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Returns to Education in Australia

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Abstract

Using data from the 2001-2005 waves of the Household, Income and Labour Dynamics in Australia survey, and taking account of existing estimates of ability bias and social returns to schooling, I estimate the economic return to various levels of education. Raising high school attainment appears to yield the highest annual benefits, with per-year gains as high as 30 percent (depending on the adjustment for ability bias). Some forms of vocational training also appear to boost earnings, with significant gains from Certificate Level III/IV qualifications (for high school dropouts only), and from Diploma and Advanced Diploma qualifications. At the university level, Bachelor degrees and postgraduate qualifications are associated with significantly higher earnings, with each year of a Bachelor degree raising annual earnings by about 15 percent. For high school, slightly less than half the gains are due to increased productivity, with the rest due to higher levels of participation. For vocational training, about one-third of the gains are from productivity, and two-thirds from greater participation. For university, most of the gains are from productivity. I find some evidence that the productivity benefits of education are higher towards the top of the distribution, but the participation effects are higher towards the bottom of the conditional earnings distribution.

Keywords: Returns to education, ability bias, high school, vocational training, university

JEL Codes: I28, J31

1 Introduction

The effect of human capital on income is an issue of central importance to economists and public policymakers alike. Comparing income differentials within countries, labour economists have generally found that better-educated workers earn higher wages and are more likely to participate in the labour force, while comparisons across countries have tended to yield the conclusion that raising levels of schooling will increase national incomes. From a policy perspective, the challenge is to determine how best to allocate scarce resources across types of education. Will the benefit of a marginal dollar be higher if it is invested in schools, technical education or universities?

Empirically, a significant challenge in estimating the returns to education is to take account of ability bias. If higher ability workers undertake more formal education, then the observed correlation between education and earnings may not be an accurate reflection of the causal impact of education on earnings. Another factor affecting estimates of the returns to education is the potential divergence between private and social returns to education. If education has substantial positive externalities, then the social benefits of higher education may be larger than the sum of the private benefits. Since policies should be based upon estimates of the social benefits of education taking account of externalities and social costs is potentially an important exercise.

This paper draws upon recent research on ability bias and the social rate of return, and uses these to inform estimates of returns to particular educational qualifications in Australia. However, a drawback of the ability bias and social returns literatures is that they typically do not estimate returns across a variety of educational qualifications. To address this limitation, I therefore estimate returns to a variety of specific educational attainments – years of schooling, trade qualifications, and university qualifications. If the extent of ability bias does not differ significantly across educational qualifications, the ability bias estimates in natural experiment studies can be used to adjust the returns to all educational qualifications.

This paper is structured as follows. Section 2 discusses Australian and international evidence on ability bias. Section 3 discusses estimates of the gap between private and social returns to education. Section 4 estimates the relationship between earning and the educational attainment, and the final section concludes.

2 Ability Bias

Researchers have long recognised that those who undertake more education may possess traits that would have led them to perform better in the labour market, even in the absence of obtaining higher levels of education. For example, individuals with better innate cognitive skills may find education easier, and therefore be more likely to complete school or undertake post-school qualifications. Assuming that workers with higher cognitive skills earn higher wages regardless of their level of education, the observed correlation between education and income will reflect both education and cognitive ability. Of course, the relationship could also go the other way. For example, since the cost of schooling will be higher to those with better outside opportunities, it is possible that lower-ability people may be more likely to undertake formal education.

To deal with this problem, some economists have sought to exploit natural experiments. The three most commonly used strategies are comparisons between identical twins, comparisons between individuals born at different times of the year, and regional variation in compulsory schooling laws. It is useful to discuss each in turn.

Twin-pair comparisons operate on the assumption that both twins have the same level of ability, and differ only in their education. Since twins were born on the same day, raised in the same household, and have similar genes (or identical genes, in the case of monozygotic twins), researchers assume that they would otherwise have the same labour market outcomes, were it not for the fact that one obtained more education than the other. Important studies of the return to education using US twins include Ashenfelter and Krueger (1994), Ashenfelter and Rouse (1998), and Behrman, Rosenzweig and Taubman (1994). This approach has also been implemented in other countries, including Australia (Miller, Mulvey and Martin, 1995, 2006), China (Zhang, Liu and Yung, 2007), Sweden (Isacsson, 1999) and the United Kingdom (Bonjour et al., 2003). In the Australian context, Miller, Mulvey and Martin (2006) estimate returns to education using twins studies that suggest upwards ability bias in the order of 10-28 percent. This is similar to the findings of Card (1999), who reviews US studies that estimate returns to education using twin-pair comparisons, and concludes that upwards ability bias is in the order of 10 percent.

