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How important are socioeconomic background and other factors to the university career vis-à-vis prior student performance: evidence from Australian longitudinal data

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ABSTRACT

The literature on the relationship between socioeconomic background (SES) and university education is inconsistent. Some studies conclude SES is important to university entry and course completion, others find trivial SES effects, net of students' prior performance, and a third group concludes that SES effects are important and policy relevant even when considering prior performance. Parallel arguments apply to demographic, school sector, and institutional differences in the university career, that is, are they unimportant when considering student performance? Using comprehensive and accurate measures of SES and student performance, and a statistical method that utilizes all non-missing data, this study quantifies the effects of socioeconomic, demographic, and institutional factors and prior student performance. SES has only weak effects on university entry and attrition, and no effects on course completion. Student performance has strong effects on entry and has moderate effects on attrition and completion. Demographic other differences mostly disappear when controlling for student performance.

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Introduction

Socioeconomic status (SES) and social class figure prominently in the literature on university participation, course attrition, and completion (Hansen & Mastekaasa, 2006; Iannelli, 2008; James, 2008, pp. 71–89; Rumberger, 2010, p. 246; Skilbeck & Connell, 2000). The general argument is that because of financial constraints, stress, pressure from significant others, attitudes and aspirations, and perhaps values and tastes, lower SES students are less likely to participate at university; and once at university are more likely to drop out and less likely to complete their degree.

Studies on socioeconomic inequalities in higher education can be divided into three groups. The first group of studies emphasizes the importance of

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students' families' socioeconomic status. These studies do not, or could not, control for prior student performance. A second group of studies finds only weak or trivial effects of SES, net of much stronger effects for prior student performance. The third group concludes that SES effects on the university career are sizable, important, and policy relevant, even when considering prior student performance.

SES effects not considering prior performance

For the US, Reisel (2011) could explain 12% of the pseudo variance in degree completion with measures of parent's education and income. Comparing the US with Norway, she (2011) concluded that there are many similarities in the relationship between family background and university degree attainment. For course completion in the US, Attewell et al. (2011, p. 554) concluded that only in the most academically selective colleges – where non-completion rates are low – does SES appear unrelated to graduation. However, SES could account for only about 4% to 5% of the pseudo variance in completion of a 4-year degree. Reisel's (2013) follow-up study found that family income is not associated with dropping out of degree courses in Norway but has effects in the United States. In Canada, higher income families are more likely to attend university. However, the effect of family income is small; a 10% increase in parental income raises the chances of university attendance for 18- to 24-year-olds by no more than 1.5% (Corak et al., 2003). Koucký et al. (2009, 2010) found that university entrance and degree completion are associated with socioeconomic background in over 20 European countries since 1950.

In Australia, there is a strong emphasis on SES. James (2002) focused almost exclusively on socioeconomic background and attributed differences in university participation to differences in attitudes and aspirations by socioeconomic group. He concluded that students from low socioeconomic backgrounds have roughly half the likelihood of participating in higher education as those from medium and higher socioeconomic backgrounds (James, 2002, p. ix). The socioeconomic group differences reported were mainly about academic factors: lack of confidence in their academic results and not choosing subjects appropriate for university entry (James, 2002, pp. ix–x), which could reflect differences in academic performance. A second report concluded that students from low-SES backgrounds are only about one third as likely as students from high-SES backgrounds to participate in higher education (James, 2008). Edwards and McMillan's (2015) bivariate analyses found SES differences in university entry, course attrition, and completion. Low SES was listed as one of several risk factors (low entrance score, male, non-metropolitan home address, being Indigenous) for non-completion of university courses (Edwards & McMillan, 2015, p. 33). Dockery et al. (2016) found effects of father's and mother's work force status and education

on the probability of a 17-year-old attending university, but no effect for an accurate measure of family income.

Weak SES effects when considering prior performance

For the US, the correlation between SES and performance in the Scholastic Aptitude Tests (SAT), one of the two cognitive assessments commonly used for university admission, was 0.42 compared to 0.54 for the correlation between SAT performance and grade point average (GPA) at senior secondary school. A parallel study utilizing the American College Testing (ACT) assessment estimated similar correlations: 0.59 between high school grades and ACT score, and 0.34 between SES (measured by a 9-point scale of parental annual income) and ACT score (Westrick et al., 2015, p. 29).

For student performance at college, Sackett et al. (2009) estimated a raw average correlation of only 0.12 between SES and college GPA in the 1st year of college, 0.22 after correcting for attenuation for the full population of SAT test takers. The comparable correlations for SAT scores were 0.35 and 0.53. The relationship between SAT and college GPA was only marginally attenuated when controlling for socioeconomic background (Sackett et al., 2009). Sackett et al. (2009) concluded that "the vast majority of the test–academic performance relationship was independent of SES" (p. 1). A meta-analysis calculated average correlations of 0.11 between college GPA and SES, compared to 0.29 for SAT test score and 0.20 for intelligence (Richardson et al., 2012, p. 366). Similarly, Westrick et al. (2015, p. 36) reported a correlation of 0.12 between SES college GPA compared to 0.38 for ACT score.

For the UK, conditional on performance in General Certificate of School Education and A levels 2 years later, Marcenaro-Gutierrez et al. (2007) found no additional role for socioeconomic background or parental education in determining pupils' likelihood of going to university. Chowdry et al. (2013) concluded that socioeconomic differences in entry to any and elite UK universities are substantially reduced once prior performance is included. SES differences, net of test scores and examinations, were only 10% of the raw differences. For Norway, Anders (2012) found substantial differences between students from high- and low-income families in university entry. However, much of the difference could be attributed to application decisions driven largely by ability measured at age 11. For Norway, Hansen and Mastekaasa (2006) found negative effects of income on 1st-year GPA when controlling for secondary school grades. However, income matters more in the US. According to Reisel (2011, p. 275), income matters only marginally after university entry in Norway, but in the US income continues to affect graduation probabilities. However, Cameron and Heckman (2001) concluded that family income has an important role at explaining grades at age 15, a modest role in high school continuation decisions, but "no role in college entry decisions" (p. 485) and, contrary to

prevailing economic theory, concluded that credit market constraints are not a strong determinant of college choices.

