AUSTRALIAN JOURNAL OF LABOUR ECONOMICS
Volume 18 • Number 1 • 2015 • pp 75 - 94

Does School Socio-economic Status Influence University Outcomes?

Ian W. Li, The University of Western Australia
A. Michael Dockery, Curtin University

Abstract

This study explores the role of schools' socioeconomic status in determining academic performance at university. Data for first year domestic undergraduates at an Australian university in 2011 to 2013 are linked to schools' data to examine the role of student- and school-level characteristics in influencing university marks. Schools' socioeconomic status is found to have moderate impacts on university performance, with students from lower socioeconomic status schools faring better. Prior academic achievement, as proxied by ATAR scores, is found to be a strong determinant of university grades. School sector and resources are found to have negligible impacts on students' academic performance at university. The results suggest that equity measures to increase university access for low SES students and those from lower-SES schools could be expanded without compromising academic standards.

Keywords: Analysis of education; Education and inequality; Government policy

JEL classification: I21, I24, I28

1. Introduction

The Australian university sector has undergone a number of reforms in recent years. The Bradley Review of Australian Higher Education (Bradley, 2008) recommended an ambitious university degree attainment target of 40 per cent for Australians aged 25 to 34 years by 2025, which was adopted formally by the Australian Labor government under the prime ministership of Kevin Rudd. Since then, Australia's higher education sector has undergone an expansion in university student numbers, particularly after the uncapping of Commonwealth funded undergraduate student places in 2012. At the same time, the Bradley Review had also recommended that the representation of

---

Address for correspondence: Ian W. Li, School of Population Health, The University of Western Australia, Crawley WA 6009, Australia. Email: ian.li@uwa.edu.au
Acknowledgement: The authors are grateful to the National Centre for Student Equity in Higher Education (NCSEHE) for data provision, and for useful comments from participants of the Honouring Paul Miller event in Fremantle, Western Australia. Li acknowledges funding support from the NCSEHE. Views expressed in this paper are those of the authors and should not be attributed to the NCSEHE, The University of Western Australia or Curtin University.

students from low socioeconomic status (SES) be increased to 20 per cent of higher education enrolments by 2020. Student statistics from the Department of Education (2014) indicate, however, that the proportion of low SES students in undergraduate courses in Australia was stable at around 16 per cent between 2000 and 2011. The uncapping of Commonwealth supported student places at Australian universities under the demand-driven system in 2012 saw the share of low SES students at university rise to 17 per cent in 2012 and 17.5 per cent in 2013 (Department of Education, 2014; Parliament of Australia, 2014).

One issue with raising the proportion of low SES university student enrolment lies in the strategies available for universities to increase the proportion of low SES students they admit, while not compromising student quality in terms of academic performance and degree completion. In addition, it is desirable that university admission pathways for low SES students be done in a transparent and objective manner. In terms of achieving equity in labour market outcomes, the efficacy of the policy of expanding university places for students from low SES backgrounds requires that the low SES students brought into the university sector will be successful in their studies and receive positive returns from gaining those qualifications. In this paper, the nexus between SES background and university success are investigated, with a particular focus on schools' SES and resources, and the intermediary role of the Australian Tertiary Admission Rank (ATAR) as the main criterion for gaining entry to university. More specifically, the research questions to be addressed are: i) is there a link between school SES and university performance?, ii), are there individual schools or school sectors which provide a better platform for university success?, iii) are SES and school effects primarily embodied in students' ATAR scores, or are there other school-related effects that shape university outcomes beyond students' leaving results?, and iv) can any school or sector effects identified be explained by the level of school resourcing?

The paper is structured in the following manner. Section 2 reviews some of the existing literature, with a focus on more recent Australian studies. Section 3 discusses the data and variables that will be used for the study, as well as summary statistics for selected variables, disaggregated by school sector. The methodological approach and estimating equations are discussed in section 4. Empirical results are presented and discussed in section 5. Section 6 concludes.

2. Literature Review

For young Australians seeking to study at university, eligibility is generally determined through high school leaving grades, upon which their ATAR is calculated. Based on a combination of school assessment and marks in leaving examinations, the ATAR ranks school leavers relative to other school leavers of the same year. For example, an ATAR score of 85 indicates that the student is ranked higher than 85 per cent of that students' cohort. For school leavers (as opposed to mature age entrants) universities use ATAR as the main basis for deciding between applicants, and institutions typically advertise minimum ATARs for acceptance into different courses. Thus, the ATAR is accepted as a robust indicator of school leavers' likely success at university.

If students are considered to be endowed with a given level of natural academic ability, the school they attend may still potentially play an important role in a young person's higher educational achievement in a number of ways. First, for any given level of ability, different schools may provide a higher probability of an individual gaining access to university. This may be because the school environment shapes their career aspirations and increases the chance they will seek to qualify for an ATAR and apply to enter university; or because some schools are more effective in raising students' leaving grades, and hence raise their ATAR scores given their ability. Second, for those students who do enter university, some schools may be more effective in preparing students for university studies.

Whether such school effects exist and, if so, the magnitude of those school effects, are significant issues. Parents will want to know whether their children are receiving a 'good education', and if the school they attend boosts their opportunity to progress to university. In particular, parents have to make the choice between sending their children to an Independent or Catholic school for which parental monetary contributions are substantially higher as opposed to public schools. Education departments need to know how schools are performing for the purposes of performance management, and identifying what factors contribute to school performance has clear implications for efforts to improve the education system. Further, equality of opportunity among children requires that certain demographic or socio-economic groups are not systematically excluded from the better performing schools.

The introduction of the low-SES equity target for university enrolments further kindles interest in the influence of schools' SES on student performance. School effects may stem from what the school does, but also the family background of who attends. Beyond the classroom, neighbourhood, family, peer and other role model effects may all influence academic emphasis and shape non-cognitive skills, making it likely that attendance at a school where students have a higher average SES background will contribute to improved student outcomes.