A second approach to addressing the ability bias problem is to compare individuals born at different times of the year. Imagine two students: student A is born on the eligibility date for school entry, and student B is born one day after the eligibility date for school entry. Because of the discontinuous operation of the entry rules, student A will start school one year earlier than student B – despite being only one day older. If both students leave school as soon as they reach the school leaving age, student A will have one year minus one day more schooling than student B. Using birth date as an instrument for schooling was first implemented in Angrist and Krueger (1991), whose instrumental variables (IV) results were nearly 30 percent higher than their ordinary least squares (OLS) estimates. Webbink and van Wassenberg (2004) reached similar conclusions using data from the Netherlands (though Plug, 2001 found lower estimates and argued that the Dutch effect operated through relative position, not total schooling). In the Australian context, Leigh and Ryan (2007) found that in their preferred specification, the IV estimate was lower than the OLS estimate, suggesting an upwards ability bias of 39 percent.

A third strategy for dealing with ability bias is to use changes in compulsory schooling laws across states. For the US, Acemoglu and Angrist (2000) estimated a private rate of return to schooling that suggested virtually no ability bias in the OLS estimates. Oreopoulos (2003) used changes in school leaving laws in states/provinces in three countries: for the US, his IV estimates were nearly double the corresponding OLS estimate, while for Britain and Canada, his OLS and IV estimates were almost identical. In Norway, Aakvik, Salvanes and Vaage (2003) used variation in school reforms across municipalities, and found IV estimates about 30 percent higher than their OLS estimates. Exploiting variation in compulsory schooling laws across Australian states, Leigh and Ryan (2007) found that in their preferred specification, ability bias was in the order of 9 percent.

Other approaches to addressing the ability bias problem have tended to find IV results that are equal to or larger than OLS estimates. For example, Card (1995) used geographic proximity to college to estimate the returns to university for young men in the US, and concluded that the IV estimate was higher than the comparable OLS estimate, by a factor of 25-60 percent. A similar approach is that of Becker and Siebern-Thomas (2001), who used geographic variation in the quality of schooling infrastructure across German states, and found that their IV estimates were nearly double the size of the comparable IV estimates. Rummery, Vella and Verbeek (1999) used a rank-order instrumental variables estimator to estimate returns to education for Australian youth, and concluded that the degree of ability bias was negligible.

Summing up the US literature on instrumental variables approaches to overcoming the ability bias problem, Card (1999) concludes that IV estimates are typically 20-40 percent higher than the corresponding OLS estimates. Part of the explanation for this may be that these instruments primarily affect disadvantaged subgroups of the population, for whom the marginal returns to education may be higher. Although fewer quasi-experimental studies have been conducted in Australia, work by Rummery, Vella and Verbeek (1999), Miller, Mulvey and Martin (2006), and Leigh and Ryan (2007) has not found evidence that ability-adjusted returns are significantly higher than OLS returns (and may be lower). One way to reconcile the Australian and US findings is that rates of educational attainment in the US have been significantly higher than in Australia, and hence that those affected by compulsory schooling laws are not noticeably different from the median worker.

In what follows, I therefore present two sets of results – one assuming that OLS estimates of the returns to education are unbiased, and another assuming that OLS returns are biased upwards by 10 percent. For readers who take the view that the ability bias is outside this range, it is relatively straightforward to adjust the estimates accordingly.

3 Social Returns to Education

It has long been recognised that the social rate of return to education may be lower or higher than the sum of individuals' private rates of return. For example, if education is merely a credential, signalling ability without raising productivity, then the social return might be lower than the private return.[1] Another possibility is that taking account of governments subsidies to education will drive down the social returns.

Alternatively, education might have a positive externality. For example, society will save money if education lowers the probability that an individual will commit a crime, be in poor health, or use welfare.[2,3] Another possibility is that, if labour markets are not perfectly competitive, the increase in value-added per worker caused by higher levels of education may not be fully captured in increased wages (Dearden et al., 2000). And it may be the case that an increase in education for the current generation raises

[1] The classic signalling model of education is that of Spence (1973). In the Australian context, Quiggin (1999) presents several pieces of evidence that suggest that signalling does not explain a significant portion of the observed returns to education.

[2] In theory, the impact of education on crime is ambiguous, since it depends on the returns to education in the legal and illegal sectors. However, empirical studies have tended to find that education lowers crime rates (see eg. Lochner and Moretti, 2004).

