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Fully Integrating Upper-Secondary Vocational and Academic Courses: A Flexible New Way?

Cain Polidano
Domenico Tabasso

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Cain Polidano
University of Melbourne
and ARC Life Course Centre

Domenico Tabasso
University of Geneva,
NCCR LIVES and IZA

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IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

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ABSTRACT

Fully Integrating Upper-Secondary Vocational and Academic Courses: A Flexible New Way?*

The tracking of students in upper-secondary school is often criticised for narrowing the career prospects of student in the vocational education and training (VET) track, which in many countries leads to the stigmatisation of VET courses. To tackle this problem, Australia blurred the lines between the two tracks by introducing VET courses that count to both a national VET qualification and university entry. In this study, we estimate the impacts of taking these courses on academic achievement and university entry using administrative data, propensity score matching and a decomposition method developed especially. We find that among those who intend to go to university, taking a VET course is associated with 5 percent lower academic achievement, due mainly to relatively weak achievement in VET, and an 8 percentage point lower chance of receiving a university offer. These findings tell a cautionary tale on the merits of integrating VET and academic courses.

JEL Classification: I20, I23, J24

Keywords: propensity score matching, university access, vocational education and training

Corresponding author:

Cain Polidano
Melbourne Institute of Applied Economic and Social Research
University of Melbourne
Parkville 3010
Victoria
Australia
E-mail: cainp@unimelb.edu.au

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Introduction

A challenge for upper-secondary schooling around the world is how to ensure enough flexibility in the curriculum to cater for post-secondary pathways that require different learning approaches and academic abilities. In the main, countries have approached this challenge by providing separate streams in academic and vocational education and training (VET) study, with participation in one or the other determined either by choice (common in English-speaking countries) and/or by performance in academic tests (German-speaking countries and Southern Europe). A criticism of streaming is that the curriculums of the two tracks are incompatible, so that for students who are on the margin between the two streams, taking upper-secondary VET courses can potentially limit their access to university (Eichhorst, et al. 2012).[1] In countries where there is strong emphasis on university study, the result is that upper-secondary VET courses are stigmatised as being a 'second-choice option' (OECD 2000; Kogan 2008).

There are several ways in which countries are attempting to deal with the stigmatisation of VET courses in upper-secondary school. For example, Ireland and Finland introduced technical colleges (Institutes of Technology in the 1970s and Polytechnics in the 1990s respectively) that sit alongside universities and provide higher education pathways (qualifications at the ISCED 5A) for upper-secondary VET students. Alternatively in England (since 2014) and Australia (since the early 2000s), the focus has been to make it easier for upper-secondary VET students to access university. In England, new 'tech level' Diploma level VET courses have A-level status and count towards entry in specific University courses. Australia has progressed further down this path by integrating upper-secondary VET and academic courses in areas such as

[1] While it is true that there are pathways between upper-secondary VET and university study, including in countries where there is streaming on academic ability, in practise the divergent level of skills and competences required means that it is not common (Woessmann 2008).

information technology, business, engineering, music and performing arts that count towards a national VET qualification (mainly at the ISCED 3 level) and entry to any university course.[2] These courses are known as ‘scored VET’ courses because unlike other VET courses that are available in the curriculum, performance is assessed on an equal footing with academic courses.

In principle improving pathways to university holds great promise in encouraging young people on the margin between the two streams to try upper-secondary VET courses, including developing fall-back options. Greater engagement in upper-secondary VET among students who intend to go to university not only helps to improve the status of VET, but it potentially helps to improve student post-secondary course match and labour market outcomes (Kang and Bishop 1989; Bishop and Mane 2004 and Meer 2007; Polidano and Tabasso 2014). However, in practice, designing VET courses that cater for a range of student interests and abilities potentially involves trades-offs. From a policy perspective, any potential trade-offs should be estimated and weighed-up against the benefits described above. In this study we focus on examining one potential trade-off by examining how taking a scored VET subject affects the academic performance and the chances of university entry among students who apply for university (around 64% of all students in these courses).

[2] This involved the development of an academic scoring system for select upper-secondary VET courses, known as ‘scored VET’, that count towards both a national VET qualification and university entry. Previously, all upper-secondary VET courses were graded as pass or fail, depending on whether nationally subscribed minimum competencies had been attained. In Australia, VET qualifications are awarded on the basis of attaining minimum competency standards in occupation-specific training packages and are graded as a pass or fail without any overall grade. The failure to grade achievement in these subjects potentially limits entry to university in Australia, which is typically based on scored achievement in upper-secondary courses. Changes to fully integrate VET courses were introduced to various degrees across states in the 1990s. However, in 2001, under the New Framework for Vocational Education in Schools (MCEETYA 2001), a national attempt was made to increase the prevalence of these types of VET courses across the country.

Whether taking a scored VET course improves or reduces academic performance and university access is unclear. On the negative side, the 'hands-on' nature of VET training is often claimed to better suit less academic students (Smith 2002). Further, there may be negative spill-over effects because skills developed in VET may be less complementary to learning in academic subjects. Finally, in subjects with a higher proportion of student who do not intend to go to university, those who *do* may be disadvantaged by negative peer effects or, in cases where assessment for university is based on relative performance in a course, strong competition from students who are incentivised to specialise their effort.[3] On the other hand, it could be argued that the 'hands-on' nature of VET gives students the context in which theory is applied, which may help them to understand the importance of theory and engage them in learning (Kolb 1984). To the extent that this improves student motivation, then taking a VET course may have positive spill-over effects on performance in academic subjects.

To estimate effects of scored VET subjects on academic achievement and university access, we examine outcomes in the last year of upper-secondary study (Year 12) in the Australian state of Victoria in 2011. Victoria was the first state to introduce scored VET subjects into their curriculum in 1997 and its subjects are more highly integrated into the academic curriculum than in other states.[4] We use propensity score matching (PSM) and three linked population administrative datasets of Year 12 students to control for non-random selection into scored VET subjects. The linked datasets contain rich school and student information, including past

[3] While scores for each subject have the same mean initially, adjustments are made to correct for differences in subject competition that may affect the difficulty of attaining the mean score. However, these adjustments do not correct for systematic specialisation in effort among students who do not intend to go to university, only differences in the academic ability of students across courses. This is discussed further in the following section.

[4] For example, Western Australia does not have any upper-secondary VET programs that can count towards both a national qualification and university entry score (Australian Curriculum, Assessment and Certificate Authorities (ACACA 2012).

performance on national standardised test scores; university course applications and final year academic scores that are used to determine university offers.

This paper makes two main contributions to the existing literature. First, this study makes an important contribution to the literature on the effects of integrating vocational courses into an academic upper-secondary school curriculum. Previous studies to date have focussed on estimating the impacts on school retention and labour market outcomes of school-based VET courses (Kang and Bishop 1989; Bishop and Mane 2004 and Meer 2007), including two Australian studies (Lamb and Vickers 2006 and Polidano and Tabasso 2014).[5] Estimating the impacts of taking scored VET subjects provides important evidence on the merits of fully integrating VET and academic courses to deal with the stigmatisation of upper-secondary VET.

Second, we derive an approach for decomposing the estimated effects of taking a scored VET course on overall academic achievement into direct and indirect effects. A direct effect is the score in a VET course relative to the score if an academic subject was chosen instead, while an indirect effect is the spill-over effect on achievement in academic subjects if a VET course is taken. This decomposition approach sheds light on the mechanisms through which effects are transmitted, and depending on the direction of indirect effects, whether VET and academic subjects are complements or substitutes in academic achievement. While evidence to date suggests that VET and academic courses are complements in the labour market (Kang and Bishop 1989; Bishop and Mane 2004), as far as we are aware, there is no evidence that they are complements/substitutes in academic achievement.

[5] Students can also take VET subjects that do not receive an academic score that counts towards university entry.

Scored VET and upper-secondary education

Upper-secondary education in Australia, like in many other English-speaking countries, is untracked and geared around preparation for university, the main form of post-secondary education. Around 50% of young Australians are expected to attain a university level qualification over their lifetime, compared to 39% across the OECD (OECD 2013). For those who do not go onto university study, post-secondary VET study is a popular option. As well as the academic upper-secondary curriculum, the high rate of university participation is due in part to the long-established and universally available deferred loans scheme and government subsidies of university qualifications. Similar to the United Kingdom, access to university is rationed at the course level mainly based on academic performance in upper-secondary subjects.[6] Academic performance in Australia is measured by scores across (usually five) subjects taken in Year 12. Typically, more desirable courses, such as medicine and law, and more desirable universities, set higher minimum university entry scores for admission.