Previous Australian literature on school effects has concentrated on the role of schools and/or school sector on leaving grades (Houng and Justman, 2014; Marks, 2010; Ryan, 2013) and school completion rates (Le and Miller, 2003a; Marks, 2007; 2013; Cardak and Vecci, 2013). This is relevant because the interpretation of school effects on university performance hinges critically on how schools impact upon individuals' ATARs and their probability of entering university. Hence we summarise the key findings from that literature, before reviewing the more limited literature investigating school effects on university performance (Birch and Miller, 2007; Cardak and Vecci, 2013; Dobson and Skuja, 2005; Mills *et al*. 2009; Win and Miller, 2005).

Student academic achievement at school

Results from the OECD's Programme for International Student Assessment (PISA) indicate that a significant proportion of the variation in student performance on standardised tests occurs at the school level – on average around one-third across OECD countries (OECD 2005). For the 2009 Australian PISA, Mahuteau and Mavromaras (2014) attribute 75 per cent of the variance in results to differences between students and 25 per cent to differences between schools. However, a landmark study into educational opportunity commissioned by the US Department of Education in the 1960s (the 'Coleman Report' – Coleman *et al.* 1966) highlighted the limited role of school funding and other school-level effects in the US after allowing for the composition of the student population. Studies with rigorous controls for student background and prior academic achievement have since consistently found no or minimal effects of measures of school quality that might have been expected to impact upon student performance, such as school resourcing, class sizes or teaching practices (Card and Krueger, 1992; Fertig and Wright, 2005; Marks, 2010). The recent empirical literature suggests that much the same conclusion holds for Australia (Marks, 2014; Ryan, 2013). There is evidence that compositional effects do affect outcomes. In other words, it is not so much what schools do that matters, as opposed to who it is goes to schools. McConney and Perry (2010, p. 429), note OECD research based on PISA data shows that in most countries mean school SES has a stronger association with student achievement than the students' own SES background.

Measures of prior academic performance, such as PISA scores (Marks 2007) and NAPLAN scores (Marks, 2014, Houng and Justman, 2014) are strong predictors of school retention, completion and leaving grades.[1] Using data from the 2003 cohort of the Longitudinal Survey of Australian Youth (LSAY) Marks (2007) found school-level measures of SES, academic environment and student-teacher ratios have no significant impact on school completion, however students at Independent schools were substantially less likely to leave school before completing Year 12. In a later study of administrative data for a large sample of Victorian high-school students, Marks (2014) found that most of the between-school variation in retention rates to Year 12 could be accounted for by an elementary set of individual controls, notably NAPLAN scores. However, SES gradients persisted after controlling for student performance (Marks, 2014, p. 345). Huong and Justman (2014) similarly find that given Year 9 NAPLAN scores, Victorian students from high SES backgrounds achieve markedly higher ATARs than those from low SES backgrounds.

The potential effect of school sector (i.e. government, Catholic or Independent) on student performance has received considerable attention (Cardak and Vecci, 2013; Le and Miller, 2003a; Mahuteau and Mavromaras, 2014; Marks, 2007, 2014; Ryan, 2013). However, the findings remain inconclusive, in part because of uncertainty over the selection effects into the different sectors (Cardak and Vecci, 2013; Le and Miller, 2003a). It is also possible that the effects of sectors have changed over time due to the rapid expansion of the private school sector (Ryan, 2013, p. 237) or the very large increase in overall school completion rates (Cardak and Vecci, 2013).

Few studies have been identified that specifically address the relationship of most interest to this current paper, the link between school SES and student performance, other than to the extent that school sector is associated with SES. Independent schools and Catholic schools have higher mean SES than government schools, but the Independent schools are more elite (Ryan, 2013; Mahuteau and

[1] The National Assessment Program - Literacy and Numeracy was introduced in 2008 and tests students in the domains of reading, writing, language conventions and numeracy in Years 3, 5, 7 and 9 (see www.nap.edu.au). PISA assesses reading, mathematical and scientific literacy and can be undertaken in Years 9, 10 or 11 depending upon jurisdiction (Ryan, 2013, p. 228).

Mavromaras, 2014). As noted, Marks (2007) found the average SES of a school's student body to be unrelated to school leaving after controlling for individual factors. In contrast, McConney and Perry (2014) examined 2006 Australian PISA results for both mathematics and science literacy, and find a strong school-level SES gradient within each quintile of students when ranked by individual SES. Furthermore, the gradient is steeper for students in the top half of the distribution by individual SES. Based on multilevel modelling, Mahuteau and Mavromaras (2014) also find evidence of substantial school-level SES effects for the Australian 2009 PISA results for reading, mathematics and science literacy. While McConney and Perry (2013, p. 431) argue such findings of strong school-level SES effects are consistent with existing studies from overseas, Marks' (2010, p. 269) assessment of the literature is that the evidence for such effects is inconclusive.

Schools and university performance

The effects of school attended and prior academic achievement on university entrance, completion and university grades have been studied using data from the LSAY (Cardak and Vecci, 2013) and from datasets matching students' university academic record to their university application data (Birch and Miller, 2007; Dobson and Skuja, 2005; Mills *et al*. 2009; Win and Miller, 2005). Le and Miller (2003b) and Cardak and Vecci (2013) also studied access to university. A clear finding is that school achievement as measured by academic grades is the most important predictor of entry to and subsequent success at university.

Win and Miller (2005) accessed administrative data containing the grades of first-year students at The University of Western Australia in 2001, along with their Tertiary Entrance Rank (similar to an ATAR score), limited demographic information and data on the school they attended drawn from their tertiary applications. The school data included location, size, school sex status (single-sex versus co-educational), and school sector. Further school level data were included from external sources, including the proportion of full-time students that graduated from each school and the proportions that attained certain leaving grades. Weighted average marks in first year university were regressed using a standard ordinary least squares regression (what Win and Miller describe as a 'first generation' model) and random coefficients models in which variables are standardised within schools and the school effects captured through school-specific intercept terms (or 'second generation' models). The results suggest that students from Catholic and Independent schools achieve lower university results than students from government schools after controlling for high school leaving grades and other background variables. Other school effects identified include lower university performance for students from rural schools and single-sex schools, and higher university performance for students from high schools with a large proportion of students with high leaving grades. Win and Miller (2005, p. 12) describe this latter result as an 'immersion effect', a positive externality in which students who attend high schools with many strong academic students, perform better at university in turn.