[3] Education most likely improves health because better-educated people are more effective at maintaining and improving their health. See Grossman and Kaestner (1997) for a review of this literature.

educational attainment for the next generation (Wolfe and Havemann 2001; Oreopoulos et al., 2006)

As Abelson (2003, pp.313-315) points out, the externalities of education are easier to list than they are to measure. Generally speaking, attempts to quantify social returns to education have found them to be modest at best. For example, Acemoglu and Angrist (2000) estimate that external returns to education are around 1 percent and not significantly different from zero, while a literature review by Psacharopoulos and Patrinos (2004) find mixed evidence, suggesting that social returns might be lower or higher than private returns. Recent work by the OECD (2006, p.130) compares a measure of private returns (the increase in after-tax earnings less costs of undertaking education) with a proxy for social returns (the sum of private returns, plus increased tax revenue, less the cost of providing education). For most of the 11 developed countries in the study, the OECD finds that the social returns to education are *lower* than the private returns (though since the study did not cover Australia, it should be regarded as suggestive rather than definitive).

In the absence of strong evidence for educational externalities, I assume that the social return is equal to the mean increase in pre-tax earnings. This takes account of the increase in taxation revenue that flows from higher educational attainment, but ignores indirect benefits such as higher value-added (to the extent that this is not captured in wages), intergenerational benefits, and less tangible benefits such as higher levels of political participation. To the extent that education lowers the chance that an individual will fall sick or enter the criminal justice system, the approach used in this paper takes account of the fall in earnings associated with such episodes, but not the public cost of hospitals and prisons.

4 Labour Market Outcomes and Educational Attainment

In estimating the returns to education, I use a standard OLS regression of earnings on educational and demographic characteristics. Following Mincer (1974), this takes the form:

$$\ln Y_{it} = \beta_0 + \beta_1 \mathbf{E_{it}} + \beta_2 \mathbf{X_{it}} + \gamma_t + \varepsilon_{it} \qquad (1)$$

In this equation, Y is a measure of the earnings of individual i in year t, and E is a vector of educational levels. X is a vector of individual characteristics, comprising indicator variables for single years of actual work experience, interacted with gender dummies. This allows for a fully flexible experience-earnings profile, which differs between men and women. Finally, γ is a survey year fixed effect, and ε is a disturbance term.

Earnings data are drawn from five waves of the Household, Income and Labour Dynamics in Australia survey (HILDA), carried out in the years 2001-2005. The sample size for the entire survey ranged from 19,914 in 2001 to 17,469 in 2005, with the sample drawn randomly from the Australian population. For more information about HILDA, see Goode and Watson (2007). For present purposes, HILDA represents the most up-to-date microdata that are publicly available, and has the advantage that it contains a measure of actual labour market experience. The five waves are simply treated as pooled cross-sectional surveys (I do not exploit the panel aspect of HILDA). To account for the fact that the same individuals' labour market outcomes may be correlated over time, standard errors are clustered at the person level.

From a practical standpoint, HILDA is also much more useful to researchers than most datasets that are collected by the Australian Bureau of Statistics (ABS). For researchers who wish to use ABS datasets on their own computer, the ABS has now adopted the practice of grouping variables such as hours worked and age into bands, thereby considerably diminishing the precision with which Mincer earnings equations can be estimated. The effect of this has been to diminish the value of ABS data for labour market researchers.

Respondents are restricted to those aged between 25 and 64 in the year of the survey. This age restriction is designed to cover the working population, and to ensure that most respondents have had adequate time to complete their education. Respondents who are studying full-time or part-time are also dropped.

In estimating returns to education, a common approach is to convert all forms of education into years of education, and then to estimate the effect of an additional year of schooling on earnings or labour market participation. While such an approach has the virtue of simplicity, it effectively constrains the returns to an additional year of education to be the same for all types of schooling. Here, the focus is on different types of schooling, so I separately analyse schooling, vocational education, and university. In doing so, it is important to recognise that individuals follow different educational pathways. For example, among those who have finished grade 12, 44 percent have a university degree as their highest qualification, while only 11 percent have a Certificate Level III/IV as their highest qualification. By contrast, among those who have not finished grade 12, 28 percent have a Certificate Level III/IV as their highest qualification. It is therefore plausible that post-school education is tailored according to the level of high schooling that the typical student has attained, and that the returns to post-school education may differ systematically by high school attainment.

Table 1 shows the breakdown of educational qualifications in the sample.