Subject scores are normalised with a mean of 30 and a maximum of 50, with adjustments subsequently made in an attempt to eliminate any advantage (disadvantage) from selecting courses where there is relatively weak (strong) student competition. Such adjustments are based on the difficulty of attaining the normalised mean in a subject relative to attaining the mean in all other subjects taken by the same students (VTAC 2011). In subjects where students score

[6] In 2013 the Australian Government introduced an entitlement to a publicly-funded place in university for all Australian students, but access remained subject to capacity constraints. This tended to increase the proportion of students enrolled in university and reduced the minimum academic requirement for entry.

higher than the mean score in all their other courses, scores are scaled-down and in subjects where students score lower than the mean in their other subjects, scores are scaled-up.[7]

VET subjects were introduced gradually into the upper-secondary curriculum in the mid-1990s, originally to retain less academic youth in school and to prepare students for work and further training (Ministerial Council on Employment Education and Training and Youth Affairs (MCEETYA) 1999). Today, over 95% of secondary schools offer VET subjects (MCEETYA 2003) and around 40% of all upper-secondary students undertake at least one subject throughout their secondary education (NCVER 2011a). Most of the training (around 80%) is at job-entry level or below, equivalent to International Standard Classification of Education (ISCED) 2C (NCVER 2011b). In Australia, the attainment of a VET qualification is based on the demonstration of minimum competency in carrying out job-specific and generic tasks, as stipulated in national training packages. Upper-secondary VET subjects are based on select national training packages and therefore count towards the attainment of national VET qualifications. Nationwide, the most popular upper-secondary VET subjects are in the fields of Management and Commerce (30%), Engineering and related technologies (12%), Health (12%) and Food, Hospitality and Personal Services (9%) (NCVER 2011a). With the exception of courses associated with apprenticeships and traineeships, there is no requirement for students to attain minimum competency through workplace learning, but it is encouraged.

Because upper-secondary VET subjects were initially introduced to engage less academic students in school, performance was not graded for the purpose of university entry. As a result, VET courses were often stigmatised as being for low-ability students. In an attempt to improve their status, state governments in Australia introduced scored VET subjects in Year 12. These subjects, as well as counting towards a national VET qualification, were also assessed in a

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[7] For more details on the scaling system see VCAA 2011 and VTAC 2011.

similar way to academic subjects for the purpose of university entry. These courses complemented and not replaced existing upper-secondary VET courses. Victoria was the first state to introduce scored VET subjects from 1997, with other states following suit in the early 2000s.

Assessment in scored VET subjects typically comprises assessment in carrying out three relevant work tasks, as specified in the specific national training package. The rest of the assessment is made up of performance in a theoretical exam held at the end of the academic year. The higher weighting given to task-based assessment (66% in most courses) is in contrast with assessment in academic courses where exam assessment is given greater weight.

Data

A feature of this study is the use of population unit-record data of Victorian Year 12 completers in 2011 from all school sectors (government, Catholic and independent private). The data comprise linked information from three administrative datasets on students, schooling and national standardised test scores in numeracy and literacy (NAPLAN) (from the Victorian Department of Education and Early Childhood Development (DEECD)); university entry scores (from the Victorian Curriculum and Assessment Authority (VCAA)); and university applications prior to completing final exams (Victorian Tertiary Admission Centre (VTAC)). These datasets were linked using a de-identified student number common to each of the datasets, which ensured that the datasets could be linked with close to 100% accuracy. We also link-in at the individual level self-reported information on whether or not a university offer had been received. This type of information came from the On-track survey, a survey of 34,000 graduates conducted around 6 months after graduation.

In 2011 there were 27 VET subjects available to students in Year 12, 17 of which were scored VET subjects (known as Victorian Certificate of Education VET subjects, or VCE VET). Overall, we observe 48,408 Year 12 school completers in Victoria in 2011, of which 3,628 (or 7.4%) took at least one scored VET subject in Year 12 and 44,780 did not (Table 1). The most popular VCE VET subjects are Interactive Digital Media; Community Recreation and Sport and Outdoor Recreation; Hospitality and Hospitality (kitchen operations); Music and Music Industry; Information Technology and Electrotechnology and Business.

INSER TABLE 1

In defining our sample for analysis, we omit a number of observations. First, we omit those who do not attain a university entry score at the end of Year 12. Students may not attain a university entry score if they do not complete requirements of the course, for example, if they commence Year 12, but dropout before the end of the year. Second, we omit those without a Year 9 NAPLAN score, an important control variable in the matching procedure. Although sitting Year 9 NAPLAN tests is compulsory, students can be exempt from sitting the tests if they have a complex disability, if they are from a non-English speaking background and have arrived in Australia within a year, or if they have written consent from a parent or guardian.[8] Third, we omit those who attain a university entry score, but do not attain a score for their VET subject. Students who take scored VET subjects can opt out of having their achievement in the course scored, in which case they do not sit an exam in this subject. In these rare cases, a student's university entry score will be made-up from a combination of their typically remaining 4 subjects. Fourth, to ensure that all of our scored VET group get the same intensity of treatment, we also omit a handful of students who choose more than one scored VET subject.

[8] Students with a disability or from a non-English speaking background who have arrived in Australian within a year still encouraged to sit the tests. Extra support is available for members of these groups if they choose to sit the exams.

Finally, because we are interested in estimating the impacts of taking scored VET subjects on university access, we omit those who do not apply for admission to a university course prior to sitting their final exams (before the end of October 2011). University applications and applications to some post-secondary VET colleges in Victoria are centrally administered by VTAC. To apply, students are required to list their preferred courses in order of priority from 1 (most preferred) to 12. For the purposes of this study, those who apply for university are those whose first preference is a university course.

Outcomes of interest

The main outcome of interest is academic achievement in Year 12, measured by a student's university entry score. For a student, their entry score can be thought of as their academic currency to buy entry to fixed numbers of university course places, where the cost of entry is the minimum required academic achievement, or the academic price, that equates demand and supply for course places. University entry scores are derived by VCAA by summing the highest score for English (from English, English as a Second Language or English Literature) with the remaining best three subject scores (known as the primary four subjects) and adding 10% of the fifth-best subject score. If a sixth subject is taken, which is not the norm, an additional 10% of a sixth subject is included as well. Because each subject is out of a possible 50, the maximum university study score is 205 (or 210 if students do 6 subjects). All students who complete Year 12 receive an entry score regardless of whether or not they apply for university.

For students who take scored VET subjects, any impact on university entry scores from taking these subjects does not necessarily affect their chances of accessing university because the receipt of an offer also depends on the minimum entry scores of the courses that they apply to. To estimate impacts on the chances of the receipt of an offer, we use two measures. First, while we do not directly observe receipt of offers to a specific course, we can impute it by comparing, for each student, the minimum required academic achievement for entry to their preferred courses to their realised achievement. We assume that students receive an offer if their university entry score is higher than the lowest necessary score for admission to any of their preferred courses. Similarly, we also impute measures for the receipt of an offer that is in the student's top three most preferred courses and receipt of an offer in the student's top six.

Because offers to some courses are not solely based on entry scores, but also on other non-academic criteria such as performance in an interview or family background, we also use self-reported receipt of a university offer as an outcome. Information on receipt of an offer is from the *On Track* survey of 2011 school completers that are linked via a unique student identifier (conducted in 2012). The 2012 *On Track* is a survey of school completers that contains information from around 34,000 2011 graduates at around six months after completing school.[9] Receiving an offer is identified by whether graduates report either being enrolled in a university course, receiving an offer and deferring commencement or receiving an offer and declining the offer.

Descriptive statistics

As may be expected, on average, students who apply to university attain higher university entry scores than those who do not (Table 2), and among those who do not apply, there is little difference in the key characteristics of those who do and do not take a scored VET subject.[10] In contrast, within our sample (those who apply for university), students who take scored VET subjects on average attain an entry score that is 17 points (13%) lower than those who do not.