With respect to the finding of lower university performance for students from non-government schools, Win and Miller (2005, p. 12) suggest that this may arise because Catholic and Independent schools 'artificially inflate' students' high school leaving grades given their ability. The evidence on school effects as presented above casts doubt on whether such inflation really occurs, at least for recent school leavers. In all specifications tested, the strong positive effect of the Tertiary Entrance Rank (high school leaving) score persisted, with its magnitude insensitive to the many controls added to the models: essentially one additional place in a student's rank in leaving grades translated to one additional mark in their weighted average university marks in first-year. In a descriptive analysis of marks for full-time first year students at Monash University between 2000 and 2003, Dobson and Skuja (2005) also find that students from government schools outperform those from Catholic and Independent schools conditional on gender and entry scores. However, they note the correlation between the entry score and first-year university marks is negligible for the lower end of the distribution of entry scores and varies substantially by field of study.

Birch and Miller (2007) largely confirm Win and Miller's (2005) results via quantile regressions for WAMs for first year students at UWA in 2001, 2002, 2003 and 2004, but with more limited school information. The school level variables included were school size, sector and co-ed status. The quantile regressions show the gradients associated with high school leaving grades (positive), having attended a co-ed school (positive) and a non-government school (negative) to be steeper among students at the lower end of the university marks distribution. The fact that many non-government schools are all-boys or all-girls schools accounted for around two thirds of the estimated penalty associated with attendance at a non-government school that is observed, when co-ed status is not controlled for. The results observed in Win and Miller (2005) and Birch and Miller (2007) relating to the importance of leaving grades and school sector were reinforced in a study of 381 first-year Health Science students at UWA in 2000 (Mills *et al*. 2010).

In the study by Cardak and Vecci (2013) noted above, estimates of the effect of attending a Catholic school (assessed against attendance at a government school) on university entrance and university completions rates range from around minus 4 per cent to plus seven per cent, depending upon the assumption regarding selection on unobservables in attendance at Catholic school. Again, however, there are no clear grounds upon which to choose between these various assumptions.

As with the effect of school characteristics on student performance at school, a gap in the literature exists with regard to the effect of the SES of schools on students' performance at university, other than what can be inferred about differences in SES between school sectors. A consistent result is that the socio-economic background of students' own families does influence results over and above measures of prior academic achievement. Cardak and Ryan (2009) find that conditional upon high school leaving grades, students are equally as likely to enter university irrespective of SES background (p. 444). That is, the SES gradient in university access is attributable to differences in school achievement prior to the school-to-university transition. Moreover, they find that much of the SES effect has materialised by Year 9, arguing that improving educational outcomes in primary school and the early years of high school is needed to address the SES imbalance in higher education participation (Cardak and Ryan, 2009, p. 444).

3. Data

This study uses linked data from three sources. Confidentialised unit record data on domestic undergraduates commencing in 2011 to 2013 at an anonymous Australian university are obtained via the National Centre for Student Equity in Higher Education. Only students who were admitted to their university course on the basis of completing Year 12 at high school and for whom information on the school they attended are available, are included in the sample. The total number of observations in the sample population for the study consists of 8,417 undergraduates.

The de-identified university student record data contains demographic characteristics such as the students' age, gender, English-speaking background, residential postcode, and university study characteristics, such as the primary field of university study, ATAR score for university admission and Weighted Average Marks obtained in their first year of university study (WAM). Information on the students' socio-economic status are also obtained by linking their residential postcodes to indices which indicate socio-economic (dis)advantage, namely, the Index of Economic Resources and the Index of Education and Occupation. Both of these indices are constructed by the Australian Bureau of Statistics. Briefly put, the Index of Economic Resources looks at measures of access to economic resources, while the Index of Education and Occupation reflects the educational attainment and occupational levels of the community living in each geographic area. Further information on the construction of these indices can be obtained at ABS (2011).

The student record data are linked to school data based on the high school at which they completed their Year 12 studies. Australian schools' data are sourced from the Australian Curriculum, Assessment and Reporting Authority (ACARA). The undergraduate sample in this study came from 186 schools. The school data includes information on schools' funding, co-educational status, education sector, institution type, religious denomination, location, size (number of student enrolments), full-time equivalent staff numbers (teaching and non-teaching) and socioeconomic status as measured by the Index of Community Socioeconomic Advantage (ICSEA).

The ICSEA was developed by ACARA in order to compare educational achievements of students from socio-educational statistically similar backgrounds, making use of both student and school-level information. Calculation of the ICSEA for each school used student level information on parental education, parental occupation, geographical remoteness, as well as aggregated school level data on the percentage of Indigenous student enrolment and the percentage of students from a non-English language background. In addition, the ICSEA also incorporates other indirect measures of socio-educational advantage by matching data from the ABS's Census Collection Districts to addresses from schools' enrolment records. The Census Collection Districts data covers information such as percentage of people with no post-school qualification, proportion of employed people with higher skill level occupations, percentage of single parent families with dependent offspring only and percentage of occupied private dwellings with no internet connection. Further details on how the ICSEA is developed can be found at ACARA (2012).

Descriptive statistics by school sector

Descriptive statistics for the full sample are presented in the first column of table 1, with separate statistics for the school sectors presented in the remaining columns. The discussion of the descriptive statistics will be focussed on variables of interest, such as the measures of academic performance, school resources and ICSEA. Nevertheless, it can be noted that for most variables, there does not appear to be much variation by school sector.[2]

