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Earnings, Schooling and Vocational Education and Training

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Abstract

Young persons who do not go on to university face two main educational choices; whether to complete Year 12 and/or whether to undertake a vocational (VET) qualification. These two choices are independent. Both early leavers and completers may subsequently obtain a VET qualification. However, the parametric models that are commonly used to analyse the causal effect of education presume that educational attainments form an ordered sequence. This has the effect of restricting the effects of educational attainments on earnings. This paper departs from this restrictive approach. It estimates the effect of Year 12 completion and VET qualifications on early career earnings using both a single and multiple treatment-effect approach. By using matching methods to estimate these effects, it also allows for the effects of educational qualifications differ between persons. It is found that neither completion of Year 12 nor a VET qualification has an effect on early career earnings over and above the forgone experience.

JEL Classification: J310; J240

1. Introduction

During the past decades there has been a strong trend towards increasing educational attainments among young persons. The most significant development has been the increase in the proportion that completes high school and go on to higher education, but there has also been many developments affecting those that do not choose this path. There is now a quite diverse post-school education and training sector that offers a wide range of levels and types of qualifications. In addition, the previously sharp divide between general and vocational education, and between school and work, has diminished with schools expanding their vocational programs and developing closer links to work-based training.

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Acknowledgement: This paper uses data from The Longitudinal Surveys of Australian Youth (LSAY). LSAY tracks young people as they move from school into further study, work and other destinations. It uses large, nationally representative samples of young people to collect information about education and training, work and social development. LSAY is funded by the Australian Government Department of Education, Employment and Workplace Relations (DEEWR), with support from state and territory by governments. The National Centre for Vocational Education Research (NCVER) provide analytical and reporting services for LSAY.

As a consequence of these developments, at the intermediate level there are now many pathways from school to work (McMillan and Marks, 2003). Leaving school early does not imply the end of all forms of education and training. About 40 per cent of early school leavers go on to some kind of post-school education and training. Reflecting the increasing diversity of choices, the public policy debate has moved away from the simplistic notion that increasing the school retention rate is the only answer to the problems young people face. Policy targets are now expressed in terms of the proportion that completes Year 12 or equivalent education and training (Government of Western Australia, 2004). Given this policy focus, the question of interest is the balance between school and other forms of education and training, and the precise forms these two main alternatives should take.

This policy direction implicitly acknowledges that young people differ. Many alternatives are provided because what suits one person is not necessarily a good choice for another person. It recognises that, for example, completing Year 12 may not be the best option for all young people even though those who do so experience a more successful transition. It recognises, in other words, that if the early school leavers had completed Year 12 they might well have experienced a different outcome from those who do complete Year 12. Using the current econometric jargon, the effect of the treatment on the treated may well be different from the effect of the treatment on the non-treated.

The empirical research into the relationship between education and labour market outcomes has paid only limited attention to this diversity. In labour economics, the principal concern has been with the estimation of the causal effect of education on earnings. This research has used restrictive specifications that limit the policy relevance of the findings. Early studies, following the standard Mincer model, forced educational attainments into a 'years of education' variable by translating vocational qualifications into years of education equivalent. More recent studies have used a more flexible specification. However, in part due to data limitations, the fiction that educational attainments can be ordered in an ascending sequence has been maintained.[1] But Year 12 completion and vocational qualifications are overlapping rather than sequential attainments. The failure to recognise this has led researchers to the view that the return to completing Year 12 is quite high compared to the return to vocational qualifications.[2] A related limitation is the almost exclusive focus on the average effect of education for the population as a whole. As a consequence, existing results on the return to Year 12 completion and vocational education and training (VET) qualifications present a confusing picture. Ryan (2002) interprets his results to imply that the return to a Level III VET qualification for those who have completed Year 12 is zero. The same result is obtained in a more explicit form in Leigh (2008). These results imply that a four year apprenticeship, a common way to attain a Level III qualification, is a waste of time.

In contrast to the aggregate measures used by economists, research into the

[1] Most statistical collections undertaken by the Australian Bureau of Statistics only records persons' highest level of qualification. According to that scheme, any post-school qualification is ranked higher than a school qualification.

[2] Much of the early Australian literature is summarised in Preston (1997) while Ryan (2002) provides a more detailed overview of the effects of VET on earnings.

school to work transition has employed much finer measures of education and training choices. Because of this finer detail, this research is more attuned to policy issues and has been very helpful in tracking the relationships between these choices and early labour market outcomes (Lamb, Dwyer and Wyn, 2000; Lamb and McKenzie, 2001; and Marks *et al*., 2000). This research agenda clearly recognises the diversity, and has contributed much to our knowledge of how well a particular alternative works for young persons who choose that alternative. However, describing these relationships does not uncover the causal effects of the choices. Thus this research does not explicitly address the 'what if' question that is of most interest for policy purposes. We know that those who complete Year 12 do fairly well, and better than those that do not, but not whether the early school leavers would have done better had they completed Year 12?

The aim of this paper is to contribute to our understanding of the merits of alternative pathways. More specifically, the paper focuses on the effect Year 12 completion and vocational qualifications on the early career earnings of young persons who do not go on to university. In contrast to previous studies we use the treatment-effect approach that is now commonly applied in the field of policy evaluation. Thus young persons are viewed as obtaining one or both of two treatments - completing Year 12 and a vocational qualification - or no treatment, leaving school before completion. To estimate the effect of these treatments we use the method of matching rather than parametric models to allow for heterogeneous effects, rather than using a parametric model.

2. Trends in School Completion and Labour Market Outcomes

Until the early 1980s leaving school before completing Year 12 was the norm. Using the previously most common measure, the apparent completion rate, in 1982 this rate stood at 36 per cent but by 1992 it had increased to 79 per cent. However, this usual measure may have overstated the completion rate at the time (Ryan and Watson, 2004; Gorgens and Ryan, 2005). Correcting for some of the distortions, it appears that the completion rate reached a peak of just over 70 per cent in 1991 and has remained fairly constant since that time. A more recent measure developed in the National Report on Schooling tells the same story; the completion rate has remained constant at about 70 per cent since 1994. But while the aggregate rate has remained constant, the composition of early leavers and completers has changed. Ability, socio-economic factors and type of school still have an influence on completion, but this influence is less than used to be the case. Also, the early school leavers do not necessarily leave school for negative reasons – not doing well or not liking it. Instead, most leave for work-related reasons – to get a job. A larger gender difference has also emerged with girls now being much more likely to complete Year 12 than boys.