[9] For more information on *On Track*, including the survey questionnaires, visit the On Track website: http://www.education.vic.gov.au/about/research/Pages/ontrackdata.aspx.

[10] Table A1 in the Appendix presents the mean values of the variables summarising the characteristics of the families and the schools of the students in the sample.

This raw difference is large, but is likely to in part reflect selection — differences in the characteristics of students who do and do not take scored VET subjects. For example, those who take scored VET subjects have lower academic ability, measured by performance in national numeracy and literacy test scores and lower rates of higher education attainment among parents.

INSERT TABLE 2

Consistent with lower academic ability, those who take scored VET subject also apply for university courses that have lower minimum university entry scores, as measured by the percentage rank required to attain their most preferred university course — top 40% compared to top 31%. However, even though they apply for courses with lower minimum academic requirements; overall, they are less likely to receive an offer, including a more preferred offer, regardless of the measure used.

Estimation strategy

As discussed above, part of the raw difference in university entry scores and the chances of receiving an offer observed in the raw data (Table 2) is likely to be due to self-selection and not due to the impacts of taking a scored VET subjects. In the absence of exogenous variation that could be exploited, for example as part of an instrumental variables (IV) strategy, to attempt to isolate causal effects, we rely on the richness of controls in our data and propensity score matching (PSM). PSM deals with self-selection by constructing a 'like' or 'matched' control group (from students who do not take a scored VET subject) against which outcomes from the treatment group (those who take a scored VET subject) can be compared to isolate the effects of the treatment (taking a scored VET subject).

PSM is generally preferred to standard regression techniques in dealing with self-selection bias because it ensures common support, that is, overlap in the distribution of characteristics between those who do and do not receive a treatment (Blundell & Costa Dias 2008). Standard regression techniques do not ensure common support, which means that the estimated effects of treatment may be based on extrapolation, which makes them difficult to interpret. However, a limitation of PSM is its heavy reliance on rich data to control for differences in all factors that affect both selection and outcomes, known as the conditional independence assumption (CIA).

Ideally, to ensure that the CIA holds, we would restrict the matched control group to individuals who took the same subjects as those of the treatment group, except for one, the scored VET subject. However, given that students have great flexibility in choosing from around 60 Year 12 subjects, such an approach would impose a tight constraint on the matching and any estimates would be arbitrarily based on choosing a specific academic subject as an alternative to taking a scored VET subject. In this study, we assume that the outcome from taking an alternative academic subject instead of scored VET is equal to the weighted average outcome from the matched control group, even though the academic courses taken by the two groups may be somewhat different. This is not likely to be a limiting assumption because after selecting a matched control group, we find that there are only minor differences in the academic subjects chosen between the two groups (Table A2 in Appendix A).

In this study, two standard PSM approaches are used to construct a matched control group — Kernel and Nearest Neighbour. Nearest Neighbour involves using a propensity score to select, for each treated individual, the individual from the control group with the closest propensity of treatment. A limitation of Nearest Neighbour is that it only uses information from one control group observation per treated individual and ignores information from control group members who may have similar predicted probabilities of treatment. To better utilise available information, we also use Kernel matching. Kernel matching uses a weighted average of outcomes from many control group member with similar propensity scores to generate a counterfactual outcome for each member of the treatment group. The weights depend on the distance between the control and the treated propensity score.[11] In small samples there is generally a trade-off between bias and efficiency (Smith & Todd 2005). Notably, Nearest Neighbour estimators are less biased while Kernel are more efficient. Because we have a large control group, this is not likely to be an issue, except when we estimate results for sub-samples. For this reason, our standard results are generated using Kernel matching, but we also generate results using one-to-one Nearest Neighbour as a robustness check.

Decomposition approach

A feature of this study is the derivation of a decomposition method to explain any gap in university entry scores between those who do and do not take scored VET subjects. As described in the text, an individual's university entry score is derived by summing the highest English study score with the remaining best three subject scores (known as the primary four subjects) and adding 10% of the scores of other subjects taken (usually only one other):[12]

$$S_i = x_{English_i} + \sum_{c=1}^{N_i} w_{ic} x_{ic} \tag{1}$$

where,

$x_{iEnglish}$=highest score in English, English as a second language or English literature for student i;[13]

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[11] Using a conservative bandwidth of 0.02.

[12] If a sixth subject is taken (not the norm), an extra 10% of that subject is added as well, which would mean adding $0.1x_{i6}$ to equation (1).

[13] Typically students only take one English subject.

x_{ic} =scores in *c* courses (that are not the highest English course) for student *i*;

w_{ic} =weight of score for course *c* for individual *i*, which is 1 if the score is in the top three and 0.1 otherwise;

N_i =number of courses taken by student *i*, excluding English (typically 4).

For individual *i*, the effect of taking a scored VET subject on university entry scores is the difference in the university entry score if a scored VET subject is taken (s_i) minus the entry score if an academic subject is taken instead (s_i'):

$$s_i - s_i' = \left[x_{English_i} + \sum_{k=1}^{N_i-1} w_{ik} x_{ik} + w_{iVET} x_{iVET} \right] - \left[x'_{English_i} + \sum_{k=1}^{N_i-1} w'_{ik} x'_{ik} + w_{iA} x_{iA} \right] \qquad (2)$$

where,

w_{ik}, x_{ik} =weights and scores for academic course *k*;

w_{iVET}, x_{iVET} =weights and scores for a scored VET course;

$w_{iA} x_{iA}$ =weights and scores for an academic course *A* that is taken instead of a scored VET course;

w'_{ik}, x'_{ik} =weights and scores in the same *k* academic courses if another academic course (*A*) is taken instead of a scored VET course;

$x'_{iEnglish}$ = score in the highest English course if an academic course *(A*) is taken instead of a scored VET course.

In this study, we assume that the effect of taking a scored VET subject (equation (2)) on university entry scores is the sum of two effects - a direct and an indirect effect. For individual *i*, the direct effect is the weighted score from taking a scored VET subject, relative to the weighted score if an academic subject was taken instead, all else being equal. The indirect effect, or spill-over effect, is the weighted sum of subject scores in all academic subjects when a scored VET subject is taken relative to when an academic course (*A*) is taken instead:

$$DE_i = \left[w_{iVET} x_{iVET} \right] - \left[w_{iA} x_{iA} \right] \tag{3}$$

$$IE_i = \left[x_{English_i} + \sum_{k=1}^{N_i - 1} w_{ik} x_{ik} \right] - \left[x'_{English_i} + \sum_{k=1}^{N_i - 1} w'_{ik} x'_{ik} \right] \tag{4}$$

A problem with estimating equations 2-4 is that for those who are observed to choose scored VET subjects, we do not observe the counterfactual outcomes (second term in equations (3) and (4)), the classic evaluation problem. In this study, we use PSM to get around this problem by generating counterfactual outcomes that are weighted (matched) outcomes from *j* students who did not take a VET course. Consistent with the underlying assumption of the matching (discussed above), we assume that the counterfactuals for the terms $w_{iA} x_{iA}$, $w'_{ik} x'_{ik}$ are mean weighted academic course scores from the control group - $\overline{wx_j}$.[14]

Assuming that the PSM function weights counterfactual outcomes by g_{ij}, a propensity score function, and substituting $\overline{wx_j}$ into equations (2)-(4), then the estimated total, direct and indirect effects for individual *i* can be written as:

$$s_i - s'_i = \left[x_{iEnglish} + \sum_{k=1}^{N_i - 1} w_{ik} x_{ik} + w_{iVET} x_{iVET} \right] - g_{ij} \left[x_{jEnglish} + \overline{wx}_j . N_i \right] \tag{5}$$

$$DE_i = \left[w_{iVET} x_{iVET} \right] - g_{ij} \left[\overline{wx_j} \right] \tag{6}$$

$$IE_i = \left[x_{iEnglish} + \sum_{k=1}^{N_i} w_{ik} x_{ik} \right] - g_{ij} \left[x_{jEnglish} + \overline{wx}_j . N_i \right] \tag{7}$$

[14] The mean weighted academic course score is calculated as: $\overline{wx_j} = \sum_{k=1}^{N_j} w_{jk} x_{jk} / N_j$

Specification of the propensity score function

As mentioned above, for PSM to deal with self-selection bias, the CIA must hold, that is we must control for differences in all factors that affect both choice of scored VET and outcomes of interest. In this study, we are able to control for key individual differences including past academic performance and post-school study aspirations and school-level factors such as differences in peers and school type.