Table 1 - Descriptive statistics, full sample and by school sector

Variable	*All*	*Independent*	*Catholic*	*Government*
Weight Average Mark	63.7	63.3	63.1	64.3
ATAR score	82.3	82.7	82.6	81.7
Demographics				
Age	17.6	17.6	17.5	17.7
Female	0.563	0.584	0.551	0.559
Foreign-born	0.189	0.187	0.112	0.248
NESB	0.088	0.047	0.058	0.139
Index of Economic Resources	1050	1054	1043	1052
Index of Education and Occupation	1030	1039	1029	1025
Field of study				
Natural and physical science	0.130	0.115	0.118	0.149
Information technology	0.012	0.011	0.012	0.012
Engineering	0.108	0.087	0.109	0.123
Architecture and building	0.065	0.066	0.075	0.058
Health and related fields	0.234	0.249	0.239	0.220
Education	0.030	0.031	0.028	0.031
Management and Commerce	0.173	0.174	0.184	0.165
Society and culture	0.222	0.234	0.214	0.220
Media and Others	0.025	0.032	0.022	0.022
School sector				
Independent	0.280	(a)	(a)	(a)
Catholic	0.307	(a)	(a)	(a)
Government	0.413	(a)	(a)	(a)
School sex status				
Boy's school	0.073	0.089	0.158	(a)
Girl's school	0.080	0.127	0.143	(a)
Co-educational school	0.847	0.784	0.698	(a)
School resources				
School income per student	15,740.8	18,360.3	14,880.0	14,602.8
Teacher-student ratio	0.078	0.084	0.075	0.076
Non-teaching staff-student ratio	0.033	0.044	0.033	0.026
ICSEA	1,070	1,117	1,065	1,041
Number of students	8,417	2,359	2,580	3,478
Number of schools	186	55	34	97

Note: (a) denote non-applicability. School income per student takes into account all funding sources, including governmental, parental and all other contributions.

[2] One exception is school sex status. Most government schools in Australia are co-educational schools, and only the Catholic and Independent sectors have same sex schools.

The 8,417 students in the data had an average ATAR score of 82.3 and achieved a mean WAM of 63.7 in their first year. As may be expected, there is a positive and highly significant correlation between the socio-economic status of schools and students' raw ATAR of +0.18, and a much stronger correlation between ATAR and WAM (+0.42). Less expected, however, is a small but significant negative correlation between school ICSEA and students' WAM (-0.05).

The mean ATAR scores for students from Catholic and other private schools, are similar at around 82.6, and are slightly higher than the mean for students from government schools (81.7), and the difference in the means are highly significant by the standard 't'-test in both cases. However, there are no significant differences between sectors in the mean of the weighted average marks achieved at university. Hence, students from private schools entered the university with higher average leaving grades than those from government schools, but this does not appear to have conferred any advantage in their early performance at university.

On average, the private sector schools are of higher socio-economic status background by the ICSEA measure. Independent schools received more funding per student and had higher teacher to student ratios, compared to the Catholic and government schools. There are differences in the non-teaching staff to student ratios, with Independent schools having more non-teaching staff compared to Catholic and government schools, and Catholic schools having more non-teaching staff compared to government schools. Thus, there are resourcing differences between school sectors, with Independent schools being better resourced than both Catholic and government schools.

4. Methodology and estimating equations

Statistical framework

Studies of university academic outcomes have been largely based on a simple education production function, where a student's university academic performance (AP_i) is modelled as a function of their background characteristics (BC_i), the characteristics of the secondary school attended (S_i), and their previous academic achievement (PAA_i). The production function for the *i*th student may be written as:

$$AP_i = f(BC_i, S_i, PAA_i), \qquad i = 1,\ldots,n \qquad (1)$$

The background characteristics (BC_i) of the individual considered in the present study are age, gender, birthplace, socioeconomic status and English-speaking background, while the school characteristics (S_i) covered include school sector, size (number of students), remoteness and socio-economic status. The university academic outcome that will be examined is the WAM acquired in the first year of university study.

The ATAR score obtained by the students is used as the measure of students' previous academic achievements (PAA_i). As noted above, most studies suggest that there is a strong positive relationship between such scores upon which university admission is based and marks at university, with findings of a one percentage point increase in students' university entrance scores being associated with an increase in marks at university by three-quarters to one percentage point being typical (see, for instance, Win and Miller, 2005).

Whether there are specific schools that are over- or under-performing can be assessed through accounting for school fixed effects in an analysis of student first-year (or later year) academic performance. This amounts to having a separate intercept term in the regression analysis for each *j*th school, and can be written as:

$$AP_i = \alpha_{0j} + \alpha_1 BC_i + \alpha_2 PAA + \varepsilon_i \tag{2}$$

A more systematic analysis of these issues may be able to be gained using the varying coefficients model (two-level hierarchical model) used by Win and Miller (2005) and discussed in Kreft (1993). This is depicted in model (3).

$$AP_i = \alpha_0 + \alpha_{1j} BC_i + \alpha_{2j}\, PAA + \varepsilon_i \tag{3}$$
$$\alpha_{1j} = f(S_i)$$
$$\alpha_{2j} = f(S_i)$$
$$i = 1, \ldots \text{n.}$$

In model (3), the way in which prior academic achievement is transformed into university success is allowed to vary according to the characteristics of the school attended.

Standardisation of continuous variables

Some of the continuous variables of interest were standardised to a mean of zero and a standard deviation of one, in keeping with the practice of most studies utilising random effects models in the study of educational performance. As Marks (2010) points out, this allows for greater ease in the interpretation of the relative impact of these variables, and is also useful in the estimation of random effects (Kreft, 1993). As the main interest of the present study lies in exploring the effect of between-school variations, the grand or population means are used in standardising continuous variables. The impact of standardising means for student-level characteristics according to the mean characteristics in each school attended (the approach taken by Win and Miller, 2005; Marks, 2010) is also explored in a later section.

5. Results

Influence of ICSEA on WAM

The results from various random intercept models (based on equation 2 above) are presented in table 2.[3] The discussion will first focus on the results of models 1 and 2. Model 1 examines the links between the ICSEA and WAM, and includes controls on the students' exogenous demographic characteristics and field of study at university. Model 2 includes controls for school type, school sex, and resource characteristics in addition to the regressors in model 1. Note that student ATAR scores are not included among the explanatory variables in these two models. Hence the estimated effects of background characteristics and school characteristics are total effects that include any intermediary effect that these variables may have upon ATAR scores.

[3] The reader is reminded that the random effects models in this study use two levels of hierarchy, first of the students, who are then treated as being clustered within schools.

A number of observations can be made with regards to the estimates in models 1 and 2. First, likelihood tests (not reported in the table) for all the models are conducted to compare the statistical validity of fitting a random intercept model as compared to fitting an ordinary linear regression. For all models, the likelihood ratio tests are statistically significant and indicate that the use of a random intercept specification of the model is valid.