One of the factors that drove the large increase in the completion rate was the state of the youth labour market. During the eighties, full-time jobs for youth decreased dramatically and school leavers faced significant problems in the transition from school to work. There has also been a long run trend towards higher skill requirements. Thus, more young people were not completing Year 12 not just for its own sake, but in order to go on to higher education.

The youth that faced the greatest problems were the early school leavers. As documented in a large body of research, early leavers have experienced a much less successful transition to work compared to those that completed Year 12. They were less likely to engage in post-school education and training, more likely to engage in marginal activities and to experience longer periods of unemployment, and more reliant on income support. Furthermore, those that did find work, obtained jobs in narrow range of lower skilled jobs.

Given the trend in completion rate and experience of the early school leavers during the 1980 and early 90s, it is not surprising that public policy became very supportive of higher rate of school completion. Numerous Government reports endorsed the quest for the universal completion of Year 12 and a number of reforms to the school curricula were made to cater for the broader range of students that were then completing, or expected to complete Year 12. Most researchers were also supportive of this policy direction.

But this quest towards universal completion of Year 12 was not sustained. Contrary to the policy drive and expectations, the completion rate remained relatively constant and the youth labour market improved. In respect of early leavers in the mid-nineties, Marks (2006) noted that many made a relatively successful transition to work. While the relative importance of apprenticeship as the path from school to work for early leavers has declined, other forms of VET have taken its place (Lamb, Dwyer and Wyn, 2000). More recently, traineeships have opened up an additional pathway (Ball and Lamb, 2001). Thus about 40 per cent of early leavers participate in some vocational education and training. In combination with more favourable labour market conditions, this has led to improved outcomes for early leavers. Indeed, the relative fortunes of the early leavers and completers have been partly reversed. Using the same data set as in this paper, McMillan and Marks (2003) report that early school leavers were less likely to be engaged in marginal activities (not working or studying full-time), have a higher wage rate (males only) and higher earnings, after controlling for differences in individual characteristics. Early leavers were also likely to be in a job they would like as a career, more satisfied with their job and in more stable jobs. In fact, the only indicator for which the early leavers displayed a worse outcome was the rate of unemployment.

These early indicators, two years after completing school, in part reflect that early leavers have had more time to complete the school to work transition. As time goes on, the completers may well catch up with and eventually overtake the early leavers. It remains the case, however, that the recent early leavers do much better than they used to. The change in fortune can be illustrated by the earnings of young people according to school completion status. In the late eighties to mid-nineties, the hourly earnings of completers were four to six per cent higher than for the early leavers after controlling for differences in individual characteristics. According to the raw data used here, relating to the period 1999-2004, this situation appears to have been reversed. The weekly full-time earnings of the early leavers exceed those of completers by 10-20 per cent. Moreover, it appears as if the completers are not catching up with the early leavers.

3. Empirical Framework

The relationship between education and earnings has been the most intensively studied issue in labour economics. Most of this research has been concerned with uncovering the causal effect of education and estimated from a sample of persons at different ages using a parametric model. The standard form of that model presumes that different educational attainments can be ordered in an ascending sequence. Most commonly, the level of education is represented by a years of education variable. Alternatively, educational attainment is represented by indicator variables representing the highest level of educational attainment.

But vocational education and training, VET for short, does not form part of an ordered sequence. Completing Year 12 does not preclude a person from obtaining a VET qualification and hence persons with a VET qualification may or may not have completed Year 12. The consequence of this is that to identify the effects of schooling and VET strong restrictions have to be imposed. The years of education specification entails translating VET qualification into years of schooling while the indicator variable specification ranks a VET qualification relative to schooling. Either specification *a priori* restricts the effect of one educational attainment relative to the other.

To avoid such restrictions and to explicitly recognise that completion of Year 12 and a VET qualification are non-sequential, the treatment-effect framework is a more appropriate method. That is, completing Year 12 or a VET qualification is taken to be the treatment and the effect of this treatment on an outcome is compared to the alternative treatment (or non-treatment) of leaving early or not completing a VET qualification. To limit the analysis to schooling and VET, we exclude persons who go on to university from the analysis. Of course, completing Year 12 carries with it the option to go on to university and to complete a degree. As stressed in the recent literature, this option has a value even if not taken up (Keane and Wolpin, 1997; Heckman and Navarro, 2007). However, methods of incorporating an option value in empirical work are very much in their infancy and not pursued in this paper.

In the first instance, we consider the effect of Year 12 completion and obtaining a VET qualification as single and independent treatments. Below we develop this single treatment model with reference to the schooling choice.

For each individual there are two potential outcomes, the person's earnings or hourly rate at some later time. Let Y_i^1 denote the outcome for an individual who has been treated (completed Year 12) and Y_i^0 for a non-treated person (left early). If both Y_i^1 and Y_i^0 were observable then the effect of the treatment would be $Y_i^1 - Y_i^0$. However, the fundamental treatment-effect problem is that for each individual we only observe the outcome associated with the chosen state.

Denoting the chosen state by Y_i

$$Yi = Y_i(D_i) = \begin{array}{ll} Y_i^0 & \text{if } D_i = 0 \\ Y_i^1 & \text{if } D_i = 1 \end{array}$$

where D_i =(0,1) is the indicator of the treatment received.

Given that the individual level effect of treatment is $Y_i^1 - Y_i^0$, the average effect of the treatment for a person drawn at random from the whole population is

$$ATE = E(Y^1-Y^0) = E(Y^1) - E(Y^0)$$

Similarly, we can define the average effect on the treated and non-treated respectively as

$$ATT = E(Y^1-Y^0 \mid D=1) = E(Y^1 \mid D=1) - E(Y^0 \mid D=1)$$
$$ANT = E(Y^1-Y^0 \mid D=0) = E(Y^1 \mid D=0) - E(Y^0 \mid D=0)$$

In general, the second term on the right hand side of these expressions is not observable. In case of ATT, for example, it is what the outcome for the treated would have been had they not been treated. If $E(Y^0 \mid D=1) = E(Y^0 \mid D=0)$ one could use the outcome for the non-treated as an estimate of what the effect on the treated would have been. In general, however, the two expectations differ because the treated and non-treated are selected groups whose outcome would differ even in the absence of any treatment.