Insert Table 1 here

To test for productivity and participation effects, I estimate three sets of regressions. The first set of regressions uses as the dependent variable pre-tax log hourly wages. The second uses log pre-tax annual earnings. Both wages and earnings are logged on the basis that the semi-log specification has been shown to fit the data well across various developed nations (see eg. Krueger and Lindahl, 2001). Inherent in such a specification is the notion that education increases income in a proportional manner (eg. by *y* percent), rather than by a fixed sum (eg. by *y* dollars). A further advantage of this set-up is that regression coefficients can approximately be interpreted as percentage effects. The approximation is more precise the closer the effect sizes are to zero. Since some of the estimated effects are quite large, I also convert all education coefficients into percentage effects.

The main disadvantage of using logs is that the relationship between education and income can only be estimated for those with positive income. For this reason, I estimate a third regression, in which the dependent variable is an indicator denoting whether the respondent had positive earned income in the previous financial year. This regression is estimated using a probit model, and takes the following form:

$$\Pr(Y>0)_{it} = \beta_0 + \beta_1 \mathbf{E_{it}} + \beta_2 \mathbf{X_{it}} + \gamma_t + \varepsilon_{it} \qquad (2)$$

The relationship between education and hourly wages (shown in the first column of Tables 2, 3 and 4) may be regarded as capturing the productivity effect. The relationship between education and annual earnings (shown in the second column) may be regarded as capturing both productivity and participation. The relationship between education and having positive annual earnings (shown in the third column) may be regarded as capturing participation only.

To begin, I focus on the relationship between high school completion and earnings. To ensure that effects are not contaminated by those who have undertaken post-school education, the sample is restricted to respondents with between 9 and 12 years of schooling, and no post-school qualifications. (An alternative approach – including all respondents, and controlling for post-school qualifications – produces very similar results.[4])

Table 2 shows the results of these regressions. Panel A presents the basic regression results, while Panel B converts the regression coefficients into percentage effects (assuming no ability bias), and Panel C converts the regression coefficients into percentage effects (assuming a 10 percent upwards ability bias).

Assuming no ability bias, the results in Panel B suggest that, compared with those who completed grade 9, respondents who completed grades 10 or 11 have hourly wages that are 10 percent higher, while respondents who finish grade 12 have hourly wages that are 23 percent higher. The effects are higher still when participation effects are taken into account: log annual earnings are 22 percent higher for grade 10 completers, 30 percent higher for grade 11 completers, and 64 percent higher for grade 12 completers. In all cases, more schooling is also associated with a greater probability of reporting positive earnings, with the increase ranging from 5 to 19 percentage points. These results suggest that although the hourly wage effects of schooling are very large, less than half of the impact of high school on annual earnings occurs through productivity (hourly wages), with the coefficients on annual earnings being at least twice as large as the coefficients on hourly wages.

Notably, the increase in earnings from attaining grade 11 (for which there is typically no credential awarded) is smaller than the increase in earnings from attaining grades 10 or 12 (which are typically associated with the award of some credential). This provides some evidence of a 'sheepskin effect' in Australian schooling.

Assuming that returns to education from Mincer-type earnings equations are biased upwards by 10 percent due to ability bias, Panel C scales down the estimated coefficients by 10 percent. Even if this is the correct estimate of the causal effect of schooling on earnings, the benefits to school completion remain extremely large, particularly for respondents who complete grade 12.

[4] With this approach, the coefficients for grades 10, 11 and 12 respectively are 0.099, 0.117, and 0.197 in the hourly wage specification; 0.172, 0.252, and 0.394 in the annual income specification; and 0.051, 0.097, and 0.144 in the positive income specification. All are statistically significant at the 1 percent level.

Insert Table 2 here

Recalling the earlier discussion about educational pathways, I next turn to consider post-school qualifications aimed at those who have not completed high school. The HILDA dataset asks respondents about three types of vocational training: Certificate Level I or II; Certificate Level III or IV; and Diplomas and Advanced Diplomas.[5] These are defined by the ABS (2001) as follows:

- *Certificate level I and II provides a knowledge and skills base ranging from basic knowledge in a narrow range of areas to basic operational knowledge in a moderate range of areas. The focus is on basic practical skills with some theoretical component and a prescribed range of functions involving known routines and procedures with some accountability for the quality of outcomes, underpinned by a basic knowledge in a range of areas. Entry to this level is by various pathways which may include the completion of Year 10 or equivalent, or completion of a recognised programme and/or recognition of prior learning.*
- *Certificate level III and IV provides a broad knowledge base incorporating some theoretical concepts and the skills necessary to perform a broad range of skilled applications, to provide technical advice of a complex nature and to provide workgroup leadership when organising activities. The focus is on the application of a defined range of well developed skills to a variety of predictable or unpredictable problems in a specific field, with a general understanding of the underlying theories and methods related to that field. Entry to this level is by various pathways which may include the completion of Year 10 or equivalent, or higher, or completion of a recognised programme and/or recognition of prior learning*
- *Diploma level provides a broad knowledge and skills base, incorporating theoretical concepts, with substantial depth in some areas. The focus is on the application of theoretical concepts and technical or creative skills to a range of situations and the evaluation of information. Education at this level may also develop basic management and administrative skills. Entry to this level is by various pathways*