Table 2 - Random Intercept Models' Estimates of School Socio-economic Status on University Academic Performance

Variable	*Model 1*	*Model 2*	*Model 3*	*Model 4*
Age (at commencement)	0.392 ***	0.403 ***	0.156 *	0.161 *
	(0.087)	(0.084)	(0.086)	(0.084)
Female	4.821 ***	4.651 ***	4.094 ***	3.960 ***
	(0.326)	(0.348)	(0.349)	(0.367)
Foreign born	0.348	0.278	0.777 **	0.691 **
	(0.361)	(0.366)	(0.304)	(0.310)
NESB	-0.536	-0.479	-0.472	-0.398
	(0.582)	(0.598)	(0.539)	(0.556)
IER+	0.414 ***	0.318 *	0.285 **	0.202
	(0.153)	(0.166)	(0.139)	(0.148)
IEO+	-0.120	0.059	-0.267	-0.075
	(0.200)	(0.203)	(0.171)	(0.168)
Natural and physical science	0.080	0.076	0.022	-0.015
	(0.646)	(0.645)	(0.592)	(0.590)
Information technology	-3.941 **	-4.070 **	-3.671 **	-3.794 **
	(1.952)	(1.943)	(1.839)	(1.832)
Engineering	7.640 ***	7.537 ***	1.733 ***	1.622 ***
	(0.664)	(0.669)	(0.618)	(0.626)
Architecture and building	2.408 ***	2.435 ***	2.718 ***	2.738 ***
	(0.662)	(0.671)	(0.594)	(0.600)
Health and related fields	7.000 ***	6.970 ***	4.561 ***	4.530 ***
	(0.471)	(0.471)	(0.452)	(0.455)
Education	2.367 ***	2.302 ***	3.533 ***	3.448 ***
	(0.880)	(0.880)	(0.847)	(0.846)
Society and culture	2.800 ***	2.790 ***	3.027 ***	3.015 ***
	(0.499)	(0.506)	(0.465)	(0.472)
Media and others	0.804	0.994	2.053 **	2.002 **
	(1.006)	(0.976)	(0.920)	(0.929)
Independent school		0.909		0.850
		(0.637)		(0.606)
Catholic school		-0.084		-0.703
		(0.602)		(0.532)
Rural school		0.796		0.624
		(0.609)		(0.599)
Boy's school		-2.127 **		-2.048 **
		(1.064)		(0.800)
Girl's school		-1.106 *		-1.823 ***
		(0.668)		(0.703)
School income per student+		-1.267 **		-1.166 **
		(0.560)		(0.491)
Teaching staff per student+		0.694 *		16.649
		(32.473)		(32.030)
Non-teaching staff per student+		-0.095		38.681
		(24.945)		(26.093)

Table 2 - Random Intercept Models' Estimates of School Socio-economic Status on University Academic Performance (continued)

Variable	*Model 1*	*Model 2*	*Model 3*	*Model 4*
ATAR+			5.924 ***	5.944 ***
			(0.247)	(0.247)
ICSEA+	-0.729 ***	-0.426	-1.744 ***	-1.506 ***
	(0.236)	(0.310)	(0.224)	(0.277)
Constant	50.016 ***	45.126 ***	55.362 ***	52.705 ***
	(1.485)	(3.044)	(1.445)	(2.947)
Prob > χ^2	0.000	0.000	0.000	0.000

Notes: Robust standard errors are presented in parentheses. ***, ** and * denote statistical significance at the one, five and ten per cent levels, respectively. + indicates that the variable is standardised. Log likelihood tests for the random intercept models reported in this table indicated that they are statistically different from an ordinary linear regression. The models estimated included two dummy variables for cohort year. There are 8,417 students and 186 schools in the sample.

Second, students' individual socioeconomic status has a very mild impact on their academic performance. The measure of students' access to economic resources, IER, is statistically significant but has very low estimates of less than half a percentage point. This means that every standard deviation shift along the IER distribution only results in a gain (or loss) of less than half a percentage point in WAM. Estimates on community occupational or educational attainment (IEO) are very small in magnitude, and not statistically significant.

Third, it is noteworthy that statistically significant estimates are not present for some characteristics that have been found to influence educational achievement at the secondary school and university level in the studies reviewed in section 2. For example, the students' school sector (Independent or Catholic), migrant status and English background are found to be statistically insignificant. These results suggest that high school attended has no discernible impacts on students' university academic performance.[4] On this basis, it might be argued that the university admission process has worked well, and students' academic performances are not influenced by their migrant background or high school characteristics. The only school effect which is statistically significant is the estimate for school sex (boy's or girl's school). In particular, students who attended a boy's or girl's school scored about two percentage points lower in their first year studies, as compared to students who attended a co-educational school.[5]

[4] It might have been possible that the school sector effects are being masked by the inclusion of schools' SES in the estimating equation. Hence, model 2 is estimated again, but without the ICSEA variable. The results of this estimation (not presented) had little impact on the size and statistical robustness of the estimates presented for model 2.

[5] Recall from the discussion of summary statistics (see table 1) that government schools in the sample are all co-educational. It is thus possible that the impacts of school sector are being muted by estimated effects of school sex status. To investigate this further, the sample is restricted to just co-educational schools, and model 2 is re-estimated (with the exclusion of the school sex dummy variables). The estimates on school sector remained negligible, and estimated effects of other variables are qualitatively identical to those presented in model 2 of table 2. The only difference of note is for the estimate on ICSEA, which is statistically significant at the one per cent level and had its effect size tripled to around -1.5 percentage points, which is similar to the effects found and discussed for subsequent models.