Matching is a method for imputing a missing potential outcome to estimate a treatment effect. Essentially, matching mimics an experimental setting by choosing a comparison group from the non-treated that is as similar as possible to the treated in terms of observable characteristics. More specifically, the method of matching solves the problem by postulating that there are a set of observable variables X that satisfy the conditional independence assumption; that conditional on covariates X the potential outcome Y is independent of D (Rubin, 1974). This means that conditional on X, the distribution of outcomes for treated, had they not been treated, is the same as the observed distribution for the non-treated. That is, matching balances the distribution of all X that affect both the choice of treatment and the potential outcomes in the treatment and control group so that

$$E(Y^j \mid X,D=1) = E(Y^j \mid X, D=0) = E(Y^j \mid X) \qquad j=0,1$$

This means that the observed outcome for the non-treated can be used as the counterfactual for the treated (and vice versa).

In addition, for matching to have any empirical content X must not be a perfect predictor of treatment status. This assumption, usually called the common support or overlap assumption, ensures all treated have a counterpart in the non-treated population and vice versa.

Most empirical analysis has been concerned with the ATT; here the average gain to schooling for those who actually undertake it. However, the exclusive focus on ATT may be misplaced. The more relevant parameter may be the ANT, which is informative about the earnings gain of a policy that seeks to induce the early leavers to complete Year 12. These two average treatment effects may differ due to differences in the observable characteristics between the early leavers and completers. Of particular interest is the possibility that the effect of observed ability differ according to completion

status. Given the policy context, one might also argue that the difference between ATT and ANT matters. If ATT is larger than ANT, it implies that those who have more to gain from completing are those who actually do so. If the converse were the case we would have a situation in which young people appear to make the wrong choice.

The conditional independence assumption implies that matched individuals must be identical with respect to all confounding variables X, i.e. with respect to all variables that influenced the selection into treatment and the potential outcomes. This assumption is problematic when estimating the effect of two treatments using a single treatment framework. The reason is that the potential outcomes of one treatment may be affected by the other treatment. However, X should not include variables that are themselves affected by the treatment. Conditioning on such variables would block the causal effect that acts through these variables. When estimating the effect of schooling it can be argued that whether or not a person chooses to do VET after leaving school is endogenous in this sense. That is, persons do not make a once in a life time choice of their educational pathway but, having left school, they then decide whether or not to do VET partly based on the observed outcomes. If that is the case the fact that the observed outcomes might be affected by VET does not invalidate the conditional independence assumption. When estimating the effect of VET, however, the effect of the prior treatment, schooling, on the potential outcomes is not endogenous. Thus, when estimating the effect of VET we include schooling status among the confounding variables. If the matching were exact, this means that treated are only compared to non-treated with the same level of schooling.

To implement a matching estimator we use the most common method of the propensity score. The propensity score is the probability of receiving treatment given the set of covariates that affect the treatment status and outcome. Rosenbaum and Rubin (1983) show that treated and non-treated observations with the same value of the propensity score have the same distribution as the full vector of covariates and the conditional independence assumption remain valid if the propensity score – a single variable – is used for matching instead of the complete set of variables. The propensity score is estimated as the prediction from a bivariate probit model.

Multiple Treatments

We now explicitly recognise that young persons can undertake one or both of two treatments – completing Year 12 and undertaking a VET qualification. If the treatment status in the two treatments are denoted by S and V respectively, S,V={0,1) there are four distinct combinations of the overall treatment status. These four combinations can be compressed into single status variable D taking four different values. Using the superscripts 0, v and s to denote the cases of no treatment, Year 12 completion and a VET qualification respectively we have the following four mutually exclusive cases

$$D = \begin{cases} (0,0) \text{ the no treatment case} \\ (s,0) \text{ completed Year 12 but no VET qualification} \\ (0,v) \text{ left school early and obtained a VET qualification} \\ (s,v) \text{ completed Year 12 and obtained a VET qualification} \end{cases}$$

Using m and l as running indices for the four cases, i.e. m,l=(0,0),(s,0), (0,v), (s,v) we denote the potential outcomes by $Y^{m,l}$. The expected average effect of treatment m relative to treatment l for a person drawn randomly from the whole population is then defined by

$$ATE^{m,l} = E(Y^m - Y^l) = E(Y^m) - E(Y^l)$$

In the single treatment case we considered the possibility that the treatment effect might differ between the treated and untreated. Hence we defined and estimated the average effect for both groups. In the event this distinction did not seem empirically important. Furthermore, maintaining this distinction here would be confusing since with more than one treatment there are a large number of potential treatment effects and sub-populations for which to estimate these effects.

Here we focus on the average treatment effect of treatment m relative to treatment l for those participating in m

$$ATT(m)^{m,l} = E(Y^m - Y^l \mid D=m) = E(Y^m \mid D=m) - E(Y^l \mid D=m)$$

on the grounds that this effect corresponds more closely to the effects in the single treatment case. An alternative would be to estimate this same effect for those participating in either treatment m or treatment l.

The identification conditions for mutually exclusive multiple treatments are developed in Lechner (2001, 2002) and have been extended to sequential multiple treatments in Lechner and Miguel (2001) and Blundell, Dearden and Sianesi (2003). In our case the two treatments are neither exclusive nor sequential; a person can take one or both of the treatments and neither treatment is a pre-requisite for the other. However, by recasting the two binary treatments into the three mutually exclusive categories (s,0), (0,v), (s,v) the Lechner framework applies. In the single treatment case the conditional independence assumption implies that matched individuals must be identical with respect to all confounding variables X, i.e. with respect to all variables that influenced the selection into treatment and the potential outcomes. With multiple treatments, however, a stronger assumption is required; that the assignment to the second treatment is independent of the potential outcome of the first treatment (Lechner and Miguel, 2001). This assumption rules out persons leaving school to see what happens, and then after observing the outcome, deciding whether to do a VET qualification. In the literature that focuses on the rate of return to education the common approach has been to abstract from this possibility. In the standard Mincer model educational decisions are made once in a lifetime; it is implicitly assumed that no new information is received and acted upon during a person's post-compulsory educational career. Likewise, most empirical work using a matching framework either circumvent the problem by estimating the effect of the first treatment or by explicitly ruling out any influence of intermediate outcomes (Blundell, Dearden and Sianesi, 2003). An exception is Lechner and Wiehler (2007) who take account of this sequential nature by allowing intermediate outcomes to play a role in the assignment to treatment.