In Australia, socioeconomic background makes little or no difference to participation at university, net of Australian Tertiary Admissions Rank (ATAR[1]; Cardak & Ryan, 2009; Norton et al., 2018b, p. 26). Marks and McMillan (2007, pp. 371–372) found no systematic differences in university participation by class background within ATAR bands. Only students from self-employed backgrounds with ATARs between 70 and 90 exhibit lower participation rates than other students.

Prior academic achievement, as proxied by students' ATAR is a strong determinant of university grades. Students' individual socioeconomic status has a very mild impact on their academic performance (Li & Dockery, 2015, p. 86). Li and Dockery (2015) concluded that earlier studies had "consistently found school achievement as measured by academic grades is the most important predictor of entry to and subsequent success at university" (p. 79). Cherastidtham et al. (2018) found only small SES differences in course attrition when controlling for tertiary entrance score and other factors. Lim (2015, p. 51) reported no significant effect for SES on course completion, net of students' scores at age 15 in the Organisation for Economic Co-operation and Development (OECD)'s Programme for International Student Assessment (PISA) and other factors but not ATAR. Analysing access to university in England, Canada, Australia, and the US, Jerrim and Vignoles (2015) found much reduced parental education differences in university participation, when controlling for PISA and comparable test scores. With the addition of age 18 performance measures, differences between the bottom and middle parental education groups in participation disappeared except in Canada. The result for Canada is likely to be a function of the measure used at age 18, rather than a substantive difference between Canada and the other three countries.

Schneider and Preckel's (2017, p. 577) meta-analysis of instructional factors and student-level characteristics on student performance while at university found that the effect size for SES was weak ($d = 0.25$), which translates to a correlation of 0.12.[2] Prior achievement which includes high school GPA ($d = 0.90$) and admission test results ($d = 0.79$) were the strongest student-level influences of performance at university. The effect for intelligence was only moderate ($d = 0.47$). Schneider and Preckel (2017, p. 590) suggest that prior achievement has stronger effects because it indexes specific relevant knowledge and skills whereas intelligence is more generic and abstract. Furthermore, the effects of intelligence are attenuated by range restriction. In a later meta-analysis of the relationship between SES and academic performance in higher education, Rodríguez-Hernández et al. (2020, p. 17) estimated an average effect size of 0.06, which they described as weak, compared to 0.29 for prior achievement. Prior academic achievement, university experience, and work status were stronger influences.

SES effects are important, net of student performance

A third body of literature argues that SES continues to be important even when considering prior performance. In the US, Thomas et al. (1979, pp. 150–152) found that only one third of the total effect of class background on college attendance operated through scholastic aptitude. The sizable direct effects of SES effects (net of measures of aptitude, class rank, and curriculum) lead the authors to conclude that "the educational system is not meritocratic". Karen (2002, p. 202), after concluding that the primary influences on college entry were academic (test scores, high school grades), highlighted the effects of parents' education and family income, which were larger in the younger, compared to an older, cohort. Significant effects for father's education ($\beta = 0.13$) and income (0.12) remained when controlling for tested ability (0.25), grades (0.18), and other factors. Comparing two youth cohorts on college entry, Belley and Lochner (2007) found increasing effects of family income, and decreasing effects of ability. Analysing data from a longitudinal cohort first surveyed in the eighth grade, Rumberger (2010) found large effects of social class. The odds of completing college for students from high-SES backgrounds were more than 6 times greater than for students from low-SES backgrounds, when controlling for test scores, high school grades (both measured in the eighth grade), and other factors. Alon (2009), modelling five post-secondary educational destinations (ranging from none to highly selective) as a function of socioeconomic status, SAT or ACT test scores, high school class rank, and other factors, concluded that a "vicious cycle of exclusion and adaptation intensifies and expedites the escalation of class inequality" (p. 731). Despite the impassioned language, class background explained only about 5% of the pseudo variance in post-secondary destination.

In the UK, Vignoles and Powdthavee (2009) found statistically significant gaps in the rate of withdrawal after the 1st year of university between advantaged and disadvantaged students, net of prior performance. Analysing access to elite universities in Australia, the UK, and the US, Jerrim et al. (2015, p. 30) concluded that although school academic achievement can explain part of the socioeconomic inequality in elite college access, substantial SES differences remained. Socioeconomic inequality in access to high-status private US colleges was more pronounced.

For Australia, Chesters and Watson (2013) concluded that although the effect of parents' education on university enrolment had declined over time, socioeconomic background remained important and warranted policy responses. Lim's (2015) report on course completions concluded that "socioeconomic status continues to play an important part in university completions" (p. 6) despite a non-significant SES effect on course completion in a multivariate model (p. 51). From a policy perspective, he suggests the low-SES students should receive greater support during their studies and greater

access to university. Czarnecki (2018) found that although ability measured by test scores "has by far superior importance in determining future educational trajectories" (p. 511), around two thirds of the total effect of parental education could not be explained by PISA test scores. Chesters (2019, p. 343) found that students from the lowest SES quartile were one third as likely as students from the highest SES quartile to enrol in a bachelor's degree programme, net of PISA test scores and other factors. She claims that "standardised test scores are a proxy for SES" (p. 345)[3] and calls for policy responses in the light of her findings.

Purpose of this study

The literature is inconclusive on the importance of SES vis-à-vis prior student performance. The emphasis on SES and class background in the first group of studies could be simply attributed to the absence of a suitable measure of prior student performance or a reluctance by researchers to include one. It is more difficult to explain differences between the second and third groups of studies. It is likely to be due to differences in the strength of the prior performance measure. Measures based on high-stakes university entrance examinations will produce smaller SES effects than measures based on tests administered earlier in the school career. Other factors may account for the discrepancies between studies: country and contextual differences, the statistical methods employed, and perhaps the analysts' interpretations.