As shown in Table 2, one of the main differences between those who do and do not take scored VET subjects is differences in past academic performance, measured by performance in national standardised test scores (NAPLAN) in Year 9. Controlling for past academic achievement makes the interpretation of our results similar to that of a value-added model, which is assumed to largely account for differences in academic ability and the effects of historical investments in education (Hanushek 1979; Todd & Wolpin 2003).

Another important student control is differences in post-school study aspirations between the two groups. It is possible that students who do and do not choose scored VET subjects aspire to different university courses, so that there are also differences in general subjects taken between the two groups that may affect outcomes. We control for differences in field of education by including dummy variables for 25 fields of university study (2-digit ASCED) into the standard propensity score matching. In the standard estimation, we do not control explicitly for the level of aspiration, measured by the minimum university entry score of the first preference from the previous year because this contains large numbers of missing observations that may affect the analysis.[15] We control for the level of aspiration in the sensitivity analysis

[15] There are large numbers of missing observations because many first preferences are for courses that do not based admission exclusively on university entry scores.

by testing whether the inclusion of first preference cut-off scores affects the standard estimates in the sensitivity analysis.

There is a body of literature that shows parents' education and occupational preferences are important in influencing student academic performance and occupational preferences (see for example Polidano et al. 2013). To control for this source of self-selection, we include information on the highest education level (Australian Standard Classification of Education (ASCED) 1-digit) and occupation skill level (Australian Standard Classification of Occupations (ASCO) 1-digit) of either parent into the selection equation.

Other individual-level information used in the matching is gender, age, indigenous status, whether the individual is from a non-English speaking background, remoteness of region, number of subjects taken in Year 12 and a measure of regional disadvantage. We control for differences in local economic opportunities by using information on local (Statistical Local Area) unemployment rates from the Australian Bureau of Statistics.[16]

We use a range of controls for school-level differences between those who do and do not choose scored VET subjects that may also be related to differences in Year 12 scores. These include school type (public or private) Year 9 leave-out school-cohort mean estimates of numeracy and literacy (NAPLAN) scores, school size (proxied by the number of students in Year 12), and proportion of students in Year 12 who participate in VET, a possible proxy for the quality and range of VET options in Year 12. We test the robustness of our results to omitted school-level factors in the sensitivity analysis.

Although there is no test for whether the CIA is met, we conduct post-match balancing tests, as proposed by Rosenbaum and Rubin (1985). The balancing tests check for differences (using

[16] These were found to explain more of the variation in selection into scored VET courses than indices of socio-economic disadvantage.

t-tests) in the variable means of the treatment and matched control groups. Significant differences suggest that the CIA is violated. In the final specification of the probit selection model into scored VET used in the matching there were no significant differences in mean characteristics between the onset and matched control group (balancing test results are presented in Figures A1, A2 and A3 in Appendix A).[17]

Results

The estimated Kernel results are presented in the tables below and represent the average treatment effects on the treated (ATET).

Impacts on university entry scores

Results presented in Table 3 suggest that controlling for non-random selection into scored VET subjects is important. Before the matching, there is a 17 point gap in the average university entry scores between those who take a scored VET subject and those who do not. After matching, the gap shrinks to around 5.47 percentage points out of a possible 205. This suggests that most of the unmatched gap (11 percentage point gap) is due to non-random selection into scored VET. The remaining six percentage point gap after matching can be interpreted as the reduction in the average university entry score associated with taking a scored VET subject.

INSERT TABLE 3

A major innovation of this study is the derivation of a decomposition method that breaks the total effect presented in Table 3 into direct and indirect effects. Decomposition results presented in Table 3 suggest that most of the gap in matched entry scores (around 70%)

[17] Results from the balancing test are available upon request from the corresponding author.

between those who do and do not take scored VET subjects is related to a negative direct effect. More specifically, 3.97 points out of the 5.47 point-gap in university entry scores can be explained by lower achievement in scored VET subjects, relative to what we estimate could have been achieved if an academic subject was chosen instead.[18] The remainder of the gap, 1.51 points out of the 5.47 point-gap represents a negative spill-over effect that taking a scored VET subject has on academic achievement in other subjects.

The most likely explanation for the negative direct effect appears to be that VET students who apply for university are negatively affected by strong competition from the relatively large proportion of students in scored VET subjects who do not apply for university (27% compared to less than 10% for academic courses). Students in scored VET subjects who do not apply for university may be highly motivated to perform well because VET gives them an opportunity to prepare for employment in their chosen career while still at school, either by gaining credits towards a national qualification or by preparing them for higher-level post-secondary VET qualifications. Unlike those who apply for university, these students do not need to maximise their university entry score and can afford to specialise their efforts in VET.[19] In contrast, some VET students who apply for university may not be well suited or may not be highly motivated in VET subjects, especially if the main motivation for taking these courses is to develop fall-back options. This explanation is consistent with results in Table 3 that show that the negative impacts are concentrated among those who may be considered to be on the margin of gaining entry to university (defined as being in the second top quartile in national tests in both literacy

[18] It is important to note that differences in achievement in this context is differences in the average contributions to the university entry score and not average scores because they take into account the different weighting given to subjects in making-up individual entry scores.

[19] University entry scores are typically only used for sorting into university places and are not commonly used for sorting into jobs.

and numeracy) who may take scored VET to develop a fall-back option.[20] The conflicting motivations for taking VET subjects is evidenced by differences in the distributions of VET and academic study scores for the two groups presented in Figure 1. For those who apply for university who are on the margin, except for a small proportion who perform extremely well in VET, they achieve higher study scores in academic subjects than in VET subjects. The opposite is true for students who do not apply for university and who perform similarly in national test scores.[21]

INSERT FIGURE 1

The negative indirect effect, albeit smaller than the direct effect, suggests a lack of complementarity between achievement in VET and in other academic subjects. One explanation is that the 'hands-on' workplace context of VET is too far removed from the learning context in academic subjects, so that the spill-over in achievement in other subjects is less than if another academic subject is chosen instead. Another explanation is that the training requirements may disrupt student performance in other subjects. The high materials, equipment and staffing costs needed to run VET courses mean that, to offer a breadth of VET courses, many schools offer VET courses through partnering with local post-secondary VET providers or with other schools. As a result, students often have to take classes off the school campus, which may impact on the time spent in other classes.

While the above explanations are plausible, we cannot rule out the possibility that the lower average entry score for scored VET students is due to uncontrolled for differences between

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[20] We choose performing in the second highest quartile (top 50-25%) as being on the margin for university entry because academic performance is highly correlated with university entry and data from the Longitudinal Survey of Australian Youth (2003 cohort) suggests around 40% of all Year 12 students are admitted to university.

[21] Results from the Kolmogorov-Smirnov one-sided tests are highly significant (p-values are less than 0.01).

those who do and do not take VET subjects that affect entry scores. That said, it is unlikely that the entire gap is due to uncontrolled for factors because of the dominance of the direct effect. If there are uncontrolled differences in factors that lead to lower entry scores for VET students, then to explain the entire gap, the uncontrolled factors must have a disproportionately *negative* effect on scores in VET subjects compared to scores in other subjects. At the most, if all of the indirect effect can be explained by uncontrolled for differences between the two groups and that uncontrolled for factors impact scores in all subjects equally, then uncontrolled for factors would only account for around a third of the estimated gap in university entry scores.[22]

Impacts on university access

INSERT TABLE 4

A key question is to what extent does a 5.47 percentage point lower average university entry score out of a possible 205 mean for access to university and the attainment of a preferred university offer? Based on imputations of course offers, using minimum course entry scores, student course preferences and student scores, we estimate that taking a scored VET subject is associated with a 8 percentage point lower chance of receiving a university offer (Table 4). This estimate is robust to the use of self-reported receipt of an offer, which also takes into account offers from courses that do not exclusively base admission on university entry scores. Not only is the gap in university entry scores associated with lower chances of receiving an over, but it is also associated with a reduced chance of receiving a an offer for admission to a preferred course — in the top 6 or top 3 most preferred courses (out of 12) (Table 4).