It is difficult to argue that intermediate outcomes play no role in the VET decision. What can be argued is that the dependence may be weak, and is not easily captured by observable variables. In the case at hand, whether a school leaver gets

a job shortly after leaving is a potential intermediate outcome is likely to influence the decisions to complete a VET qualification. But the direction of that influence is ambiguous. To complete a Level III qualification via an apprenticeship, a person has, in most cases, been employed for the past four years. That is, there is a positive association between job history and VET completion. In other cases, young persons never enrol in, or fail to complete, a VET qualification because they have a stable job. Here the argument is that there is little to gain by a VET qualification if you already have a good job. But the youth 'at risk' concept that has figured so prominently in the Australian policy debates suggests that job status has the opposite effect. Youth at risk are commonly defined as persons aged 15-19 who have left school but are not in full-time education and not in full-time employment. They are perceived to be at risk because their inactivity is believed to be detrimental to their future labour success, and by implication, to make them less likely to undertake a VET qualification.

This discussion suggests that intermediate outcomes are unlikely to have a systematic influence on assignment to the second treatment (VET). Hence, conditioning on the covariates that jointly determine the assignment to treatment and outcomes is sufficient to identify the treatment effects. Given this assumption information from the subsample of participants in m and l is sufficient to identify the ATT, the propensity score can be estimated from a binary probability model applied to each subsample.

4. Data

In this paper we use the data from the Longitudinal Survey of Australian Youth (LSAY). This is a series of panel surveys that follow the transition of young persons from school to work. Here we use the 1995 Year 9 panel that was first surveyed in 1995 when students were in Year 9, the year when most turned 14 years. Since then the panel has been surveyed every year until 2006. About 15 per cent left school in years 10 and 11 while most of those that stayed on completed Year 12 in 1998. The transition from school to work as revealed by this data set have been analysed in great detail in a series of publications (see, Hillman, 2004 for a summary). Persons who intend to go to university must first complete Year 12 and have, generally speaking, little to gain by doing a VET qualification. Thus, the analysis is restricted to the non-university bound persons who have a real choice between the more academic path, completing Year 12, and the VET alternative.

The two limitations of the data are that only the early labour market outcomes can be observed and the attrition in a panel data set. As regards the first limitation, it means that we can only estimate the early career effect of completing Year 12 and/or a VET qualification. In contrast, most empirical studies of education and earnings use a cross-section sample that contains persons of all ages. However, to estimate a causal effect, it is essential to use a rich data set that contains most of the variables that determine both schooling choices and outcomes. The crucial variables are measures of ability and socio-economic characteristics that affect decisions about schooling and VET. Such variables are typically absent from cross-section samples of persons of all ages. Attrition poses additional problems. In a panel of young persons, attrition is substantial. By the time we first observe completers at work (Wave 5 at age 18), about one third of the original sample has dropped out from the panel. As we follow their

progress during the next five years until 2004 (Wave 10 at age 23), a further one third of the original sample drop out.[3]

Two indicators of outcomes are used; the weekly earnings for those in full-time work and the hourly earnings of all persons with a positive earnings. When estimating the effect of Year 12 completion we estimate the effect on outcomes separately for each of the six post-school years for which we have data (Waves 6-10). In the case of VET qualifications, which typically are obtained at a later age, we estimate the effect on the outcomes in Waves 7 to 10. This means that the data for each wave are treated as independent cross-sections.

5. Empirical Results

The estimation of treatment effects by matching methods is a non-standard process. The four most common methods are stratification, nearest neighbour, radius and kernel matching. In turn, each of these methods can be implemented in several different ways. There is, however, little to guide the selection of a particular method for a specific application. In applied work therefore it is common to select one method on *a priori* grounds and, if deemed necessary, to investigate how robust the estimates are if one or more of the other methods are used.

Critical to the matching strategy is the conditional independence assumption. The satisfaction of this assumption depends of including all the variables that influence both the assignment to treatment and the outcomes in the estimation of the propensity score. The selection of variables was guided by the extensive analysis of the data set undertaken by educational researchers (Marks and Fleming, 1999; Marks *et al*. 2000; Ball and Lamb, 2001; Lamb and McKenzie, 2001; and Marks, 2006). This analysis has narrowed down a potentially very large number of factors to a relatively small set of variables; ability, language/ethnical background, socio-economic characteristics and the type of area in which students live. Type of school has also been found to exert an important influence on educational choices. However, this variable is not available in the public use data set.

The influence of these set of variables on the educational decisions are also well known from previous analysis of the data. Thus the propensity score estimates imply that the probability of completing Year 12 is increasing in ability and socio-economic status. Of these, the self-assessed ability has the largest positive influence on the probability of completing Year 12. However, as has been noted in recent research, completers and early leavers are now more similar than they were in the past. This makes matching a more attractive estimator as it is possible to find good matches even for those in the tails of the propensity score distribution. Generally speaking the covariates have the opposite effect on the probability of a VET qualification. Self-assessed ability plays no role and persons with high achievement scores and high socio-economic status are less likely to undertake a VET qualification.

