100 across all OECD countries. In 2015, the average New Zealand student scored 513, 509 and 495 in science, reading and mathematics, respectively; in comparison, Māori students scored 466, 465 and 452, respectively, while Pasifika students scored 446, 450 and 441, respectively. This equates to an average performance difference of -45% and -60% of one standard deviation for Māori and Pasifika students, respectively. Ministry of Education. "PISA 2015: New Zealand Summary Report," Ibid.
[55] Yoko Yamamoto and Susan D. Holloway, "Parental Expectations and Children's Academic Performance in Sociocultural Context," *Educational Psychology Review* 22 (2010), 189–214.
[56] Tomorrow's Schools Review Independent Taskforce, "Tomorrow's Schools Review Independent Taskforce Meeting June 2018" (Wellington: Ministry of Education, 2018).
[57] Te Ara, "Child, Youth and Family notifications, investigations and confirmations, 2003–2015," op. cit.
[58] Daniel Potter, "How Maltreatment Matters: Effects of Child Maltreatment on Academic Performance," *Sociological Studies of Children and Youth* 13 (2011), 167–202.
[59] Jeffrey Leiter and Matthew Johnsen, "Child Maltreatment and School Performance," *American Journal of Education* 102:2 (1994), 154–189.
[60] Brian Jacob and Joseph Ryan, "Child Maltreatment and Academic Performance" (University of Michigan: Youth Policy Lab & Child Adolescence Data Lab, 2018).
[61] Stella Chatzitheochari and Lucinda Platt, "Disability Differentials in Educational Attainment in England: Primary and Secondary Effects," *British Journal of Sociology* 70:2 (2018), 502–525.
[62] Statistics New Zealand, "Disability Survey: Key facts," Website.

[63] Paul Amato, “Children of Divorce in the 1990s: An Update of the Amato and Keith (1991) Meta-Analysis,” *Journal of Family Psychology* 15:3 (2001), 355–370.
[64] Thomas O’Connor, “Are Associations Between Parental Divorce and Children’s Adjustment Genetically Mediated? An Adoption Study,” *Developmental Psychology* 36:4 (2000), 329–437.
[65] Robert Haveman and Barbara Wolfe, “The Determinants of Children’s Attainments: A Review of Methods and Findings,” op. cit.
[66] Martha Hill and Greg Duncan, “Parental Family Income and the Socioeconomic Attainment of Children,” *Social Science Research* 16 (1987), 39–73.
[67] Brogan Powlesland, “What PISA tells us about grade inflation in NCEA,” *Newsroom* (19 April 2017).
[68] One of the most common indices found in the research on the effects of schooling is the percent of variance explained, or PV. The index used to judge the influence of predictor variables is the ratio of variance accounted for by the predictor variables over the total variance of the predicted variable multiplied by 100.

$$PV = \frac{\begin{array}{c}\text{percent of variance}\\ \text{explained by independent variables}\end{array}}{\begin{array}{c}\text{percent of variance}\\ \text{explained by dependent variables}\end{array}} \times 100$$

Robert J. Marzano, *A New Era of School Reform: Going Where the Research Takes*, op. cit. 3.
[69] See the average percentage of variance explained in Table 4.2 in Robert J. Marzano, *A New Era of School Reform: Going Where the Research Takes* Us, Ibid. 46.
[70] See the average percentage of variance explained in Table 6.1 in Robert J. Marzano, *A New Era of School Reform: Going Where the Research Takes*, Ibid. 67.

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ABOUT THE INITIATIVE

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