[22] If we assume that all of the indirect effect is due to differences in uncontrolled for factors and that these factors have the same negative affect on all subject scores, then we can say that 0.38 (1.51/4) percentage points of the 3.97 percentage point direct effect is also explained by uncontrolled for factors. Therefore, at the most (in total), uncontrolled for factors would explain 1.9 (1.51+0.38) out of the total 5.47 percentage point gap, or a third.

INSERT TABLE 5

On face value, given that those who take scored VET generally apply to courses with lower minimum entry scores than those who do not (Table 2), this large effect appears to be somewhat of a surprise. However, after matching any remaining difference is not great enough to dampen the effect of lower academic performance on the chances of receiving an offer. The key to understanding the relatively large effect on the chances of receiving an offer is the concentration of negative effects among those on the margin of attaining access to university. Compared to high performing students, a relatively small negative impact on university entry scores has a large impact on the chances of students on the margin receiving a university offer. This is demonstrated by the larger negative impacts estimated for those performing in the top and second top quartile in national test scores (Table 5), although the estimated impacts are not statistically significant due to the small sample sizes.

Sensitivity analysis

We test the robustness of our standard model results in Table 3 by re-estimating under a range of alternative scenarios (Table 6). Overall, our results appear to be highly robust. We discuss each of the alternative scenarios and their results in turn below.

INSERT TABLE 6

As discussed above, Kernel estimators are more efficient because they use information from a number of matched individuals, not just the nearest matched individual. A down-side of using a Kernel estimator instead of Nearest Neighbour is that there is a greater risk of bias (Smith & Todd 2005) in small samples. To gauge the extent of this problem, we also estimate results for one-to-one and closest-five Nearest Neighbour. Results presented in Table 6 are very close to the standard Kernel result, which suggests that our results are robust to the choice of matching method.

A key assumption in our analysis is the CIA. One reason why it may be violated is if those who do and who do not take scored VET subjects have quite different post-school career aspirations. In particular, despite applying for university, those who choose VET subjects may be more willing to follow career paths that do not involve university study, so that they are less highly motivated to achieve high grades. This may not be completely captured in the matching by including field of study dummies for students' first preferences. To test this, we re-estimate the standard results with the minimum entry score required for admission in 2010 of each student's preferred course included. Minimum entry scores from the previous year are a good indication of the academic requirements for entry in the existing year and entry scores for the preferred course should capture differences in academic ambition. Results with this variable included in the matching are still negative and significant, although the magnitude of the effect is slightly lower. It should be kept in mind that there is a considerable number of missing observations under this scenario because some courses do not use entry scores for admission.

Another possible reason for a violation of the CIA is that there are unobserved differences in the schools attended by students who do and do not choose scored VET subjects. This may be particularly true between schools that do and do not offer scored VET subjects. To reduce this risk, we exclude around 6,000 control group members who attend schools that had no enrolments in any scored VET subject in 2011. Given that there may be potentially large differences in the nature of the schools that do and do not offer scored VET subjects, the robustness of our results under this scenario suggests any differences in schools not captured by the matching may be inconsequential for student outcomes.

Conclusions

The streaming of students in upper-secondary school is often criticised for limiting opportunities for VET students on the margin to enter higher education, which in some countries, causes upper-secondary VET courses to be stigmatised. In an attempt to avoid this problem and improve the status of VET, Australia introduced VET programs that are fully-integrated into the academic curriculum, so that performance counts towards both a national VET qualification and university entry. This model potentially abrogates the need for streaming because it caters for both students who do VET to prepare for work or post-secondary VET study and those on the margin to explore VET options in school (perhaps to develop fall-back options) without potentially closing-off access to university. This study provides the first evidence on the impacts of these courses on academic performance and university access for students who intend to go to university compared to if they had taken academic courses instead.

Our results suggest that varied motivations and/or abilities of students who do and do not intend to go to university within these courses are difficult to cater for, and that they appear to be, at least partly, associated with lower academic achievement and university access among students who take these courses. In particular, we find that among those who apply for university, taking a scored VET subject in the last year of secondary school is associated with an estimated 5 percentage lower academic achievement and an 8 percentage point lower chance of receiving a university offer compared to taking an academic course. Using a decomposition approach developed for this study, we show that the bulk of the lower performance is due to relatively weak scores in VET compared to scores in other subjects, especially among those on the margin — those in the second highest quartile in national test scores. The most likely explanation is that compared to students who are preparing for work (and not university), students on the margin are not as well suited, or as highly motivated to specialise their effort, in VET courses. In a system where academic performance for entry to university depends on the relative (not absolute) performance of students in their selected courses, strong competition from VET students who do not apply for university makes it more difficult for students on the margin to attain sufficiently high scores in VET to gain entry to university. While it is true that students on the margin face even higher competition from students in academic courses, based on their higher academic ability on average, subject scores are adjusted for this type of competition in the Australian system to reduce the chance of gaining an advantage through course choice.

From a policy design standpoint, these results tell a cautionary tale. Fully integrating VET and academic courses potentially involve trading-off competing student interests that should be assessed against any benefits. Potential benefits not considered in this study include better matches to post-secondary courses for students on the margin that may arise through increased participation in, and improved status of, VET. Also not included in this study are other potential trade-offs for those who do not apply for university, including possible dilution in the quality of preparation for work or further VET study. A further implication of our study is that when integrating VET and academic subjects, broader consideration needs to be paid to whether existing assessment procedures for university entry can cater for the peculiarities of these subjects. In the Australian context, existing assessment procedures that are based on relative performance within a course appears to be disadvantaging VET students on the margin who apply for university. This problem could be addressed by using absolute assessments instead, similar to the A-level system in the United Kingdom, with moderations made to ensure consistent year-on-year course standards.[23]

A second main contribution of our paper is in the development of a decomposition framework that can be used to separate any effects from course choice according to direct and spill-over

[23] A simpler approach would be to restrict the relative course assessment to only students who apply for university. However, this may not be a viable solution if it means that students who do not intend to go to university apply anyway to get a score that could be used for future university access.

effects. We find evidence of a small, but significantly negative spill-over effect from VET study, which suggests that taking these is detrimental to performance in other subjects. This contradicts the theory of experiential learning that proposes the need for applied settings to help motivate engagement in study (Smith 2002). It is possible that the applied setting of VET only motivates effort in VET or that it is not effective in motivating higher ability students. In future studies, this framework may be used to examine spill-overs for other subjects, especially for enabling courses, such as information technology and research methods.

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Tables and Figures

Table 1: Number of students in the sample by scored VET subject

	Total number of students	***Less* number without a an entry score**	***Less* number without Year 9 NAPLAN**	***Less* number who don't attain a study score for scored VET**	***Less* those who do not intend to go to university**
Scored VET subject					
Business	257	191	165	162	124
Community recreation	572	469	420	411	267
Community services	274	208	180	173	133
Dance	90	74	59	57	44
Electrotechnology	96	63	48	45	15
Engineering studies	146	113	103	98	50
Equine industry	49	40	36	32	21
Financial services	8	7	5	5	3
Furnishing	102	83	75	73	25
Hospitality	338	253	209	205	130
Hospitality (kitchen operations)	297	228	194	188	106
Information technology	241	186	161	150	112
Interactive digital media	660	526	460	451	324
Laboratory skills	9	8	8	8	8
Music	128	112	99	96	68
Music industry (technical production)	253	186	162	162	98
Sports and outdoor recreation	108	88	77	71	55
Takes a scored VET subject	3,628	2,835	2,461	2,387	1,583
Doesn't take a scored VET subject	44,780	36,070	30,380	29,998	25,854

Note: Students with multiple VET scored courses, students with less than 5 scored courses and students with missing observations for control variables are also omitted.