Therefore, the purpose of this study is to conclude if SES and other factors are important to university entry, and course attrition and completion vis-à-vis prior student performance. This extends Jerrim and Vignoles's (2015) key question "to what extent can family background differences in university access be explained by differences in prior achievement?" (p. 905) from access to the university career. This study differs from previous Australian studies because it examines the entire university career from entry to completion, employs a comprehensive measure of SES and well-established measures of student performance, and utilizes an analytical method that maximizes the data analysed. In contrast, most studies discard useful data by arbitrarily choosing single time points to measure participation, attrition, and completion. It minimizes the impact of study attrition (not to be confused with course attrition), which is a major statistical issue in longitudinal studies.

Australian context

For school graduates, entrance to university is largely a function of students' tertiary entrance performance as measured by ATAR. It is possible to gain a university place through the International Baccalaureate or (more rarely) through other criteria for school leavers.[4]

Female students and students from non-English-speaking backgrounds and from two-parent families exhibit slightly higher ATARs (Gemici et al., 2014; Marks, 2010, 2015). Students from higher socioeconomic backgrounds are more likely to exhibit higher ATARs with a correlation around 0.3 to 0.4 (Marks, 2009a, 2015). Students from independent and, to a lesser extent, Catholic schools, exhibit higher ATAR ranks. Test scores collected when students were in middle secondary school are clearly the strongest influence on ATAR (Cardak & Ryan, 2009; Gemici et al., 2014; Houng & Justman, 2014; Marks, 2010, 2015).

University participation is higher among women, those from metropolitan, higher socioeconomic, non-Indigenous, and non-English-speaking backgrounds, and students who attended non-government (Catholic or independent) schools (Lim, 2015). Students from non-English-speaking backgrounds are more likely to participate at university, net of their tertiary entrance performance and other factors (Marks, 2009b, p. 100). Controlling for prior achievement substantially reduces the sizable Indigenous/non-Indigenous gap in university entry (Parker et al., 2015).

Once enrolled in a bachelor's degree course, approximately 21% of students do not complete their degree course at the same institution and 14% do not complete a commenced degree at the initial or any other institution (Department of Education and Training [DET], 2015a). A report focusing on students that commenced a bachelor's degree course in 2005 found that 8% dropped out from their initial course and never returned to university study, 74% completed their degree by 2013, and 4% were still enrolled at university in 2013 (DET, 2015b, p. 11). Edwards and McMillan's (2015) course completion estimate from these data was the same, 74%.

Attrition and course completion also differ between socioeconomic and demographic groups, institution type, and fields of study. Women are less likely to drop out (21%) compared to men (25%) and exhibit higher completion rates: 76% compared to 71% for men (DET, 2015b, Table 1). Students from metropolitan areas exhibit lower attrition and higher completion rates (21% and 75%) than students from regional (26% and 70%) and remote (35% and 60%) areas (DET, 2015b, Table 1). Students from non-English-speaking backgrounds exhibit lower dropout rates than other students (18% vs. 24%) and higher completion rates: 79% compared to 74% (DET, 2015b, Table 1). Students from high socioeconomic backgrounds exhibit lower dropout rates and higher completion rates (19% and 78%) than students from medium (25% and 73%) and low (26% and 69%) socioeconomic backgrounds (DET, 2015b, Table 1). Although access to higher education has increased for Indigenous Australians, participation and completion rates remain lower than those of non-Indigenous Australians (Gore et al., 2017).

There is considerable variation in course attrition across institutions. Elite institutions tend to have much lower attrition rates, for example, the University of Melbourne (4%), the University of Sydney (6%), the Australian National

Table 1. Univariate statistics for time-invariant variables.

			ESCS		PISA Score		ATAR			
	N	(%)	Mean	*SE*	Mean	*SE*	*N*	(%)	Mean	*SE*
All	6,734	100.0	0.17	0.01	0.28	0.01	4,441	100.0	75.8	0.3
Gender of respondent										
Men	3,177	47.2	0.20	0.02	0.29	0.02	2,030	45.7	74.5	0.4
Women	3,557	52.8	0.15	0.02	0.26	0.01	2,411	54.3	76.9	0.3
Region										
Capital	3,824	56.8	0.23	0.02	0.31	0.02	2,654	59.8	76.9	0.3
Other Metropolitan	1,114	16.5	0.33	0.03	0.28	0.03	687	15.5	75.8	0.6
Provincial	1,679	24.9	−0.05	0.02	0.22	0.02	1,031	23.2	73.0	0.5
Remote	117	1.7	−0.04	0.09	−0.05	0.09	69	1.6	75.6	1.7
Family Type										
Traditional	4,989	74.1	0.25	0.01	0.33	0.01	3,473	78.2	76.4	0.3
Single Parent	1,108	16.5	−0.04	0.03	0.14	0.03	623	14.0	73.9	0.7
Mixed	482	7.2	0.01	0.04	0.16	0.04	263	5.9	72.5	1.1
Other	155	2.3	−0.16	0.08	−0.22	0.09	82	1.8	75.0	1.9
Father's Country of Birth										
Missing	75	1.1	−0.14	0.13	−0.25	0.13	43	1.0	71.6	2.8
Australia	4,501	66.8	0.20	0.01	0.30	0.01	2,897	65.2	75.5	0.3
Other English-Speaking Country	757	11.2	0.38	0.03	0.37	0.03	480	10.8	75.8	0.7
Non-English-Speaking Country	1,401	20.8	−0.01	0.03	0.16	0.03	1,021	23.0	76.8	0.6
Indigenous Status										
Non-Indigenous	6,475	96.2	0.20	0.01	0.30	0.01	4,352	98.0	76.0	0.3
Indigenous	259	3.8	−0.37	0.06	−0.42	0.06	89	2.0	66.2	1.9
School sector										
Government	3,970	59.0	−0.02	0.02	0.14	0.01	2,341	52.7	73.2	0.4
Catholic	1,534	22.8	0.22	0.02	0.31	0.02	1,066	24.0	75.7	0.5
Independent	1,230	18.3	0.75	0.02	0.66	0.02	1,034	23.3	81.9	0.5
Type of Institution										
No Institution + Missing	3,549	52.7	−0.05	0.02	−0.01	0.02	1,689	38.0	68.0	0.4
Group of Eight	985	14.6	0.71	0.03	0.92	0.02	930	20.9	88.7	0.3
Australian Technology Network	551	8.2	0.40	0.04	0.57	0.03	476	10.7	80.4	0.6
Innovative Research Universities	419	6.2	0.22	0.05	0.46	0.04	341	7.7	76.8	0.8
Regional Universities	151	2.2	−0.03	0.07	0.31	0.06	119	2.7	70.8	1.2
Other Universities	1,079	16.0	0.32	0.03	0.41	0.02	886	20.0	75.0	0.5
Broad Field of Study										
No Institution + Missing	3,579	53.1	−0.05	0.02	−0.01	0.02	1,709	38.5	67.9	0.4
Natural and Physical Sciences	367	5.4	0.41	0.05	0.83	0.04	335	7.5	84.3	0.7
Information Technology	108	1.6	0.53	0.09	0.65	0.08	95	2.1	75.0	1.5
Engineering and Related Technology	209	3.1	0.45	0.06	0.88	0.05	195	4.4	84.2	1.0
Architecture and Building	96	1.4	0.56	0.10	0.64	0.07	83	1.9	83.8	1.3
Agriculture, Environment and Related	46	0.7	0.47	0.15	0.43	0.14	40	0.9	73.7	2.1
Health	411	6.1	0.35	0.05	0.69	0.04	363	8.2	82.0	0.8
Education	232	3.4	0.15	0.06	0.43	0.04	188	4.2	77.4	0.8
Management and Commerce	619	9.2	0.34	0.04	0.44	0.03	517	11.6	79.0	0.6
Society and Culture	707	10.5	0.52	0.04	0.59	0.03	607	13.7	81.7	0.6
Creative Arts	360	5.3	0.58	0.05	0.51	0.04	309	7.0	78.3	0.8