Given the estimated propensity scores, the treated were matched with controls

[3] The analysis of attrition in the LSAY data have shown that while some factors are more strongly associated with attrition than others, they share a common factor: lower scores on the achievement tests taken in Year 9. Consequently the recommended LSAY attrition weights, to be used to obtain population estimates, are based on only sex and achievement scores. Thus it is claimed that the LSAY samples are robust and retain strong statistical properties, even down to 25 per cent of the original sample (Rothman, 2009). These remarks apply to ignorable attrition. Nothing is known about the extent to which non-ignorable attrition in the LSAY may bias estimates.

using the three closest neighbours with replacement.[4] The most obvious drawback with this method is that the closest neighbour might not be very close. As noted above, however, this did not seem to be a major concern. Furthermore, there was no need to impose a common support as this requirement was automatically satisfied by the matching process. Although the treated and non-treated groups differ in many respects, they are not so different that close matches cannot be found. The relative sizes of the two groups (there are three times as many treated as non-treated) means that it is more difficult to find good matches for the treated. To achieve a well balanced comparison to estimate the ATT, a few of the non-treated observations were used very frequently. While this results in a good balance, and hence low bias, the drawback is that the estimates have a larger variance.

Since propensity score matching does not condition on all the covariates, it is appropriate to check if the matching procedure balances the distribution of all the variables in the treated and control groups. One common indicator is the standardised bias before and after matching suggested by Rosenbaum and Rubin (1985). For each covariate the standardised bias is defined as the difference in sample means between the treated and matched control groups as a percentage of the square root of the average variance of the two groups. The reduction in the standardised bias gives an indication of the extent to which matching improves the balance, and the remaining bias is an indication of the degree to which balance has been achieved. For both treatments, completion of Year 12 and VET, the remaining bias is less than 3 per cent for most of the variables. Rather than reporting the bias for each covariate, the distribution of the remaining bias provides a more concise measure of the balance. However, with a total of 20 matching procedures, even a concise measure of matching quality entails large amount of detail. Table 1 gives the figures for one case only (Males in Wave 7). These figures can be taken as illustrative of the other cases even though the precise details differ from case to case.

Table 1 - Summary of the Distribution of the Standardised Absolute Bias Before and After Matching (Wave 7)

Treatment	*Quartile*	*Before Matching*	*After Matching*
Males			
Year 12 completion	25%	9.02	0.28
	50%	14.80	1.41
	75%	35.22	4.22
VET qualification	25%	4.13	1.57
	50%	11.07	2.49
	75%	16.90	4.31
Females			
Year 12 completion	25%	11.55	0.21
	50%	18.35	1.03
	75%	40.05	3.85
VET qualification	25%	7.45	1.84
	50%	15.24	3.05
	75%	23.62	4.50

[4] To estimate the effects we used the STATA code written by Abadie *et al*. (2001).

The propensity score does a better job of balancing the treated and controls for the schooling decision. This is not surprising. The large variety of VET qualifications means that the separate influence of the covariates tends to be obscured. The factors that influence undertaking a low level qualification may be different from the factors that drive the decision to undertake a higher level qualification. It is still the case, however, that the even for VET the remaining bias is still within an acceptable limit for most of the covariates.[5]

Another test of balance is to compare the fit of the propensity score model before and after matching (Sianesi, 2004). In table 2 the pseudo-R^2 before matching indicates how well the covariates explain the treatment probabilities. When the propensity score model is re-estimated from the matched samples, the pseudo-R^2 is much lower as most of the systematic differences in the covariates of the two groups have been removed by matching. More formally, before matching the covariates are jointly significant, but when re-estimated using only the matched controls the likelihood tests reject their joint significance.

Table 2 - Fit and Joint Significance of Covariates in the Estimation of the Propensity Score Before and After Matching (Males, Wave 7)

Treatment	*Sample*	*Pseudo R^2*	*Likelihood Ratio (Chi^2 (24))*	*P>Chi^2*
Males				
Year 12	Before matching	0.148	91.3	0.000
	Matched	0.021	15.8	0.895
VET	Before matching	0.095	69.7	0.000
	Matched	0.031	27.9	0.264
Females				
Year 12	Before matching	0.182	121.2	0.000
	Matched	0.015	11.5	0.985
VET	Before matching	0.110	60.3	0.000
	Matched	0.030	25.2	0.395

Notes: The last column gives the p-value of the likelihood ratio test of the hypothesis that the covariates are jointly insignificant, i.e. well balanced in the treated and control groups.

The results for the single treatment models are given in table 3. The first column gives the raw difference in earnings between Year 12 completers and non-completers followed by the estimated treatment effects: the average effect of the treatment on the treated (ATT) and the average effect on the non-treated (ATU).

In the case of males working full-time, we find that the weekly earnings of completers is generally less than that of the early leavers but the difference declines as the persons get older. The estimates of the ATT suggest that most of this difference is a causal effect. That is, the effect of completing Year 12 for those who complete is to decrease full-time earnings. As indicated by the generally larger estimates of the ATU's the early leavers would have suffered an even greater loss of earnings had they completed Year 12. However, it would be wrong to claim that the heterogeneity of the treatment effect is an important issue in view of the small differences between the ATT and ATU.

[5] Caliendo and Kopeinig (2005) suggest that a standardised bias below 3 or 5 per cent is regarded as sufficient.

This negative effect of Year 12 completion is mainly due to the longer hours of early leavers in full-time jobs. Thus, looking at the hourly earnings of all males in jobs we find much smaller differences between the completers and early leavers. Taking the results as a whole the estimated ATT's are close to zero, meaning that there is no effect on hourly earnings for completers. As above, however, there is weak evidence that the early leavers would have done worse than completers had they completed Year 12 in that the estimated ATU's are generally smaller than the ATT's.

Table 3 - Estimates of the Effect of Completing Year 12; Single Treatment Model

Males: Log weekly earnings (full-time only)			
	Unmatched	*Matched*	
Wave		*ATT*	*ATU*
5	-0.002	0.038	0.003
6	-0.137*	-0.099*	-0.161*
7	-0.099*	-0.093*	-0.157*
8	-0.113*	-0.131*	-0.150*
9	-0.069*	-0.074*	-0.069*
10	-0.035	-0.025	-0.043
Males: Log hourly earnings (all persons with positive earnings)			
	Unmatched	*Matched*	
Wave		*ATT*	*ATU*
5	0.102*	0.094*	0.059*
6	-0028	-0.042	-0.088*
7	-0.017	0.022	-.092
8	-0.041	-0.068	-0.065
9	-0.024	-0.034	-0.052
10	0.009	0.065	-0.065
Females: Log weekly earnings (full-time only)			
	Unmatched	*Matched*	
Wave		*ATT*	*ATU*
5	-0.026	-0.059	0.022
6	-0.045*	-0.057*	-0.046
7	0.020	0.002	0.002
8	0.007	0.045	-0.025
9	0.064	0.103	0.044
10	-0.017	-0.058	-0.045
Females: Log hourly earnings			
	Unmatched	*Matched*	
Wave		*ATT*	*ATU*
5	0.046*	0.007	0.032
6	-0.029	-0.025	-0.059
7	0.027	-0.000	0.045
8	0.065*	0.080	0.031
9	0.055	0.096	0.009
10	-0.045	-0.060	-0.051

Note: An asterisk (*) indicates that the estimate is significantly different from zero at the five per cent level.