Table 2: Mean outcomes for outcome and key student characteristics

	Applied for university (sample for analysis)		Did not do not apply for university (omitted from the sample)[a]	
	Scored VET students	Other students	Scored VET students	Other students
Outcome variables				
University entry score (out of 205)	111.32	128.59	93.15	92.00
Offered any place (%)	55.89	75.06	-	-
Offered a top 3 course (%)	40.57	53.37	-	-
Offered a top 6 course (%)	50.99	67.93	-	-
Self-report receipt of an offer (%)	67.65	86.39	-	-
Key student characteristics[b]				
Male (%)	50.47	44.94	59.88	51.10
Indigenous students (%)	0.19	0.23	0.20	0.57
Non-English speaking background (%)	27.80	30.99	22.42	20.58
Unemployment rate in SLA (%)	5.71	5.29	5.68	5.63
NAPLAN numeracy score in Year 9 (out of 874)	589.63	622.19	573.53	575.79
NAPLAN reading score in Year 9 (out of 874)	586.87	612.94	570.19	573.35
Minimum percentage rank of university entry score to attain first course preference (out of 100)	60.56	69.69	-	-
Number of individuals	1,583	25,854	992	5,080

[a]This sample includes the same restrictions as the sample for analysis except that these individuals do not apply for university study. [b]See Table A1 in the Appendix for mean values of all control variables in our analysis.

Table 3: Estimated impacts from taking a scored VET subject on university entry scores (out of a maximum of 205) among those who apply to university, Kernel

	Enrolled in a scored VET subject		**Did not enrol in a scored VET subject**		**Difference (ATET)**		**Number of obs.**
	Avg.	s.e.	Avg.	s.e.	Avg.	s.e.	
Overall							
Unmatched entry score (out of 205)	111.32	23.19	128.58	27.12	-17.26***	0.71	27,437
Matched entry score (out of 205)	111.32	23.19	116.79	4.34	-5.47***	0.78	27,437
Decomposition results							
Direct effect (out of 50)	19.30	13.49	23.27	0.87	-3.97***	0.37	27,437
Indirect effect (out of 155)	92.02	23.73	93.52	3.48	-1.51**	0.71	27,437
Results by prior academic performance (Year 9 numeracy and literacy)[a]							
Top 25%							
Unmatched entry score (out of 205)	144.31	17.21	159.36	21.18	-15.05***	2.75	3,041
Matched entry score (out of 205)	144.97	16.78	143.72	10.72	1.25	5.84	3,032
Top 50-25%							
Unmatched entry score (out of 205)	112.43	16.72	121.77	19.81	-9.34***	1.72	2,174
Matched entry score (out of 205)	112.63	16.89	117.96	9.44	-5.32**	2.72	2,170

*Significant at 10%, ** significant at 5%, *** significant at 1%.

[a]The sample size for this sub-sample is disproportionately small because to be included, students must perform in this range in both numeracy and literacy.

Table 4: Estimated impacts from taking a VCE VET subject on the chances of attaining entry to a university course, Kernel

	Enrolled in a scored VET subject		Did not enrol in a scored VET subject		Difference (ATET)		Number of obs.
	Avg.	s.e.	Avg.	s.e.	Avg.	s.e.	
Imputed receipt of any offer (%)							
Unmatched	0.559	0.497	0.755	0.430	-0.196***	0.011	29,600
Matched	0.559	0.497	0.638	0.076	-0.080***	0.018	29,600
Imputed receipt of an offer for admission to a course that is at least the sixth most preferred (out of 12)							
Unmatched	0.509	0.500	0.686	0.464	-0.176***	0.012	29,266
Matched	0.509	0.500	0.580	0.074	-0.070***	0.018	29,266
Imputed receipt of an offer for admission to a course that is at least the third most preferred (out of 12)							
Unmatched	0.404	0.491	0.543	0.498	-0.139***	0.013	28,271
Matched	0.404	0.491	0.464	0.077	-0.060***	0.018	28,271
Self-reported receipt of an offer[a]							
Unmatched	0.675	0.469	0.864	0.342	-0.189***	0.012	16,923
Matched	0.675	0.469	0.765	0.087	-0.090***	0.022	16,923

*Significant at 10%, ** significant at 5%, *** significant at 1%.

[a]The number of observations for being offered a university place is less than in Table 6 because the sample is based on *On Track* data, which is a sample of the population of school completers. The number of observations for attaining the preferred university preference and for attaining one of the first three and first six preferences is higher than in table 6 because of the higher number of non-missing observations in the outcome variable.

Table 5: Estimated impacts from taking a scored VET subject on the chances of attaining entry to a university course by past academic performance, Kernel

	Enrolled in a VCE VET subject[a]		Did not enrol in a VCE VET subject		Difference (ATET)		Number of obs.
	Avg.	s.e.	Avg.	s.e.	Avg.	s.e.	
Top 25% in Year 9 numeracy and literacy							
Imputed receipt of any offer (out of a possible 12)							
Unmatched	0.937	0.244	0.966	0.182	-0.028	0.023	3,735
Matched	0.929	0.260	0.943	0.080	-0.014	0.065	3,727
Self-reported receipt of an offer							
Unmatched	0.913	0.285	0.979	0.142	-0.066***	0.012	1,996
Matched	0.912	0.288	0.882	0.199	0.029	0.129	1,984
Top 50-25% in Year 9 numeracy and literacy							
Imputed receipt of any offer (out of a possible 12)							
Unmatched	0.796	0.405	0.865	0.342	-0.069**	0.036	2,427
Matched	0.782	0.414	0.849	0.192	-0.067	0.064	2,421
Self-reported receipt of an offer[a]							
Unmatched	0.797	0.406	0.908	0.289	-0.112***	0.039	1,369
Matched	0.765	0.428	0.828	0.281	-0.064	0.107	1,361

*Significant at 10%, ** significant at 5%, *** significant at 1%.

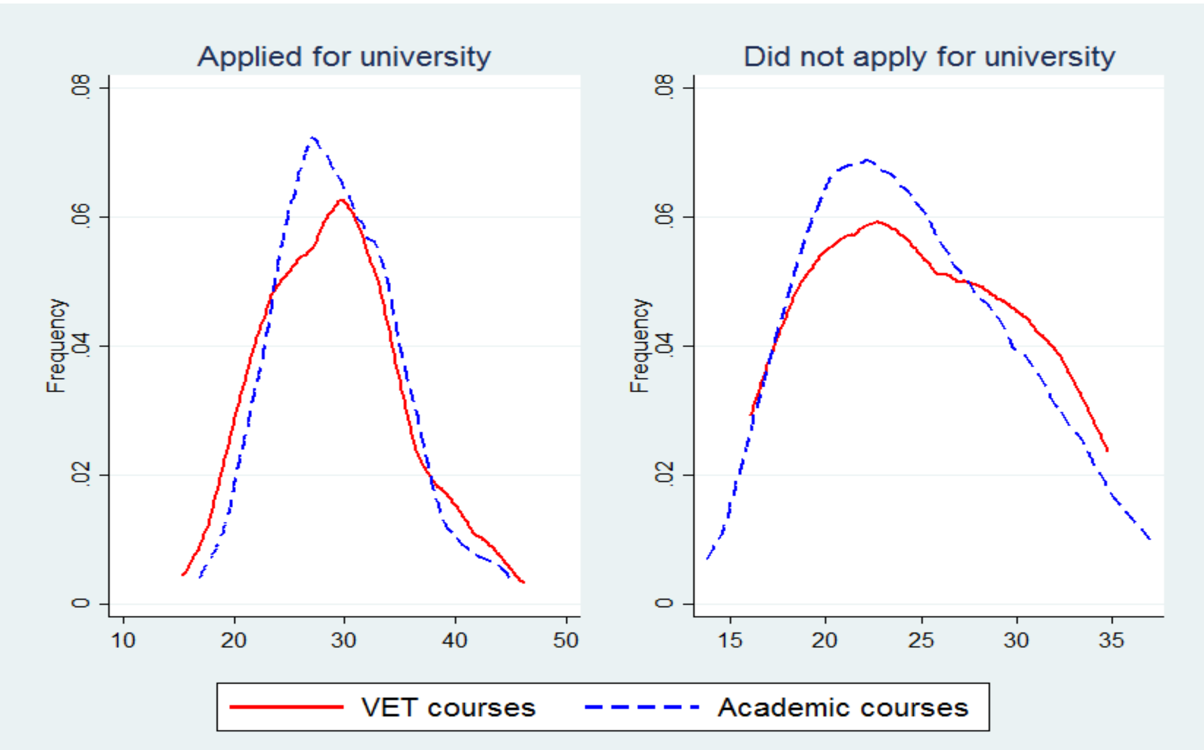
[a]The number of observations for being offered a university place is less than in Table 6 because the sample is based on On Track data, which is a sample of the population of school completers. The number of observations for attaining the preferred university preference and for attaining one of the first three and first six preferences is higher than in table 6 because of the higher number of non-missing observations in the outcome variable.