[5] Some HILDA respondents stated that they held a Certificate, but did not define the level. Since only a small number of respondents (less than 0.5 percent of the total sample) fell into this category, I drop them from the analysis.

which may include the completion of Year 12 or equivalent, or completion of a recognised programme and/or recognition of prior learning.

- *Advanced Diploma and associate degree level provides a highly specialised knowledge and skills base, incorporating theoretical, technical, creative or conceptual skills, with substantial depth in some areas. The focus is on applying a significant range of fundamental principles and complex techniques across a wide and often unpredictable variety of contexts in relation to either varied or highly specific functions. Education at this level includes analysing information and concepts at an abstract level and executing judgements across a range of technical and management functions. Entry to this level is by various pathways which may include the completion of Year 12 or equivalent, or completion of a recognised programme and/or recognition of prior learning.*

In essence, Certificate I/II qualifications primarily provide operational knowledge, and require little prior schooling; Certificate III/IV qualifications provide greater theoretical depth and focus on a broader range of skills; and Diploma qualifications incorporate an even greater focus on fundamental principles and conceptual skills, generally with grade 12 schooling or its equivalent as a prerequisite.

Table 3 restricts the sample to respondents with 11 or fewer years of schooling (but controls for single years of schooling). As in the previous table, the dependent variable is hourly wages in the first column, annual earnings in the second column, and an indicator for positive annual earnings in the third column. Again, Panel B converts the coefficients into percentage effects assuming no ability bias, while Panel C converts the coefficients into percentage effects, assuming a 10 percent upwards ability bias.

Insert Table 3 here

The results suggest that – for individuals who have not finished high school – the increase in hourly earnings (the productivity benefit) is 7 percent for Certificate III-IV, and 12-13 percent for Diplomas (hourly wage returns to Certificate Level I/II qualifications are not statistically significant). The increase in annual earnings associated with Certificate III/IV qualifications and Diplomas is around 3 times as large as the hourly wage benefit – in the order of 19-21 percent. (For annual earnings, the coefficient on Certificate Level I/II qualifications is negative, but not statistically significant.) All three forms of vocational education are associated with higher participation rates: 16

percentage point higher for Certificate I/II, 5 percentage points higher for Certificate III/IV, and 7 percentage points higher for Diplomas. This suggests that higher-level vocational training has an economic payoff, but that it is mostly through participation rather than productivity effects.

In Table 4, I estimate the returns to post-school qualifications, relative to respondents with 12 years of schooling and no post-school qualifications. In addition to Certificate III/IV qualifications and Diplomas, I now estimate the returns to three types of university qualifications: Bachelor degrees, Graduate Diplomas/Certificates, and Masters/Doctorate degrees. (Certificate I/II are regarded as a lower level of educational attainment than grade 12, so there are no respondents in the sample who are observed with 12 years of schooling and a Certificate Level I/II.)

For those who have completed grade 12, Certificate III/IV qualifications appear to have no effect on productivity or participation, while Diplomas increase hourly wages by 13-14 percent, and annual earnings by 17-19 percent. The economic returns to Bachelor degrees are around twice as large as the returns to Diplomas. Bachelor degrees are associated with a 32-35 percent increase in hourly wages, and a 45-50 percent increase in annual earnings. Those with Graduate Diplomas and Graduate Certificates earn hourly wages that are 35-39 percent higher, and annual earnings that are 42-46 percent higher. Those with Masters degrees and Doctorates earn hourly wages that are 41-45 percent higher, and annual earnings that are 66-74 percent higher. All three forms of university qualifications are associated with a 10-11 percentage point increase in labour force participation.

Insert Table 4 here

The estimates above show the average effect of education on earnings. However, it is plausible that the benefits of education differ across the conditional earnings distribution. For example, a remedial education program might have a stronger effect on raising earnings at the bottom of the distribution, while an education program tailored towards high-ability students might have a larger impact on the top of the distribution.