Fourth, school resourcing characteristics are found to have very modest influences on university academic performance. Model 2 contained three variables for school resourcing: income per student, and staff ratios (teaching and non-teaching). The amount of income received per student by the school is found to have a small, negative impact on academic performance, by about 1 WAM score for each standard deviation of the income per student distribution. While the estimated coefficient on teacher-student ratios is significant at the 10 per cent level, the estimated impact is, once again, very modest, and indicates only a 0.7 percentage point improvement in WAM for a standard deviation increase in the teacher-student ratio. The estimated impact of non-teaching staff to student ratio is statistically insignificant. These findings are complementary to other studies which found no meaningful association between class sizes and academic scores (Mahuteau and Mavromaras, 2014). Mahuteau and Mavromaras (2014) concluded that the lack of association between staffing resources and scores could potentially be due to the similarity in teacher-student ratios across schools, due to governmental regulation. The summary statistics reported above add credence to this, with the presented mean staff to student ratios indicating that staffing ratios are similar across school sectors and have little variation. The OECD's Education Policy Outlook (OECD, 2013) notes though, that the funding model for Australia's schools is not transparent and lacks coherence. This had also been highlighted in the Gonski Review of Funding for Schooling, which noted the extensive number of programs and funding streams, at different levels of government (Gonski, 2011, p. 48).

Fifth, estimated coefficients on gender and some fields of study are consistently statistically significant, often at the one per cent level, across models 1 and 2. Female students consistently outperform their male counterparts, by almost five percentage points in their WAM. Students in the engineering, architecture and building, health, education and society and culture disciplines have higher WAMs than their peers in the benchmark category of management and commerce.

Lastly, the estimated coefficient on the variable, ICSEA, has a value of around negative 0.7 in model 1. For model 2, however, the estimated coefficient on ICSEA is smaller and statistically insignificant. Regardless of statistical significance, the magnitude of the effect is modest, and can be interpreted as only a less than one percentage point decrease in WAM when students move by one standard deviation across the school SES distribution (towards higher SES). This indicates that schools with lower SES are associated with positive impacts on university academic performance, but that the magnitude of the relationship is minimal.

Impact of Prior Academic Achievement on WAM

In order to assess the impact of prior academic achievement (ATAR) on university academic performance, as well as any differences in the way schools' SES are translated into academic scores, models 1 and 2 are estimated again, with a standardised ATAR variable.[6] These models are presented in table 2 as models 3 and 4, respectively. There are five observations that can be made regarding the addition of the ATAR variable into the estimating equations. First, prior academic achievement has large impacts

[6] Specifically, the ATAR variable is standardised across the sample population, with a mean of zero and a standard deviation of one.

on performance at university. Specifically, the estimated coefficients on ATAR have values of around 6 percentage points for models 3 and 4, indicating that having ATAR scores of one standard deviation above or below the mean ATAR score impacts on first year WAM by 6 marks. In most universities, this is equivalent to moving more than half a grade band, and hence the impact of ATAR can be said to be rather substantial. This reinforces findings of earlier studies such as Win and Miller (2005) which found prior academic achievement to be a good predictor of academic success at university. Second, in model 4, the estimates on school types (Independent and Catholic) are still statistically insignificant. Thus, no school sector appears to provide a better platform in preparing their students for university study.

Third, the estimates on schools' SES remain statistically significant at the one per cent level, and have also doubled in magnitude, when compared with earlier estimates in models 1 and 2. This indicates that low SES schools prepare their students better for university study compared to high SES schools, and this effect is more pronounced when controls for students' ATAR are added. Put another way, higher SES schools appear to provide an 'inflation' of ATAR scores that does not translate to improved academic performance at university. From an equity perspective, this finding is positive, and indicates higher education policy and university admission processes to encourage students from low SES schools to participate in higher education could be expanded with no compromise in standards or academic achievement.

Fourth, the estimated impact of students' access to economic resources (IER) remained small across models 3 and 4, but is statistically insignificant in model 4. Hence, it appears that after prior academic achievement is controlled for, individual level SES (or access to economic resources) does not enhance academic performance in university. This is, once again, encouraging from an equity perspective.

Fifth, the estimated impact of teacher-student ratio is found to be statistically insignificant. The estimated coefficient has a very large value of almost 17 percentage points, but also has very large standard errors for this estimate. There is thus no clear relationship between teaching staff to student proportions and student performance at university. As earlier studies argue, teacher quality can be heterogeneous, and a measure of teacher quality would be required to explore the impact of teaching staff on student academic outcomes.

Table 3 - Random effects models, school-level standardised means

Variables	*Model 5*	*Model 6*
Age (at commencement)	0.143 *	0.139 *
	(0.083)	(0.084)
Female	4.024 ***	4.005 ***
	(0.368)	(0.366)
Foreign born	0.693 **	0.664 **
	(0.312)	(0.313)
NESB	-0.500	-0.483
	(0.550)	(0.545)
IER (standardised within schools)	-0.042	-0.041
	(0.136)	(0.135)
IEO (standardised within schools)	0.135	0.141
	(0.128)	(0.129)
Natural and physical science	-0.085	-0.084
	(0.590)	(0.589)
Information technology	-3.753 **	-3.832 **
	(1.841)	(1.837)
Engineering	1.600 ***	1.504 **
	(0.596)	(0.596)
Architecture and building	2.767 ***	2.752 ***
	(0.598)	(0.599)
Health and related fields	4.447 ***	4.382 ***
	(0.444)	(0.443)
Education	3.640 ***	3.617 ***
	(0.858)	(0.862)
Society and culture	2.967 ***	2.915 ***
	(0.472)	(0.475)
Media and others	1.832 **	1.735 *
	(0.916)	(0.923)
Independent school	0.804	0.791
	(0.653)	(0.643)
Catholic school	-0.212	-0.035
	(0.613)	(0.596)
Rural school	0.987	0.675
	(0.609)	(0.609)
Boy's school	-2.598 **	-2.635 **
	(1.117)	(1.090)
Girl's school	-1.078 *	-1.381 **
	(0.641)	(0.661)
School income per student+	-1.148 **	-1.166 **
	(0.561)	(0.525)
Teaching staff per student+	40.673	44.400
	(33.140)	(32.059)
Non-teaching staff per student+	2.617	5.591
	(21.834)	(21.808)
ATAR (standardised within schools)	5.870 ***	5.693 ***
	(0.171)	(0.176)
ICSEA+	-0.370	-0.386
	(0.313)	(0.309)
Constant	51.983 ***	51.777 ***
	(3.154)	(3.052)
Prob > χ^2	0.000	0.000

Notes: Robust standard errors are presented in parentheses. ***, ** and * denote statistical significance at the one, five and ten per cent levels, respectively. + indicates that the variable is standardised at the population level. Log likelihood tests for the random effects models reported in this table indicated that they are statistically different from an ordinary linear regression. The models estimated included two dummy variables for cohort year. There are 8,417 students and 186 schools in the sample.