Table 6: Estimated impacts from taking a VCE VET subject on university entry scores (out of a maximum of 205) under various assumptions

	Enrolled in a scored VET subject		Did not enrol in a scored VET subject		Difference (ATET)		Number of obs.
	Avg.	s.e.	Avg.	s.e.	Avg.	s.e.	
Standard results (from Table 3)							
Unmatched	111.32	23.186	128.58	27.12	-17.26***	0.71	27,437
Kernel matching (out of 205)	111.32	23.186	116.79	4.34	-5.47***	0.78	27,437
Alternative matching methods							
Nearest Neighbour, one-to-one	111.32	23.186	117.062	24.229	-5.742***	1.249	27, 437
Nearest Neighbour, closest five	111.32	23.186	116.636	10.809	-5.316***	0.914	27, 437
Kernel with alternative assumptions							
With controls for entry score of first preference[a]	111.715	22.797	116.501	23.223	-4.786***	0.634	21,603
Exclude schools that don't offer scored VET subjects	111.32	23.186	116.497	3.884	-5.187***	0.772	22,146

***Significant at 1%. [a]There are fewer observations because not all courses admit students on the basis of entry scores. Courses without entry scores are omitted from the analysis.

Figure 1: Distribution of Year 12 subject scores for students who take scored VET subjects who are in the second top quartile (top 50-25%) in national test scores in Year 9



Appendix A: Additional descriptive statistics and other results

Table A1: Mean values of students' family and school characteristics

	Applied for university (sample for analysis)		Did not do not apply for university (omitted from the sample)[a]	
	Scored VET students	Other students	Scored VET students	Other students
Students' family characteristics				
Highest ANZSCO occupation among parents				
Not stated	11.18	11.83	7.94	8.23
Not in paid work	8.34	5.81	6.42	8.40
Labourer	14.97	12.05	19.48	19.60
Tradesman/clerk	20.66	17.22	26.66	26.57
Other manager	26.22	25.25	27.20	24.66
Senior managers, qualified professionals	18.64	27.84	12.30	12.55
Highest ASCED education level among parents				
Not stated	13.01	12.42	9.47	9.96
Year 9 or below	2.91	2.56	2.07	3.15
Year 10/11	10.23	7.38	17.52	16.47
Year 12	9.48	8.94	9.90	10.18
VET level ISCED 2-4	25.96	19.46	31.23	30.39
Diploma	14.47	14.52	14.91	15.65
Bachelor degree or above	23.94	34.71	14.91	14.20
School characteristics				
Non-government school (%)	45.48	53.35	30.24	31.18
School average NAPLAN numeracy score (out of 692)[b]	599.05	613.07	592.87	595.09
School average NAPLAN reading score (out of 692)[b]	594.00	603.99	588.56	590.64
School average % of students taking scored VET[b]	6.78	3.85	6.95	4.84
Inner Regional Australia (%)	15.48	13.86	17.09	20.04
Major Cities of Australia (%)	65.19	68.02	59.26	54.69
Outer Regional Australia (%)	2.65	2.47	3.48	4.14
Mixed location (%)	16.68	15.65	20.16	21.13

[a]This sample includes the same restrictions as the sample for analysis except that these individuals do not apply for university study. [b]Excluding student's own outcome

Table A2: The ten most common academic subjects taken by students who do and do not take a VCE subject

Students who take a VCE VET subject (treatment group)		Students who don't take a VCE VET subject (control group)		Matched control group	
	%		%		%
Further Mathematics	19.81	Further Mathematics	14.32	Further Mathematics	16.19
Health & Human Development	7.66	Mathematical Methods (CAS)	8.86	Business Management	7.74
Business Management	7.56	Psychology	7.09	Psychology	7.5
Psychology	6.35	Chemistry	5.8	Health & Human Development	6.43
Physical Education	5.93	Health & Human Development	5.37	Physical Education	5.83
Studio Arts	4.17	Biology	5.33	Biology	5.24
Visual Communication & Design	4.08	Business Management	5.1	Mathematical Methods (CAS)	4.88
Media	3.64	Physical Education	4.44	Studio Arts	4.76
Mathematical Methods (CAS)	3.58	Physics	3.81	Visual Communication & Design	4.52
Food & Technology	3.23	Legal Studies	3.76	Legal Studies	3.93

Table A3: Results from the probit model of participation in a VCE VET subject used in the propensity score matching

	All students		**Students that intend to start higher education**	
	Marginal effect	t-stat	Marginal effect	t-stat
Individual characteristics				
Respondent is male	0.00211***	(2.59)	0.00116*	(1.87)
Age of respondent (years)	-0.00107	(-1.42)	-0.000684	(-1.22)
Indigenous status	-0.00461	(-1.33)	-0.00312	(-1.48)
Non-English speaking background	0.000547	(0.60)	-0.000264	(-0.41)
Rural area	-0.000922***	(-3.29)	-0.000582***	(-2.69)
Unemployment rate in SLA (%)	-0.000173	(-1.12)	-0.00000621	(-0.05)
NAPLAN numeracy score in Year 9 (out of 874)	-0.00004***	(-4.60)	-0.000024***	(-3.75)
NAPLAN reading score in Year 9 (out of 874)	-0.0000154*	(-1.92)	-0.0000131**	(-2.19)
Number of subjects taken in VCE	0.0165***	(7.68)	0.0104***	(6.45)
Taken VET subjects at unit 1 or 2 level	0.00275***	(15.72)	0.00174***	(11.36)
School level factors				
Non-government school	0.00585***	(6.02)	0.00352***	(4.97)
School average NAPLAN numeracy score (out of 692)[a]	-0.0000214	(-0.75)	-0.000009	(-0.48)
School average NAPLAN reading score (out of 692)[a]	-0.0000648*	(-1.80)	-0.0000265	(-1.00)
School average % of students taking scored VET[a]	-0.0000009	(-0.01)	0.000120*	(1.69)
Number of Year 12 students in the school	0.0000353***	(7.59)	0.0000217***	(6.06)
Highest ANZSCO occupation among parents (ref. case: senior managers, qualified professionals)				
Not stated	0.00357	(1.42)	0.00112	(0.68)
Not in paid work	0.00377	(1.53)	0.00405*	(1.81)
Labourer	0.00374*	(1.95)	0.00250*	(1.66)
Tradesman/clerk	0.00140	(0.97)	0.00157	(1.36)
Other manager	0.00308**	(2.22)	0.00181*	(1.81)
Highest ASCED education level among parents (ref. case: Bachelor degree or above)				
Not known	0.00122	(0.63)	0.00242	(1.39)
Year 9 or below	-0.00256	(-1.43)	-0.00163	(-1.29)
Year 10/11	-0.000156	(-0.11)	-0.000468	(-0.46)
Year 12	-0.00104	(-0.79)	-0.00132	(-1.54)
VET level ISCED 2-4	-0.000986	(-0.89)	-0.000472	(-0.58)
Diploma	-0.00165	(-1.53)	-0.00102	(-1.33)
Intended field of education at university (ASCED code for first preference (ref. case: Maths and Science)[b]				
Other Natural and Physical Sciences	-0.00636***	(-6.18)	-0.00473***	(-8.54)
Computer Science and IT Systems	-0.00599***	(-6.16)	-0.00635***	(-5.68)