One way to test this is by estimating interquartile regressions, formally testing whether the returns to education at the 75th percentile of the conditional earnings distribution are different from the returns to education at the 25th percentile of the distribution. Table 5 shows the results of this exercise. The general pattern that emerges is that the hourly wage effects of education appear to be slightly higher at the top of the conditional earnings distribution. This is true for grade 12, Certificate III/IV (for high school dropouts), Diplomas (for high school dropouts), and Bachelor degrees. The only exception is the return to Certificate III/IV (for high school graduates), which seems to yield larger returns for those towards the bottom of the conditional earnings distribution: a finding consistent with this qualification being primarily directed at high school dropouts.

By contrast, using log annual earnings as the dependent variable indicates that returns are typically higher towards the bottom of the conditional earnings distribution. The annual earnings gain associated with grade 12, Certificate III/IV (for high school dropouts), and a Masters/Doctorate. Since the participation gains are, on average, larger than the productivity gains (Tables 2-4), this suggests that while those at the 75th percentile gain a larger productivity benefit from education, those at the 25th percentile gain a larger participation benefit.

Insert Table 5 here

Lastly, I compare the returns to various educational qualifications on a per-year basis. Since there is no firm duration for most qualifications, it is necessary to make some assumptions about the number of full time equivalent years that would be required. In Table 6, I assume that each year of high schooling takes 1 year (ie. ignoring the possibility of students repeating a grade). The marginal benefit of grade 11 is estimated as the return to completing grade 11 minus the return to completing grade 10 (and similarly for the marginal return to completing grade 12). Post-school qualifications are assigned the following durations: 0.5 years for Certificate I/II, 1 year for Certificate III/IV, 2 years for a Diploma or Advanced Diploma, 3 years for a Bachelor degree, Bachelor degree, 4 years for a Graduate Diploma or Graduate Certificate, and 5 years for a Masters or Doctorate (note that the last two estimates include the time taken to complete a Bachelor degree). I then divide the returns in Tables 2-4 by the respective number of years. To conserve space, I show only the returns that assume a 10 percent ability bias (ie. those in Panel C). This does not affect the relative comparisons.

The results from this comparison suggest that the per-year productivity gains are largest for grade 12 and Bachelor degrees, both of which boost hourly wages by 11 percent. For annual earnings, per-year benefits are largest from high school, with year 10 completion boosting annual earnings by 20 percent, and year 12 completion boosting annual earnings by 30 percent. For positive earnings, per-year benefits are largest from high school and vocational education.

Insert Table 6 here

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5 Conclusion

Using ability bias estimates in the published literature, I estimate returns to a wide variety of educational qualifications. These estimates suggest that the increase in hourly wages from raising educational attainment by one year is in the order of 8-11 percent. Comparing across high school attendance, vocational training, and university, the productivity gain appears to be largest for grade 12 completion and Bachelor degree completion. On a per-year basis, the lowest hourly wage returns are from grade 11, Certificate I/II (for high school dropouts), and Certificate III/IV (for high school graduates).

When participation effects – on the intensive and extensive margin – are taken into account, the benefits of education and training are larger still. This calculation favours high schooling the most. For example, the annual earnings increase from completing year 12 is estimated to be a massive 30 percent. This suggests that greater policy attention should be given to increasing school completion rates in Australia.

Within the vocational training sector, I find no significant earnings boost associated with Certificate I/II qualifications, but substantial increases associated with Certificate III/IV (for high school dropouts), and Diplomas. Interquartile regressions suggest that the hourly wage benefits of education tend to be higher at the 75th percentile than at the 25th percentile, while annual earnings benefits tend to be higher at the bottom of the distribution. Although these calculations have not taken into account the costs of education (in the form of tuition and foregone earnings), the fact that foregone earnings are lowest for high schooling (coupled with the fact that the increase in earnings is biggest) suggests that the net returns are likely to also be larger for high schooling than for vocational training or university education.

A key assumption in this methodology is that the extent of ability bias estimated in natural experiment studies (most of which is based on differences in high school attainment) can be applied to all educational qualifications. To the extent that ability bias differs substantially between high schooling, vocational training, and university, this method may imprecisely estimate the causal impact of these different types of education.