For females, the results are less clear cut as the magnitude of the differences are smaller and more variable across the waves of the survey. The results for Waves 8 and 9 in particular are very different from the remaining waves. Since most persons in successive waves are the same, the differences across waves must be due to variations in individual relative earnings over time. Taking the results as a whole would suggest that completing Year 12 has an uncertain effect on either weekly (for those working full-time) or hourly earnings. This applies to completers and early leavers alike, but the variability of the estimates means that it is also unclear whether early leavers have any more or less to gain from completing than completers do.

A negative or zero treatment effect does not mean that completion of Year 12 has no effect on earnings. In contrast to the Mincer type model that holds potential experience (or observed experience) constant, the effect of completing Year 12 is here compared with the non-treatment outcome. This typically entails additional work experience; while the completers are in school most of the early leavers gain experience in a job. A zero treatment effect simply means that the time spent in school and at work have the same effect on earnings. Thus the results are quite consistent with most other studies (see, for example, Leigh, 2008) that have found that completion of Year 12 increases earnings by about 10 per cent (holding experience constant). Likewise, the negative treatment effect found for the weekly earnings of full-time males is not implausible but mainly reflects that the early leavers tend to work in jobs with longer hours.

Given these findings, it should not come as a surprise to find that there is no evidence of any earnings gain from a VET qualification either. The results in table 4 show that both the unmatched and matched differences are very small. In other words, like schooling, a VET qualification has no real effect on early career earnings. As above, this finding should of course be qualified by the large variability of earnings that preclude strong results. The standard errors of the estimated effect are of the order of 0.03 meaning that none of the estimates are significantly different from zero. Abstracting from the imprecision in the estimates we note that for males the estimated ATT is always positive in contrast to be mainly negative effect of schooling. Another feature of the results for males is that the estimated effect becomes smaller in successive waves (as persons get older). This is contrary to what we would expect; the more educated ought to experience a faster growth of earnings than the less educated.

In passing we also note that the selection into VET is not as strongly related to socio-economic and ability factors as was the case for schooling. However, one variable, the completion of Year 12, has a strong effect of the probability of undertaking a VET qualification but only for the early waves (Waves 7 and 8). This merely reflects that only early leavers would have had the time to complete a VET qualification by that time. The covariates have little effect on earnings, however, as is evident from the small differences between the unmatched and matched differences.

Table 4 - Estimates of the Effect of Undertaking a VET Qualification; Single Treatment Model

Males: Log weekly earnings (full-time only)			
	Unmatched	*Matched*	
Wave		*ATT*	*ATU*
7	0.068	0.043	0.041
8	0.029	0.019	0.013
9	0.021	0.021	0.017
10	-0.017	0.002	-0.005
Males: Log hourly earnings (all persons with positive earnings)			
	Unmatched	*Matched*	
Wave		*ATT*	*ATU*
7	0.039	0.052	0.038
8	0.034	0.035	0.048
9	0.026	0.044	0.029
10	0.009	0.015	0.010
Females: Log weekly earnings (full-time only)			
	Unmatched	*Matched*	
Wave		*ATT*	*ATU*
7	0.043	-0.022	-0.058
8	0.009	-0.006	0.010
9	-0.070	-0.053	-0.104
10	-0.014	0.020	0.030
Females: Log hourly earnings			
	Unmatched	*Matched*	
Wave		*ATT*	*ATU*
7	-0.023	-0.019	-0.016
8	0.014	0.032	0.039
9	-0.025	0.006	-0.038
10	-0.015	-0.000	-0.013

The results for the multiple treatment case are given in table 5. The completers are split into two sub-populations, (s,0) and (s,v) depending on whether they have done a VET qualification or not. Similarly, the VET graduates are split into two categories (0,v) and (s,v) depending on whether they completed Year 12 or not. A particular figure in the table represents the estimate of the average effect of treatment m relative to treatment l for those treated with either m or l. Conceptually, the average effects are the same as in tables 1 and 2, it is only the subpopulations to which they apply that differ. The above diagonal estimates, the effects of l relative to m, have been omitted to limit the amount of detail. It should be noted that the effects of treatments m and l are not symmetric since they pertain to different subpopulations of the treated.

Table 5 - Estimates of the Average Treatment Effects of the Treated for Treatment m Relative to Treatment l ($ATT^{m,l}$); Wave 10 Outcomes Only

Males: Log Weekly Earnings				
	Treatment l			
Treatment m	*(0,0)*	*(s,0)*	*(0,v)*	*(s,v)*
(0,0)	-			
(s,0)	-0.044	-		
(0,v)	0.005	0.076	-	
(s,v)	-0.104	-0.004	-0.071	-
Males: Log Hourly Earnings				
	Treatment l			
Treatment m	*(0,0)*	*(s,0)*	*(0,v)*	*(s,v)*
(0,0)	-			
(s,0)	0.028	-		
(0,v)	0.025	0.050	-	
(s,v)	0.032	-0.004	0.065	-
Females: Log Weekly Earnings				
	Treatment l			
Treatment m	*(0,0)*	*(s,0)*	*(0,v)*	*(s,v)*
(0,0)	-			
(s,0)	-0.008	-		
(0,v)	-0.032	0.036	-	
(s,v)	-0.032	0.065	-0.076	-
Females: Log Hourly Earnings				
	Treatment l			
Treatment m	*(0,0)*	*(s,0)*	*(0,v)*	*(s,v)*
(0,0)	-			
(s,0)	-0.074	-		
(0,v)	-0.024	0.019	-	
(s,v)	-0.090	-0.013	0.030	-