Note: Estimates for *N*, %, ESCS, and test score means and standard errors conditional on completion of Year 12. Estimates for ATAR restricted to those with a valid ATAR. ESCS = parents' economic, social and cultural status (standardized). PISA = combined PISA test scores (standardized). ATAR = Equivalent National Tertiary Entrance Rank.

University (8%), and the University of Western Australia (7%). Universities with high attrition rates include Swinburne University of Technology (28%), Charles Darwin University (26%), the University of the Sunshine Coast (25%), and Southern Cross University (23%). Within each state, the elite *Group of Eight* universities have lower attrition rates than other universities with little year-to-year variation (DET, 2015a).[5]

Course attrition and completion also vary with field of study. Course attrition tended to be higher and completion lower in the broad fields of information technology (11% and 63%); agriculture, environmental, and related studies (11% and 67%); and society and culture (8% and 72%), compared to the broad fields of health (6% and 82%), architecture and building (6% and 79%), and the natural and physical sciences (6% and 78%; DET, 2015b, Table 1).

Students' tertiary entrance performance is strongly associated with attrition and completion. Cherastidtham et al. (2018, p. 22) show that the risk of course non-completion after 8 years is over 40% for students with ATARs below 60 but only about 20% for students with ATARs 90 or above. According to official statistics, only 2% of students with ATARs above 95 dropped out, and 95% completed their course. In contrast, the corresponding figures for students with ATARs between 50 and 59 were 16% and 56% (DET, 2015b, Table 1). Norton et al. (2018a, p. 3) found that students with ATARs below 60 were twice as likely to drop out of university than otherwise similar students with ATARs above 90.

Materials and methods

Data

The data were generated from the Australian component of the 2003 Programme for International Student Assessment (PISA) study conducted by the OECD and the 2004 to 2013 Longitudinal Surveys of Australian Youth (LSAY) study that follows young Australians over 10 years, from their mid-teens to mid-twenties, as they move through school to further study, and work and become adults.

The PISA sample was constructed by randomly selecting 50 students from each school from a sample of schools designed to represent all states and school sectors. The sample comprised approximately 12,500 and is representative of 15-year-old school students in 2003. A little more than 70% of the 2003 PISA sample was in Year 10, 19% in Year 11, and 8% in Year 9 (Thomson et al., 2004, p. 77). Assessments in mathematical literacy, reading literacy, scientific literacy, and problem solving were administered in their schools to provide information on student achievement. Mathematics was the major domain, so all students were tested in mathematics, but only a proportion were tested in the minor domains of reading and science. Students also completed a background questionnaire about their families, educational and vocational plans, attitudes to school, and a range of other matters (Thomson et al., 2004). The 2003 PISA sample over-sampled Indigenous students. Of selected schools, all Indigenous students were invited to participate. The 2003 PISA sample included 815 Indigenous students (De Bortoli & Thomson, 2009, pp. 5–7).

The LSAY component of the 2003 cohort began with a follow-up telephone interview, during which students provided further information on their

schooling and work. There was sample attrition around 10% each year, which compounded over time, so that the sample size in the final 2013 wave was only 3,741, that is, only 36% of the original LSAY sample.[6] The impact of missing data is reduced by using generalized estimating equations (GEE), which is detailed below. Details on the LSAY 2003 cohort study including sample design and attrition are available (National Centre for Vocational Education Research [NCVER], 2020b). Weights were not used in the analysis since estimates from unweighted data have superior statistical properties (Winship & Radbill, 1994).

Measures

Many of the measures used in this study were constructed from the derived variables already in the data set. The derived variables were constructed by staff at NCVER and detailed in a LSAY technical paper (NCVER, 2020a).

Outcome variables

Questions on respondents' university course participation, attrition, and completion were asked every year between 2004 and 2013, although no respondent was enrolled at university before 2005.