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TABLE 1

DISTRIBUTION OF EDUCATIONAL QUALIFICATIONS

	Positive hourly wages	Positive annual earnings	Full sample
High school sample (used in Table 2)			
Respondents with no post-school qualifications			
Grade 9	9%	10%	12%
Grade 10	39%	39%	42%
Grade 11	17%	17%	16%
Grade 12	35%	35%	31%
N	*8969*	*9796*	*15394*
Vocational training sample (used in Table 3)			
Respondents with 11 or fewer years of schooling			
No post-school qualifications	58%	58%	64%
Certificate Level I or II	3%	3%	3%
Certificate Level III or IV	33%	32%	28%
Diploma or Advanced Diploma	7%	7%	6%
N	*11635*	*12658*	*20642*
Post-school qualifications sample (used in Table 4)			
Respondents with 12 years of schooling			
No post-school qualifications	28%	28%	31%
Certificate Level III or IV	10%	10%	11%
Diploma or Advanced Diploma	13%	13%	14%
Bachelor degree	29%	29%	27%
Graduate Diploma or Graduate Certificate	12%	12%	10%
Masters or Doctorate	8%	8%	7%
N	*11414*	*12273*	*15348*

Note: Percentages may not add to 100 due to rounding. All respondents are aged between 25 and 64, and not presently studying. A small number of respondents have university qualifications, but did not complete high school. These individuals are not included in the analysis.

TABLE 2

HIGH SCHOOL AND EARNINGS

Sample is respondents with 9-12 years of schooling and no post-school qualifications. All estimates are relative to those who left school at the end of grade 9.

Panel A: Regression results			
	(1)	(2)	(3)
Dependent variable:	**Log hourly wage**	**Log annual earnings**	**Indicator for positive earnings**
Grade 10	0.094***	0.199***	0.047*
	[0.032]	[0.070]	[0.025]
Grade 11	0.099***	0.263***	0.131***
	[0.034]	[0.074]	[0.026]
Grade 12	0.208***	0.493***	0.186***
	[0.033]	[0.071]	[0.024]
Observations	8969	9796	15394
R^2 or Pseudo-R^2	0.07	0.19	0.12
Panel B: Percentage effects - assuming no ability bias			
Grade 10	10%	22%	5%
Grade 11	10%	30%	13%
Grade 12	23%	64%	19%
Panel C: Percentage effects - assuming 10% upwards ability bias			
Grade 10	9%	20%	5%
Grade 11	9%	27%	13%
Grade 12	21%	57%	19%

Note: Robust standard errors, clustered at the person level, in brackets. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels respectively. All specifications are estimated for respondents aged between 25 and 64, and not presently studying. Specifications in column 1 are restricted to those with positive hourly wages, and specifications in column 2 are restricted to those with positive annual earnings. Regressions in columns 1 and 2 are estimated using OLS, and estimates in column 3 are marginal effects from a probit model. All regressions include indicator variables for each single year of experience, interacted with the respondent's sex, plus year fixed effects. For columns 1 and 2, results in Panels B and C are calculated as $\exp(\beta)-1$ and $0.9*(\exp(\beta)-1)$, respectively. For column 3, results in Panels B and C are identical to the marginal effects shown in Panel A.

TABLE 3

VOCATIONAL TRAINING AND EARNINGS

Sample is respondents with 11 or fewer years of schooling. All estimates are relative to those with 11 or fewer years of schooling and no post-school qualifications.

Panel A: Regression results	(1)	(2)	(3)
Dependent variable:	**Log hourly wage**	**Log annual earnings**	**Indicator for positive earnings**
Certificate Level I or II	0.003	-0.058	0.155***
	[0.049]	[0.101]	[0.033]
Certificate Level III or IV	0.072***	0.187***	0.047***
	[0.016]	[0.029]	[0.016]
Diploma or Advanced Diploma	0.124***	0.201***	0.071***
	[0.032]	[0.055]	[0.027]
Observations	11635	12658	20642
R^2 or Pseudo-R^2	0.07	0.20	0.13
Panel B: Percentage effects - assuming no ability bias			
Certificate Level I or II	0% (ns)	-6% (ns)	16%
Certificate Level III or IV	7%	21%	5%
Diploma or Advanced Diploma	13%	22%	7%
Panel C: Percentage effects - assuming 10% upwards ability bias			
Certificate Level I or II	0% (ns)	-6% (ns)	16%
Certificate Level III or IV	7%	19%	5%
Diploma or Advanced Diploma	12%	20%	7%

Note: Robust standard errors, clustered at the person level, in brackets. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels respectively. All specifications are estimated for respondents aged between 25 and 64, and not presently studying. Specifications in column 1 are restricted to those with positive hourly wages, and specifications in column 2 are restricted to those with positive annual earnings. Regressions in columns 1 and 2 are estimated using OLS, and estimates in column 3 are marginal effects from a probit model. All regressions include indicator variables for each single year of experience, interacted with the respondent's sex, plus indicator variables for years of high schooling and year fixed effects. For columns 1 and 2, results in Panels B and C are calculated as $\exp(\beta)-1$ and $0.9*(\exp(\beta)-1)$, respectively. For column 3, results in Panels B and C are identical to the marginal effects shown in Panel A. ns=not statistically significant.