Table 5 reports the estimates for Wave 10 outcomes only as using the outcome from earlier waves give similar results. The first column contains the estimates of the effect of the three treatment combinations relative to no treatment (leaving school early). The first part of the table (weekly earnings for fulltime males) we see that both (s,0), completing Year 12 but not doing a VET, and (s,v), competing Year 12 and doing a VET results in lower earnings. A VET qualification alone, however, has a negligible effect. Thus these estimates suggest that it is Y12 completion that lowers earnings while VET does not have much of an effect. This interpretation is complicated by the fact that the estimates pertain to three different sub-populations but is confirmed by holding the treated population constant at (s,v) in the last row. The comparison with (s,0) reveals that the VET qualification has almost no effect on earnings (-0.004) while the comparison with (0,v) indicates that it is the Year 12 completion that leads to lower earnings.

Comparing these results with the single treatment estimates in tables 3 and 4 clearly illustrates how sensitive the estimates are to which sub-population they apply. Thus in table 3, the effect of Year 12 completion on full time earnings for males in Wave 10 was estimated at -0.025. In table 5 above, the corresponding estimates are

-0.044 (for (s,0)) and -0.104 (for (s,v)) relative to (0,0). The expectation, that the former is a weighted average of the latter two, is not quite borne out by the figures. This is because the estimated propensity score, and hence the choice of matches, also vary with the respective sub-populations.

Since the sample sizes in table 5 are much smaller than in tables 3 and 4, the standard errors are corresponding larger (of the order of 0.06). Thus none of the estimates are significantly different from zero. In other words, the hypothesis that any one treatment has a different effect from any other treatment cannot be rejected - completing Year 12 and/or a VET qualification has no effect on the earnings of young persons. Nevertheless, there are two features of the table 5 as a whole that suggest that there is more to be gained from VET than complete Year 12. The first is that completing Year 12 (s,0) lowers earnings compared to leaving early (0,0) (except the hourly rate for males). The second feature is that the effect of VET relative to schooling, that is (0,v) relative to (s,0), are all positive. On the other hand, looking at those who complete Year 12 and do VET,(s,v), versus VET only, (0,v), the evidence is more mixed in the sense that schooling now is estimated to decrease full-time earnings but increase the hourly rate. In view of the large standard errors we do not comment on the further detail in the table except to note that all the estimates are small. Hence, the statistical significance aside, no treatment has a large effect relative to another treatment. As before, the important proviso is that this applies to young persons only.

6. Life-cycle Earnings and the Return to Education

A limitation of the data used in this paper is that young persons are only followed until their mid-twenties. Hence the findings have nothing to say about the longer term effects of schooling of VET. In contrast, most of the evidence about the relationship between education and earnings come from cross section data sets that contain information about persons of all ages from which the longer term effects can be ascertained. Almost all the evidence from studies using such data sets indicates a quite large effect of education on earnings. In contrast, during the early career we found no evidence that education increases earnings any more than potential work experience.

To account for this apparent difference, we first note that the raw data on earnings from a longitudinal survey of school cohort are broadly compatible with earnings in other data sets. Figures 1 and 2 plot the smoothed age-earnings profiles according to school completion and VET qualification using data from HILDA. According to these profiles, there is no real difference in earnings between persons of the same age but with different educational attainments until the mid- or late twenties. Thereafter, however, the profiles separate and those with more education earn significantly more than those with less education. This suggests that the findings in this paper are not a result of the data being markedly different from that in other data sets.

Figure 1 - Age-earnings Profiles by Year 12 Completion

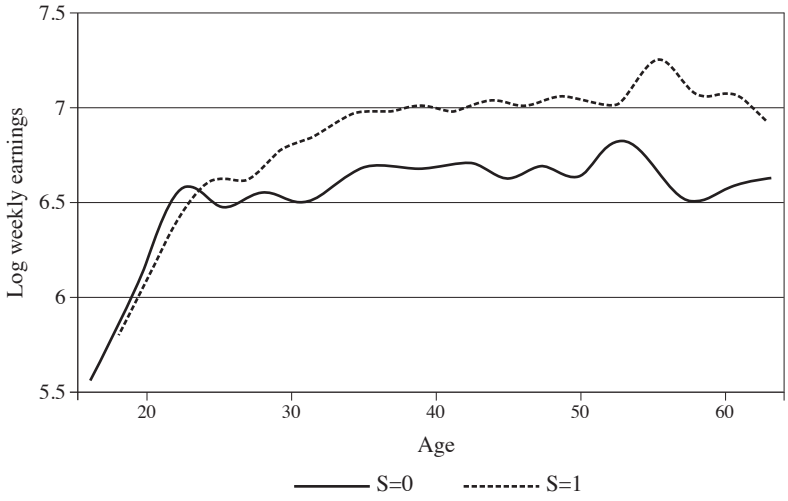
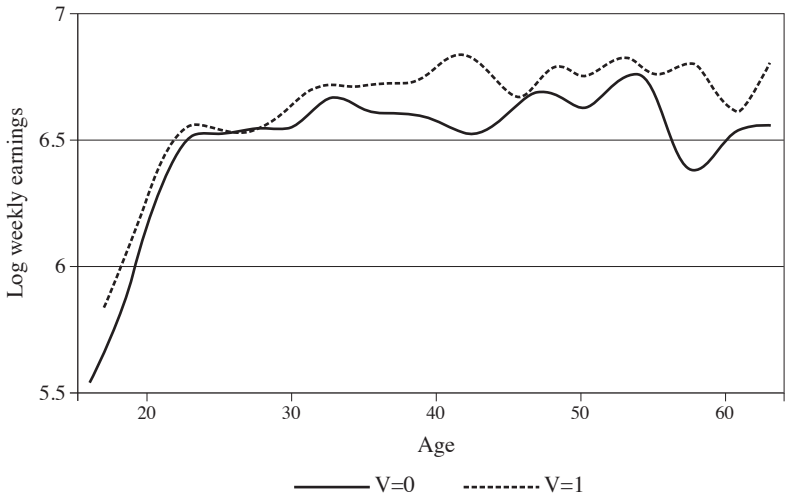


Figure 2 - Age-earnings profiles by VET qualification



Source: Household, Income and Labour Dynamics in Australia (HILDA) Survey. The graphs plot the median average weekly earnings for males who have not obtained a university degree using the data from Wave 1 of the survey. The plot is smoothed by a cubic spline function.