Three measures of bachelor's degree status were constructed from the derived variable, which classified respondents' bachelor's degree (for that year) into one of four categories: "currently undertaking", "completed", "completed and undertaking further study", and "commenced but did not complete". Dichotomous variables were created for *currently undertaking a bachelor's degree*, *commenced but did not complete*, and *completed a bachelor's degree*. A lag variable was created so that attrition and completion status was ascertained only for students who were undertaking a bachelor's degree course in the previous year. Note that for a single year course completion cannot simply be the inverse of course attrition. This would only be the case if we had complete data across the entire time period.

Predictor variables

The measure of *Socioeconomic Background* used was the OECD's constructed measure of economic, social and cultural status (ESCS). It is a combination of parental occupational status and educational attainment, and includes information on household possessions, educational resources, and cultural items. It was standardized to a mean of zero and a standard deviation of 1. Higher socioeconomic status is indicated by higher values.

The measurement of the sociodemographic variables gender, region, ethnicity (based on father's country of birth), and Indigenous status is apparent from Table 1. *Family type* comprised four categories: traditional, single parent, mixed, and "Other Family Type". "Traditional" is when the student lives in the same

household as both parents; "Single parent" includes both single-mother and single-father families; "mixed" comprises families where the student is living with a parent and a step-parent; and "other" is a residual group which includes students living with two step-parents of opposite sex, students living with one or more grandparents but no parent or step-parent, and students living with siblings but without parents, step-parents, or grandparents.

School sector was measured as a trichotomous variable that distinguished students who attended government, Catholic, and independent schools at the time of PISA testing.

Students' test scores were measured by combining students' non-missing scores in mathematics, reading, and science.

Students' *tertiary entrance scores* were obtained from self-reports in telephone interviews with participants in the 2005 to 2008 waves of the study. ATAR comprises percentiles ranging from 30 to 99.95. In analyses where ATAR is a predictor variable, it was centred at 75 and divided by 10 so a one-unit change is equivalent to a 10-rank difference.

In the LSAY data, educational institution was coded according to the schemas developed by the Australian Bureau of Statistics (ABS, 2001).[7] Institutions were then categorized into the four university groupings: Group of Eight, the Australian Technology Network, Innovative Research Universities, and Regional universities. Other universities were categorized as "Other".[8] Fields of study were measured by the two-digit Australian Standard Classification of Education (ABS, 2001) codes. This broad classification of field of study has been used in analyses of university participation and completion (DET, 2015b; Lim, 2015).

Data summaries

Table 1 presents the percentages for the time-invariant measures and the means and standard errors for socioeconomic background and combined PISA test score restricted to respondents that have completed Year 12 (6,734). The final group of columns presents the frequencies, percentages, and the ATAR means and standard errors restricted to respondents with a valid ATAR. The standard errors allow the reader to assess if the differences between groups are statistically significant.[9]

Table 2 presents summary statistics for time-variant measures. Table 2 shows substantial over-time changes in the cohorts' bachelor's degree status. Notably, the percentage enrolled in a bachelor's degree increased from 9% in 2005 peaking at 49% in 2008. This estimate is of respondents that had completed Year 12. Of all respondents the estimate is 43%, higher than Jerrim and Vignoles's (2015) estimate of 39% by age 20, but in accordance with Lim's (2015, p. 19) estimates. The percentage of the sample that had completed a bachelor's degree reached 57% in 2013, and the percentage "commenced but did not complete" was around 8%.

Table 2. Univariate statistics for time-variant variables.

	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013	
Variable	*N*	Mean	*N*	Mean	*N*	Mean	*N*	Mean	*N*	Mean	*N*	Mean	*N*	Mean	*N*	Mean	*N*	Mean	*N*	Mean
Currently in Degree Course	6,683	0.00	6,692	0.09	6,436	0.38	5,694	0.48	5,244	0.49	4,762	0.39	4,292	0.25	3,909	0.16	3,514	0.10	3,343	0.07
Completed Degree	6,683	0.00	6,692	0.00	6,436	0.00	5,694	0.01	5,244	0.04	4,762	0.17	4,292	0.33	3,909	0.44	3,514	0.52	3,343	0.57
Did not Complete Degree	6,683	0.00	6,692	0.01	6,436	0.04	5,694	0.06	5,244	0.07	4,762	0.08	4,292	0.08	3,909	0.09	3,514	0.09	3,343	0.08

Note: Proportions conditional on completion of Year 12.

Methods

Generalized estimating equations (GEE) are employed to investigate the effects of the predictor variables on respondents' university course participation, attrition, and completion. GEEs were introduced by Liang and Zeger (1986) and Zeger and Liang (1986) to analyse correlated data that otherwise could be modelled as a generalized linear model. GEE analysis is a type of random effects model. The main advantage of the GEE approach is that it maximizes the amount of data analysed. There is considerable attrition: Because of the variation in Year levels, respondents were "at risk" of participation, attrition, and completion in different calendar years, and approximately 10% of the sample delayed university entry. It can be understood as a regression analysis on respondent-year data with suitable adjustments for the clustering of observations among respondents without list-wise deletion of missing data. It reduces the amount of missing data by using the all available pairs method, in which all non-missing pairs are used in the estimation of parameters (Diggle et al., 2013, Chapter 13). Less technical discussions of GEEs are available (Ghisletta & Spini, 2004; Zorn, 2001).

The estimates from GEE analyses of continuous variables are interpreted in the same manner as coefficients obtained from ordinary least squares regression. For analysis of the dichotomous dependent variables – university participation, attrition, and completion – the distribution was specified as binominal and the link function as logit, so the coefficients are best interpreted as odds ratios which are the exponents of the coefficients.[10] A coefficient of zero translates to an odds ratio of 1. Odds ratios are a ratio of odds. For example, an odds ratio of 2 for men on university participation means that the odds of men participating *rather than not participating* at university is twice the corresponding odds for women. An odds ratio equal to (or close to) 1 signifies no (or little) effect of the variable concerned on the dependent variable. Odds ratios above 1 indicate an increased likelihood, and odds ratios less than 1 indicate a decreased likelihood.