Other IT	0.000694	(0.24)	-0.00438***	(-5.88)
Engineering, Manufacturing & Technology	0.0194***	(3.05)	-0.00323	(-1.38)
Maritime Engineering and Technology	-0.00298	(-1.51)	-0.00466***	(-7.32)
Other Engineering and Technology	-0.00347**	(-2.06)	-0.00471***	(-8.42)
Architecture and Building	-0.00389**	(-2.21)	-0.00470***	(-8.09)
Agriculture; Natural Resources & Environment	-0.00429***	(-3.66)	-0.00491***	(-7.38)
Other Agriculture and Related Studies	-0.00462***	(-3.40)	-0.00479***	(-8.19)
Medical Studies; Pharmacy and Nursing	-0.00497	(-1.52)	-0.00450***	(-8.69)
Veterinary Studies, Public Health & Related	-0.00528***	(-5.70)	-0.00645***	(-5.03)
Other Health	-0.00471***	(-4.21)	-0.00541***	(-6.69)
Teacher Education; Curriculum and Education Studies	-0.00335***	(-2.58)	-0.00511***	(-6.47)
Other Education	-0.000384	(-0.25)	-0.00515***	(-4.90)
Accounting, Business, Marketing & Related	0.000788	(0.22)	-0.00438***	(-6.57)
Banking and Finance & Related	-0.00139	(-1.16)	-0.00604***	(-4.33)
Other Management and Commerce	-0.00439	(-1.39)	-0.00449***	(-8.64)
Behavioural Science, Law & Related	-0.00662***	(-7.55)	-0.00553***	(-7.33)
Language and Literature, Economics, Philosophy & Related	-0.00314***	(-2.71)	-0.00630***	(-4.61)
Sport and Recreation	-0.00115	(-0.47)	-0.00454***	(-7.72)
Other Society and Culture	0.00208	(0.76)	-0.00439***	(-6.03)
Arts, Design, Media Studies & Related	-0.00566***	(-6.23)	-0.00614***	(-5.65)
Other Creative Arts	0.00256	(1.58)	-0.00534***	(-3.47)
Personal Services	0.0158*	(1.88)	-0.00383***	(-2.79)
Observations	*32 562*		*27 437*	

***Significant at 1%, ** significant at 5%, *significant at 10%.
[a] Excluding student's own outcome. [b] These headings reflect the 2-digit ASCED fields of study based on the 4-digit headings that makeup the 2-digit categories.

Figure A1: Reduction in bias among covariates for university entry scores

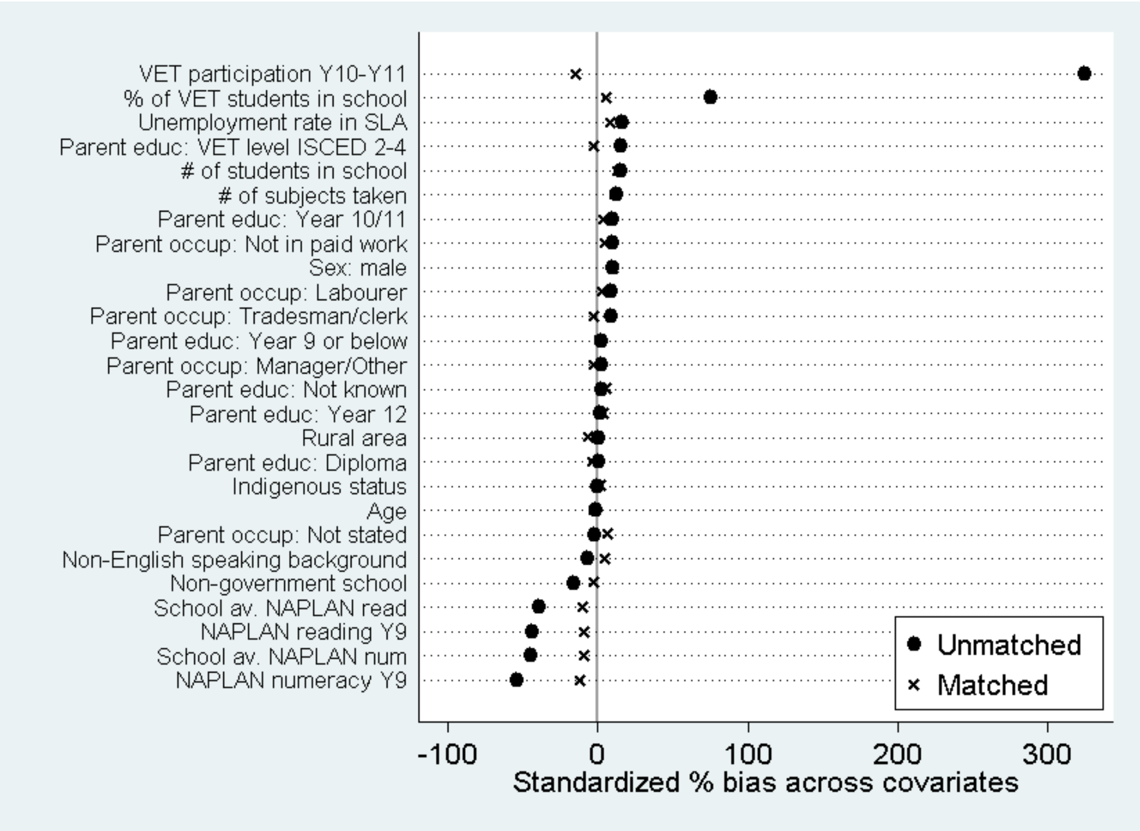


Figure A2: Reduction in bias among covariates, imputed receipt of any university offer

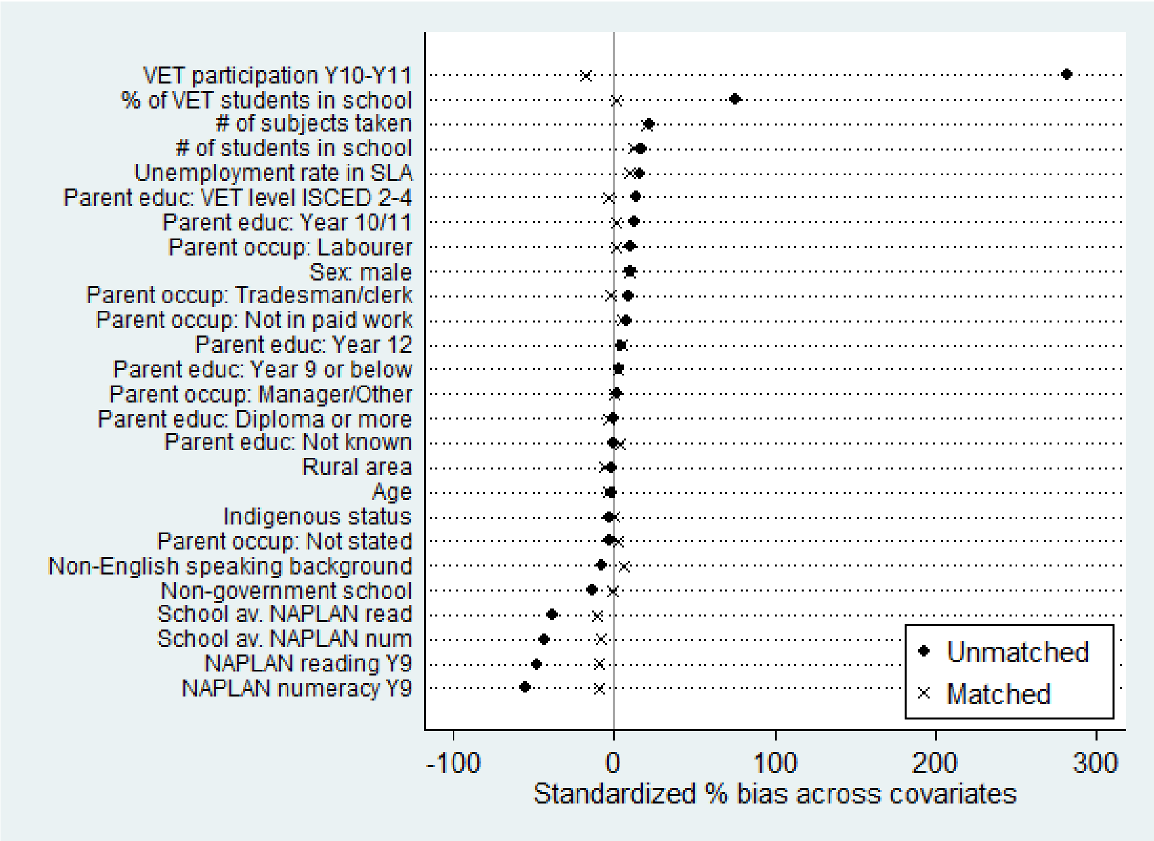


Figure A3: Reduction in bias among covariates, self-reported receipt of any university offer.