The difference is that fitting a parametric model of the Mincer type to data on persons of all ages (as in figures 1 and 2) would reveal a significant and positive return to both school completion and VET, and education in general. This is borne out by a large number of studies that estimate a return of about 10 per cent to school

completion and VET. This result is more clear cut if, as is commonly the case, the sample is restricted to persons who are 25 years and above. But fitting the same model to a sample of young persons gives quite different results. Thus Rummery, Vella and Verbeek (1999) find that the estimates of the effect of a year of education is about the same as a year of experience, i.e. the earnings of young persons of the same age do not differ much according to the level of education.

There are two problems with this result. The first is that the theoretical explanation is problematic. Human capital theory explains the age-earnings profile as being the outcome of two factors; investments in education prior to entering the job market and investments in on-the-job training while at work. Both have an instantaneous effect on potential earnings but the effect on observed earnings is muted. Potential and actual earnings differ because some proportion of potential earnings is foregone to pay for the investments in on-the job training. If we take it that the rate of return on both types of investments are the same, the problem is that the identical early career profiles could only come about if the initial proportion of potential earnings that is invested is close to one. This is implausible. Similarly, the separation of the profiles in the early thirties could only be a result those with more education having a different investment profile than those with less education. Although this has been explored in the literature, starting with Mincer (1974), it not clear what the theoretical explanation might be.[6] The second problem is that parametric models fitted to older persons only, or to persons of all ages, do not account for the age-earnings profile of young persons. Such models hide that the return to education is a long time coming and may give an exaggerated impression of the benefits of education.[7]

7. Conclusions

Young persons who do not go on to university can now choose a variety of pathways. To contribute towards an understanding of their relative merits, this paper has estimated the effects Year 12 completion and vocational qualifications on the early career earnings of young persons. In contrast to previous studies, we use the treatment-effect approach that is now commonly applied in the field of policy evaluation. Young persons are viewed as obtaining one or both of two treatments – completing Year 12 and/or obtaining a vocational qualification – or no treatment, leaving school before completion. To estimate the effect of these treatments, we use the method of matching rather than parametric models that allows for heterogeneous effects in a more natural way.

Whether we treat schooling and VET as single independent treatments or combinations of multiple treatments we find no significant effect on early career earnings from competing Year 12 or a VET qualification. Considering the point estimates only, the findings suggest that males have more to gain from a VET qualification than Year 12 completion. For females, however, the evidence is less consistent and permits no specific interpretation. It was also found that while ability and socio-economic factors have a strong impact on the choice of pathway, and completing Year 12 in particular,

[6] The exhaustive study of the specification of the age-earnings profile in Australia, Borland and Suen (1994), notes that the preferred parametric specification might vary across schooling groups. However, this study is exclusively concerned with the effect of experience alone - not how education and experience interact to result in a certain level of earnings.

[7] In Leigh and Ryan (2008) the estimates of the age-experience profile estimated from a sample of 25-64 year old is extrapolated to 15-24 year olds resulting in a massive (20 per cent) internal rate of return to one additional year of schooling.

the early career earnings are largely independent of these factors. Age aside, how much young people earn seems to be a matter of luck.

These findings do not deny that there is a significant return to education, be that in the form of schooling or VET, as documented in a large literature. Rather the main implication is that the return is a long time coming. This is difficult to reconcile with the theory of human capital on which parametric models are based and cautions against drawing strong policy conclusions from models that are not compatible with all facets of the data. By the same token, the weak and partial findings in this paper also preclude strong policy conclusions. The current policy stance, which provides a variety of pathways but encourages young persons to complete Year 12 or its VET equivalent appears to have the balance right. It is cognisant of the longer term benefits of education but recognises that these benefits can be obtained in more than one way.

Appendix

The Longitudinal Surveys of Australian Youth

This survey follows the experience of young persons as they move from school into post-secondary education, training and work. The survey is currently managed by the National Centre for Vocational Education and Research.

This paper uses the data from the Year 9 1995 cohort who were first surveyed when they were in Year 9 in 1995 and have then been followed via yearly surveys until 2006.The data are described in a series of Technical Reports and have been extensively analysed by educational researchers in a series of Research Reports. Pennman (2004) provides an overview of the findings from of a total of 36 such reports.

The set of variables included in the analysis and their measurement follows closely previous analyses.

Outcome Indicators

Earnings. Each wave of the survey collected current earnings from all jobs and number of hours worked. Two measures were derived from this information; weekly income and hourly earnings.

Treatment Indicators

School completions status. Completers of a Year 12 are defined as persons who commenced Year 12 and remained in school until at least August that year. An extensive explanation for why this definition is preferable to alternative definitions can be found in a number of LSAY Research Reports including Marks (2006).

VET qualification status. Persons are defined as having a VET qualification if they in the current or a previous wave of the survey indicated that they had completed one or more designated qualifications.

Covariates Used in the Analysis

Literacy and numeracy achievement in Year 9 was measured by a person's score on a standard test administered by the Australian Council for Education Research. The raw score is a number in the range 0 (lowest) to 20 (highest). In the analysis persons were grouped as falling within

Self-conception of ability in maths and English is based the students own rating of their capabilities in maths and English measured on an eight point scale.

Parental occupation is classified into four groups; professional/managerial, clerical/sales/personal service; skilled manual and semi/unskilled manual.

Parental education was classified into three levels based on the highest qualification attained; higher education, other post-secondary qualification and secondary school or less.

Indigenous status. Persons who classified themselves being of Aboriginal or Torres Islander decent.

Language used at home classified as being English or other language.

Parents' country of birth. Father's country of birth being Australia, other English speaking countries and non-English speaking countries.

Region. Classified into three categories; metropolitan, regional and rural/remote, based on the number of people in the locality of the persons place of residence.

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