The analyses of participation at university were conditional on having completed Year 12. The analyses of course attrition and completion were conditional on the enrolment in a university degree in the previous year.

The correlations of outcome variables within persons in longitudinal studies must be considered. The observations are not statistically independent, so the standard errors were adjusted. Statistical significance is indicated in the conventional way; the probability that the null hypothesis is true.

Results and discussion

Participation

Table 3 presents the logit estimates for participating in a university degree course, conditional on having completed Year 12. SES has only small effects

Table 3. Influences on participation in a bachelor's degree course.

Factor (Reference Category)	Parameter (Unit of Measure)	Base Model	+School sector	+ Test Sores	+ATAR
	Intercept	−1.43 ***	−1.54 ***	−1.73 ***	−1.22 ***
Socioeconomic Bkg.	ESCS (1 *SD*)	0.36 ***	0.32 ***	0.17 ***	0.07 ***
Gender (Women)	Men	−0.21 ***	−0.21 ***	−0.23 ***	−0.05 †
Region	Other Urban	−0.10 *	−0.06	−0.04	−0.02
(Major Urban)	Regional	−0.12 **	−0.10 **	−0.09 *	−0.06
	Remote	−0.06	−0.05	0.09	0.06
Family Type	Single Parent	−0.16 ***	−0.14 **	−0.11 *	−0.01
(Traditional)	Mixed	−0.25 ***	−0.23 ***	−0.19 **	−0.03
	Other Family Type	0.03	0.04	0.18 †	0.09
Father's Country of Birth (Australia)	English-Speaking	−0.07	−0.06	−0.05	−0.03
	Non-English Speaking	0.36 ***	0.37 ***	0.41 ***	0.18 ***
Indigenous Status (Non-Indigenous)	Indigenous	−0.47 ***	−0.44 ***	−0.22 *	0.03
School sector (Government)	Catholic	.	0.16 ***	0.14 ***	0.02
	Independent	.	0.31 ***	0.22 ***	0.01
Student Performance	PISA test score (1 *SD*)	.	.	0.52 ***	0.03
	ATAR (10 ranks)	.	.	.	0.27 ***

Note: Conditional on having completed Year 12. ESCS = parents' economic, social and cultural status.
†$0.10 > p > 0.05$. *$0.05 > p > 0.01$. **$0.01 > p > 0.001$. ***$p < 0.001$.

on university participation. A 1-standard deviation increase in socioeconomic background increases the odds of university entry about 1.4 times, net of demographic factors and school sector. With the addition of PISA test score, the ESCS coefficient almost halves. The logits of 0.17 for SES and 0.52 for PISA indicate the relative magnitudes of their effects for a 1-standard deviation difference. A 1-standard deviation increase in ESCS increases the odds of participation 1.2 times. The comparable odds ratio for PISA test score is 1.7. So, PISA test score has much stronger effects on university entry than SES, which is more consistent with the second group of studies.

SES effects are substantially smaller with a high-stakes prior performance measure taken as close as possible prior to university entry (ATAR) compared with PISA test score at age 15. The addition of ATAR further reduces the logit coefficient for ESCS to 0.07. A 1-standard deviation difference in ESCS increases the odds of university participation only 1.07 times, net of ATAR. So socioeconomic background has a negligible effect on participation at university given students' ATAR. The coefficient of 0.07 may reflect students from self-employed backgrounds more likely not to go to university compared to other students with similar ATARs.

Unsurprisingly, ATAR is a strong predictor: A 10-rank increase in ATAR increases the odds of participation compared to non-participation 1.3 times, a 30-rank increase 2.2 times.

Differences in university entry by gender, region, family type, Indigenous status, and school type can all be attributed to differences in ATAR. Students with fathers born in non-English-speaking countries are more likely than other students to attend university when considering ATAR. That means that for a given ATAR, non-English-speaking background students are more likely to attend university.

Attrition

The results of the analysis of attrition from university, conditional on enrolment in a students' first university degree course the previous year, are presented in Table 4. The effect of ESCS on course attrition is small with a logit of −0.12. With the addition of institution and broad field of study, the effect of ESCS halves and is not statistically significant.

In contrast, the strongest (negative) effect on attrition is ATAR: A 10-rank increase in ATAR reduces the odds of course attrition 1.3 times, a 30-rank increase 2.3 times. The effects of ATAR on attrition do not change with the addition of type of institution and broad field of study. Net of ATAR score, higher PISA scores are associated with a greater likelihood of attrition. This unexpected result for PISA test score may reflect high-scoring students deciding to drop the course they initially enrolled in and students with lower PISA scores less likely to do so.[11]

Young men are more likely to discontinue their university studies, and this gender difference cannot be attributed to lower ATARs. The gender difference moves out of conventional levels of statistical significance with the addition of institution and field of study.

Table 4. Influences on dropping out (attrition).