Random Coefficients Models and Within-school Variation in Student Characteristics

Further analyses are conducted to explore two further issues. The first relates to whether differences exist in the way within-school variation in student characteristics impact on the determinants of university performance, particularly, the role of ATAR on influencing university scores. This can be explored by standardising student-level continuous variables according to the mean values of those variables within each school. That is, variables for students' SES (IER and IEO) as well as ATAR scores are standardised using mean values for those characteristics within each school the student attended.[7] As Marks (2010) and Win and Miller (2005) point out, standardisation of variables in such a way will permit the assessment of within-school effects, and highlight the importance of those individual characteristics on university performance. The estimation results from using these school-standardised variables in a random intercept model are presented in table 3 (model 5).

The second issue relates to whether the determinants of university performance have differing impacts by schools with varying SES or mean ATAR performance. To explore this issue further, a random coefficients model is estimated. In this random coefficients model (model 6), the slope coefficients on ICSEA and ATAR are allowed to vary by school. Estimation results from model 6 are also presented in table 3.

Comparisons of the estimates from model 5 with results from model 4 (table 2) indicate that there are negligible changes to the estimated influences on university performance in model 5 from employing the estimation strategy described above. The only difference of note is that the estimated impact of schools' SES in model 5 is now negligible and statistically insignificant. Specifically, the variables for students' individual SES and ATAR are standardised using the schools' mean, and the impact of those variables should be interpreted as the impact of individual students having characteristics more or less than the mean characteristic in the school attended. The estimates in model 5 indicate that individual or schools' SES do not affect university academic performance, and that ATAR holds as a strong predictor of WAM at university.

Finally, estimates from model 6 confirm that ATAR is a strong predictor of university academic performance. Further, the utilisation of a random coefficients model where the slope coefficients for ATAR and ICSEA are allowed to vary reveal that there are no substantial differences in the way schools transform these into university academic performance.[8]

---

[7] School-level characteristics that are standardised, such as school income and ICSEA, are still standardised according to the grand or population mean.

[8] A separate random coefficients model (not reported) using population means for standardisation of the ATAR variable shows two findings. First, the estimate on ICSEA is statistically significant and of comparable magnitude in comparison to previous models. Second, the slopes of estimated impacts of ATAR and ICSEA by schools are still very similar. Hence, no school comes across as being superior conduits of prior ability or SES into academic success.

6. Conclusion

This study examined the student- and school-level characteristics that impacted on university marks in the first year of study for Australian undergraduates. Note, however, that there are some limitations to the study and hence the findings of the study should be viewed with these caveats in mind. First, the sample population consists of first-year undergraduates in a single university who were admitted on the basis of their ATAR. As such, any interpretation of the findings of the study needs to consider sample bias, specifically, that these are students who have already been admitted into university, while some of the characteristics used in the study (such as prior academic achievement and SES) are also determinants of participation in higher education (see, for example, Le and Miller, 2005). In particular, the effect of schools on their students' access to university is unable to be assessed and all results from the study need to be interpreted as applying within a pool of successful university entrants.

Further, while the study covers students from 186 schools, the data used is only for one university. This matters because universities typically have listed cut-off ATAR scores for entry into undergraduate courses and these minima vary considerably across institutions.[9] Therefore, there may be further selection processes at work, relating to selection into this particular university or this type of university, with consequences for the distribution of prior ability of the sample, as proxied by ATAR.

Notwithstanding the caveats above, this study makes important contributions to the literature. As noted, the literature remains divided on the importance or otherwise of school level SES effects. Of the handful of Australian studies identified that utilised linked student records and schools data to analyse performance at university, Birch and Miller (2007), Mills *et al*. (2009) and Win and Miller (2005) relate to students who graduated from high school more than a decade ago, while Dobson and Skuja (2005) condition only on leaving grades, gender and school sector. There is clear evidence in the literature that school effects may have changed substantially over time, notably with respect to the benefits of attending Catholic and Independent schools, and therefore there is a need for updated estimates. Moreover, those previous four studies are based on data for students at just two universities, three using data from The University of Western Australia and one from Monash. A further innovation of the present study is that it uses a rich array of previously unavailable data on Australian schools' characteristics, including a robust measure of school SES.

Some important findings have been uncovered. First, schools' SES has been found to have modest impacts on university performance, and students from lower SES schools have been found to perform marginally better than their peers from higher SES schools. This suggests that higher SES schools inflate their students' ATAR scores and improve their access to university. From an equity perspective, however, it is encouraging that the university system appears to level the playing field in terms of academic achievement for students entering from more privileged and less privileged schools. Furthermore, the individual students' SES background had

[9] For example, Central Queensland University has an indicative ATAR cut-off of 39.75 for entry into their Bachelor of Arts for 2013, while Curtin University and the Australian National University have ATAR cut-offs of 70.00 and 80.00 for the same course, respectively (Universities Admissions Centre, 2014; Tertiary Institutions Service Centre, 2014).

no discernible impact on university performance. From this viewpoint, participation in higher education for students from lower SES background should be encouraged, particularly as they are under-represented. At the university level, admission regimes could take into account the relatively good performance of students from schools of lower SES, and restructure their admission regimes to advantage them accordingly.

Another finding of importance, and which needs to be investigated further in future research, lies in the fact that most school characteristics and school resourcing measures do not appear to have any substantial or meaningful impact on students' performance in university. While this finding may go against the expectations of many, it is not inconsistent with previous international and Australian findings of limited school effects on high school leaving grades (Marks, 2010). This has important implications for strategies to achieve equity in higher education participation and on school resourcing. The results indicate that school sector does not confer any advantage on performance at university, and that larger or smaller amounts of funding per student do not translate into better outcomes at university. It may be possible that the quality rather than level of school resources, notably teacher quality, is more important for shaping student achievement, a hypothesis that could not be tested with the current data.