Factor (Reference Category)	Parameter (Unit of Measure)	Base Model	+ Test Sores	+ ATAR	+Univ/ Field
	Intercept	−2.47***	−2.36***	−2.59***	−2.50***
Socioeconomic Bkg.	ESCS (1 *SD*)	−0.17***	−0.14**	−0.12*	−0.06
Gender (Women)	Men	0.18*	0.21*	0.21*	0.21†
Region	Other Urban	−0.09	−0.11	−0.17	−0.16
(Major Urban)	Regional	0.00	−0.01	−0.14	−0.33*
	Remote	0.27	0.20	−0.26	−0.31
Family Type	Single Parent	0.23*	0.23*	0.14	0.09
(Traditional)	Mixed	0.14	0.13	0.04	0.01
	Other Family Type	0.79***	0.73**	0.78**	0.93**
Father's Country of Birth	English-Speaking	−0.09	−0.08	−0.08	−0.24
(Australia)	Non-English Speaking	−0.63***	−0.66***	−0.54***	−0.44**
Indigenous (Non-Indig.)	Indigenous	0.58*	0.52*	0.49†	0.47†
School sector (Government)	Catholic	−0.30**	−0.30**	−0.17	−0.14
	Independent	−0.33**	−0.31**	−0.14	−0.20
Student	PISA test score (1 *SD*)	.	−0.19***	0.17*	0.22**
Performance	ATAR(10 ranks)	.	.	−0.32***	−0.36***
University	Aust. Technology Network (ATN)	.	.	.	0.16
Group	Innovative Research Uni. (IRU)	.	.	.	0.42*
(Group of Eight)	Regional Universities	.	.	.	0.39
	Other	.	.	.	−0.01
Broad Field of Study	Information Technology	.	.	.	0.26
(Natural and Physical Sciences)	Engineering and Related Technologies	.	.	.	−0.16
	Architecture and Building	.	.	.	−0.07
	Agriculture, Environmental and Relat.	.	.	.	0.30
	Health	.	.	.	−0.47*
	Education	.	.	.	−0.05
	Management and Commerce	.	.	.	−0.29
	Society and Culture	.	.	.	−0.14
	Creative Arts	.	.	.	−0.02

Note: Conditional on having commenced a degree. ESCS = parents' economic, social and cultural status. †$0.10 > p > 0.05$. *$0.05 > p > 0.01$. **$0.01 > p > 0.001$. ***$p < 0.001$.

There are no differences associated with region in the initial models. However, when controlling for type of institution and broad field of study, students from regional areas are less likely to discontinue university study.

Students with a father born in a non-English-speaking country are substantially less likely to discontinue their course, and this effect is only marginally accounted for by ATAR, type of institution, and field of study. In the final model, the odds of this group discontinuing university study is 1.6 times less than the comparable odds for students with Australian-born fathers.

The greater propensity of students from single-parent families, Indigenous students, and students that attended government schools to discontinue university study are accounted for by ATAR.

Students attending universities belonging to the Innovative Research University group show higher levels of attrition than students attending one of the Group of Eight universities: The odds of such students dropping out is about 1.5 times the comparable odds of students at Group of Eight universities. There is no difference in attrition for the Australian Technology Network, Regional Universities, and Other types compared to Group of Eight Universities, net of ATAR. Of the broad fields of study, only "health" shows significantly lower attrition than "Natural and Physical Sciences".

Completion

Course completion is unrelated to SES. The ESCS coefficient is not statistically significant in any of the four models (Table 5). The effect of ATAR on course completion is not particularly strong with the odds of degree completion increasing 1.05 times for every 10-percentile increment in ATAR. So, even a difference of 30 ATARs would increase the odds of course completion only 1.16 times. There is no significant effect for PISA test scores in the second model, but it has a small significant negative effect controlling for ATAR. A 1-standard deviation increase in PISA test score reduces the odds of course completion 1.07 times, net of ATAR and other factors in the last two models. Again, this counter-intuitive result is likely to reflect those students with high PISA scores having secured a university place wishing to pursue another course or do something else entirely.

There are no effects for language background, Indigenous status, and school sector on completion in any of the four models. Young men are less likely to complete their course than young women with an odds ratio of about 1.2. This difference is not accounted for by ATARs, institution, and field of study. There are statistically significant positive effects for "other urban" region on course completion, which is not accounted for by ATAR, university type, or field of study. The negative relationship between coming from a single-parent family and course completion disappears when considering ATAR.

Table 5. Influences on completion of a bachelor's degree course.

Factor (Reference Category)	Parameter (Unit of Measure)	Base Model	+ Test Sores	+ ATAR/ ATAR	+Univ/ Field
	Intercept	−1.43***	−1.44***	−1.36***	−1.46***
Socioeconomic Bkg.	ESCS (1 *SD*)	0.01	0.01	−0.01	−0.01
Gender (Women)	Men	−0.15***	−0.15***	−0.14***	−0.12***
Region	Other Urban	0.10**	0.10**	0.12**	0.12**
(Major Urban)	Regional	0.06†	0.07†	0.08*	0.14***
	Remote	−0.14	−0.13	−0.20	−0.14
Family Type	Single Parent	−0.11*	−0.11*	−0.10*	−0.06
(Traditional)	Mixed	−0.08	−0.08	−0.07	−0.04
	Other Family Type	−0.14	−0.13	−0.16	−0.30*
Father's Country of Birth	English-Speaking	0.06	0.06	0.06	0.06
(Australia)	Non-English Speaking	0.05	0.05	0.01	0.03
Indigenous (Non-Indig.)	Indigenous	−0.08	−0.08	−0.11	−0.13
School sector	Catholic	0.05	0.05	0.02	0.02
(Government)	Independent	0.02	0.02	−0.02	0.01
Student	PISA test score (1 *SD*)	.	0.02	−0.07**	−0.07*
Performance	ATAR/ATAR (10 ranks)	.	.	0.07***	0.09***
University Group	Aust. Technology Network (ATN)	.	.	.	0.02
(Group of Eight)	Innovative Research Uni. (IRU)	.	.	.	−0.08
	Regional Universities	.	.	.	−0.19†
	Other	.	.	.	0.09*
Broad Field of Study	Information Technology	.	.	.	−0.24†
(Natural and Physical Sciences)	Engineering and Related Technologies	.	.	.	−0.14*
	Architecture and Building	.	.	.	0.13
	Agriculture, Environmental and Relat.	.	.	.	−0.08
	Health	.	.	.	0.13*
	Education	.	.	.	−0.01
	Management and Commerce	.	.	.	0.01
	Society and Culture	.	.	.	−0.04
	Creative Arts	.	.	.	0.24***

Note: Conditional on having commenced a degree. ESCS = parents' economic, social and cultural status.
†$0.10 > p > 0.05$. *$0.05 > p > 0.01$. **$0.01 > p > 0.001$. ***$p < 0.001$

Degree completion is marginally higher in universities defined as "other" compared to Group of Eight universities (odds ratio ≈ 1.1). There are no significant differences in completion for the other types of institutions compared to the Group of Eight. There are some differences with broad field of study. Course completion is significantly lower for "Information Technology" and "Engineering", and higher for "Health" and the "Creative Arts" compared to the "Natural and Physical Sciences". Only the negative effect for "Information Technology" and the positive effect for "Creative Arts" are sizable with odds ratios around 1.3.

Limitations

One limitation of this study is that although ESCS comprises of many items, it does not include comprehensive and accurate measures of income and wealth. Rutkowski and Rutkowski (2013) pointed out that the PISA home possessions index which purportedly measures wealth is problematic. Income

and wealth are important theoretically. It is plausible that students from low-income or poor households are less likely to pursue university studies than academically comparable richer and wealthier students. However, according to the Household Income and Labour Dynamics of Australia (HILDA) household panel, a carefully constructed measure of income has no effects on university entry in Australia, in contrast to parental education and labour force status (Dockery et al., 2016). The effect of income in other countries (possibly not including the US) net of prior performance tends to be small (Anders, 2012; Corak et al., 2003; Reisel, 2011). The Australia Higher Education Contribution Scheme (HECS) effectively removes the upfront costs of university education since repayment of course fees is postponed until reasonably well-paid employment is secured (Chapman & Ryan, 2005). Therefore, family income and probably wealth are less important than may be the case with upfront university fees. However, accurate measures of, at least, family income, possibly through taxation records, would be an important addition to the Longitudinal Surveys of Australian Youth data. It may settle the issue of whether academically able students from poorer background are unable to pursue university studies.

There are other aspects of SES not included in the ESCS measure. Karmel and Lim (2013) pointed out that different social groups are likely to have different values and tastes. For example, students from trade or vocational backgrounds are more likely to decide to opt for vocational training than go to university compared to white collar background students with comparable university entrance scores. It would be a rational decision given that there would be resources and networks available to pursue a career in trade. Karmel and Lim (2013) argued that because social groups often have different values and tastes, equality of outcomes is not a viable goal whereas equality of opportunity is.

Another limitation is the absence of measure of student performance while at university, such as GPA as in the US. A measure of performance while at university would be useful in the study of course attrition and completion. The Australian equivalent of the college GPA is weighted average mark (WAM). However, WAMs are imperfect since they do not adjust for course difficultly, its entrance requirements, year of course, or the general proficiencies of course participants. That said, the addition of WAMs to the LSAY data would have been useful for these analyses.

Population data would provide a far better understanding of university participation and course completion than data from sample surveys. Population data comprise many more students from disadvantaged groups that policy-makers are most interested in. Attrition is very much reduced. Such data would provide accurate and ongoing information on the major influences on university entrance and course completion, which could be easily disaggregated by sociodemographic group, institution, and course providing far more robust results than those obtained from longitudinal surveys. It is already

theoretically possible to link the data on secondary students, university students, and income through taxation records.

Conclusion

It is clear from these analyses that in Australia, SES does not have strong effects on university entry, and course attrition and completion. The strong focus on socioeconomic background by many researchers, higher education bureaucrats, and commentators is misplaced. Net of prior performance, socioeconomic background has only a small effect on university participation, negligible effects on attrition, and no effects on completion. These conclusions apply to the Australian context. In other contexts where there are sizable upfront fees, private universities, or where university admission includes non-academic criteria, SES effects may be larger.

Differences in the university career by region, family type, Indigenous status, and school sector can be simply attributed to differences in university entrance performance (ATAR). So, initiatives and policies designed to increase the percentage of disadvantaged groups that hold university degrees need to be implemented well before university entry. Similarly, the large differences in attrition and course completion by institution and field of study reported in Department of Education (2014, 2015) publications are much smaller or disappear, net of ATAR. So, institutional and field of study differences in attrition and completion do not exist because of differences in the provision of services to students or pastoral care but because of differences in the academic mix of students.

The clear implication of this study for Australia is that policies aiming to increase participation and university course completion should focus on student performance in secondary school rather than students' socioeconomic and demographic characteristics.

Notes

1. ATAR is a percentile ranking ranging from 30 to 99.95. All students with ranks 30 or below are assigned a rank of 30. The ranking is based on students' performance in the last year(s) of secondary school adjusted for differences in the academic profiles of students taking easier and more difficult subjects.
2. Author's calculation.
3. This claim is not true since only about 13% of the variance PISA test scores can be attributed to the OECD's comprehensive SES measure, ESCS (OECD, 2019, p. 17).
4. For example, at present, entry to Victoria University, Federation University, and the University of Divinity does not require an Australian Tertiary Admissions Rank (https://universityreviews.com.au/atar-course-entry-scores). In addition, there are courses in other universities at which admission is not based solely on tertiary entrance rank, for example, art and the performing arts.

5. These attrition rates are based on a match process using universities' student identification number and the Commonwealth Higher Education Student Support Number (CHESSN). This provides a more accurate calculation of attrition as it identifies students at either the same or a different higher education institution (DET, 2015a).
6. The data analysed for this paper are available from Australian Data Archive (https://www.ada.edu.au/longitudinal/home).
7. The coding schemas can be found at http://www.lsay.edu.au/publications/2225.html
8. Universities Australia details the grouping of individual universities into the four networks (http://www.australianuniversities.com.au/directory/group-of-eight/).
9. A rough rule of thumb is: If the values of the mean plus or minus twice the standard error for two groups do not overlap, then the difference is statistically significant.
10. The odd ratios are the ratio of two odds. They are calculated as simply the exponent of estimates. Odds ratio $= e^{b_k}$ or odds ratio $= \exp(b_k)$.
11. These unexpected results for PISA test score controlling for ATAR in the attrition and completion analyses are not due to multicollinearity. In these data, ATAR and PISA score correlate at 0.58, and in the tests for multicollinearity the variance inflation factors are well below 10 and the lowest tolerance is a healthy 0.65.

Disclosure statement

No potential conflict of interest was reported by the author.

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