There are also outstanding issues which fall beyond the scope of this study, but which warrant investigation. First, from an equity perspective, a priority for future research should be the assessment of school effects on access to university, an issue that could not be addressed with this dataset. Second, the university academic outcome addressed in this study is the WAM in the first year of university study. It would be useful to have an assessment of university academic outcomes in later years to see if the effects of schools' SES and ATAR hold. Third, due to data unavailability, it was also not possible to assess other academic outcomes, such as degree course dropout. An examination of the effect of school and individual attributes on the likelihood of university degree completion would add a further dimension and richness to the evidence base for higher education policy. And finally, it would be of interest to evaluate the post-graduation activities of the graduates. Higher education policy aimed at increasing the university participation and completion of lower SES students assumes that university education will generate returns in the form of labour market employment and better earnings, and an evaluation of these outcomes will aid in policy decision marking.

References

Australian Bureau of Statistics (2011), Census of Population and Housing: Socio-economic Indexes for Areas (SEIFA), Australia, 2011. Available from: <http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/2033.0.55.001~2011~Main%20Features~What%20is%20SEIFA%3f~4>[16th October 2014]

Australian Curriculum, Assessment and Reporting Authority (2012), Guide to Understanding ICSEA. Available from: <http://www.myschool.gov.au> [9th October 2014]

Birch, E.R. and Miller, P.W. (2007), 'The Influence of Type of High School Attended on University Performance', *Australian Economic Papers*, 46(1), 1-17.

Bradley, D., Noonan, P., Nugent, H. and Scales, B. (2008), 'Review of Australian Higher Education: Final Report', DEEWR, Canberra, ACT.

Card, D. and Krueger, A. (1992), 'Does School Matter? Returns to Education and the Characteristics of Public Schools in the United States', *Journal of Political Economy*, 100(1), 1-40.

Cardak, B. and Ryan, C. (2009), 'Participation in Higher Education in Australia: Equity and Access', *Economic Record,* 85(271), 433-448.

Cardak, B. and Vecci, J. (2013), 'Catholic School Effectiveness in Australia: A Reassessment Using Selection on Observed and Unobserved Variables', *Economics of Education Review*, 37(1), 34-45.

Coleman, J., Campbell, E., Hobson, C., McPartland, J., Mood, A., Weinfeld, F. and York, R. (1966), *Equality of Opportunity*, Washington DC: US Government Printing Office.

Department of Education (2014), Selected Higher Education Statistics – 2013: Student Data. Available from: <https://education.gov.au/selected-higher-education-statistics-2013-student-data> [29th August 2014]

Dobson, I. and Skuja, E. (2005), 'Secondary Schooling, Tertiary Entry Ranks and University Performance', *People and Place*, 13(1), 53-62.

Fertig, M. and Wright, R. (2005), 'School Quality, Educational Attainment and Aggregation Bias', *Economics Letters*, 88(1), 109-114.

Gonski, D.M. (2011), *Review of Funding for Schooling: Final Report*. Australia. Department of Education, Employment and Workplace Relations. Review of Funding for Schooling.

Houng, B. and Justman, M. (2014), 'NAPLAN Scores as Predictors of Access to Higher Education in Victoria', Working Paper 22/14, Melbourne Institute Working Paper Series, University of Melbourne.

Kreft, I. (1993), 'Using Multilevel Analysis to Assess School Effectiveness: A Study of Dutch Secondary Schools', *Sociology of Education*, 66(2), 104-129.

Le, A.T. and Miller, P.W. (2003a), 'Choice of School in Australia: Determinants and Consequences', *The Australian Economic Review*, 36(1), 55-78.

— (2003b), 'Participation in Higher Education: Equity and Access', *The Economic Record*, 81(253), 152-165.

Mahuteau, S. and Mavromaras, K. (2014), 'Student Scores in Public and Private Schools: Evidence from PISA 2009', IZA Discussion Paper no. 8471.

Marks, G.N. (2007), 'Do Schools Matter For Early School Leaving? Individual and School Influences in Australia', *School Effectiveness and School Improvement: An International Journal of Research, Policy and Practice*, 18(4), 429-450.

— (2010), 'What Aspects of Schooling are Important? School Effects on Tertiary Entrance Performance', *School Effectiveness and School Improvement: An International Journal of Research, Policy and Practice*, 21(3), 267-287.

— (2014), 'Reaching Year 12 in Victoria, Australia: Student and School Influences', *Educational Research and Evaluation: An International Journal on Theory and Practice*, 20(5), 333-347.

McConney, A. and Perry, L.B. (2010), 'Science and Mathematics Achievement in Australia: The Role of School Socioeconomic Composition in Educational Equity and Effectiveness', *International Journal of Science and Mathematics Education*, 8(3), 429-453.

Mills, C., Heyworth, J., Rosenwax, L., Carr, S. and Rosenberg, M. (2009), 'Factors Associated with the Academic Success of First Year Health Science Students', *Advances in Health Science Education*, 14(2), 204-217.

Organisation for Economic Co-operation and Development (OECD) (2005), *School Factors Related to Quality and Equity: Results from PISA 2000*, OECD.

Organisation for Economic Co-operation and Development (2013), *Education Policy Outlook: Australia*, OECD.

Parliament of Australia (2014), 'Higher Education', Available from: <http://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/rp/BudgetReview201213/HigherEducation> [27th November 2014]

Ryan, C. (2013), 'What is Behind the Decline in Student Achievement in Australia?', *Economics of Education Review*, 37(1), 226-239.

Tertiary Institutions Service Centre (2014), Cut-off Ranks. Available from: <http://www.tisc.edu.au/static/statistics/cutoff-rank/cutoff-index.tisc> [25th November 2014]

Universities Admissions Centre (2014), The Australian Tertiary Admission Rank. Available from: <http://www.uac.edu.au/media-hub/atar.shtml> [25th November 2014]

Win, R. and Miller, P.W., (2005), 'The Effects of Individual and School Factors on University Students' Academic Performance', *The Australian Economic Review*, 38(1), 1-18.