TABLE 4

POST-SCHOOL QUALIFICATIONS AND EARNINGS

Sample is respondents with 12 years of schooling. All estimates are relative to those with no post-school qualifications.

Panel A: Regression results	(1)	(2)	(3)
Dependent variable:	**Log hourly wage**	**Log annual earnings**	**Indicator for positive earnings**
Certificate Level III or IV	-0.025	-0.029	0.002
	[0.027]	[0.042]	[0.020]
Diploma or Advanced Diploma	0.131***	0.172***	0.030*
	[0.027]	[0.043]	[0.016]
Bachelor degree	0.303***	0.406***	0.103***
	[0.023]	[0.034]	[0.013]
Graduate Diploma or Graduate Certificate	0.328***	0.380***	0.110***
	[0.027]	[0.046]	[0.015]
Masters or Doctorate	0.373***	0.553***	0.114***
	[0.035]	[0.052]	[0.016]
Observations	11414	12273	15348
R^2 or Pseudo-R^2	0.13	0.18	0.11
Panel B: Percentage effects - assuming no ability bias			
Certificate Level III or IV	-2% (ns)	-3% (ns)	0% (ns)
Diploma or Advanced Diploma	14%	19%	3%
Bachelor degree	35%	50%	10%
Graduate Diploma or Graduate Certificate	39%	46%	11%
Masters or Doctorate	45%	74%	11%
Panel C: Percentage effects - assuming 10% upwards ability bias			
Certificate Level III or IV	-3% (ns)	-3% (ns)	0% (ns)
Diploma or Advanced Diploma	13%	17%	3%
Bachelor degree	32%	45%	10%
Graduate Diploma or Graduate Certificate	35%	42%	11%
Masters or Doctorate	41%	66%	11%

Note: Robust standard errors, clustered at the person level, in brackets. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels respectively. All specifications are estimated for respondents aged between 25 and 64, and not presently studying. Specifications in column 1 are restricted to those with positive hourly wages, and specifications in column 2 are restricted to those with positive annual earnings. Regressions in columns 1 and 2 are estimated using OLS, and estimates in column 3 are marginal effects from a probit model. All regressions include indicator variables for each single year of experience, interacted with the respondent's sex, plus year fixed effects. Certificate Level I/II was not included, since it is regarded as a lower qualification than 12 years of schooling. For columns 1 and 2, results in Panels B and C are calculated as exp(β)-1 and 0.9*(exp(β)-1), respectively. For column 3, results in Panels B and C are identical to the marginal effects shown in Panel A. ns=not statistically significant.

TABLE 5

DO THE BENEFITS OF EDUCATION DIFFER ACROSS THE EARNINGS DISTRIBUTION?

Estimates are the difference between the return at the 75th percentile of the conditional distribution and the 25th percentile		
Panel A: High school and earnings		
	(1)	(2)
Dependent variable:	**Log hourly wage**	**Log annual earnings**
Grade 10	-0.001	-0.019
	[0.020]	[0.041]
Grade 11	0.011	-0.011
	[0.025]	[0.058]
Grade 12	0.084***	-0.085*
	[0.024]	[0.047]
Observations	9022	9861
Panel B: Vocational training and earnings		
Certificate Level I or II	0.004	0.023
	[0.031]	[0.051]
Certificate Level III or IV	0.021**	-0.051**
	[0.010]	[0.021]
Diploma or Advanced Diploma	0.084***	0.022
	[0.026]	[0.050]
Observations	11717	12754
Panel C: Post-school qualifications and earnings		
Certificate Level III or IV	-0.042*	-0.023
	[0.024]	[0.027]
Diploma or Advanced Diploma	0.011	0.02
	[0.022]	[0.035]
Bachelor degree	0.044***	-0.019
	[0.012]	[0.021]
Graduate Diploma or Graduate Certificate	-0.014	-0.024
	[0.026]	[0.031]
Masters or Doctorate	-0.026	-0.065**
	[0.026]	[0.031]
Observations	11444	12315

Note: Robust standard errors, clustered at the person level, in brackets. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels respectively. Estimates are from inter-quartile regressions. All specifications are estimated for respondents aged between 25 and 64, and not presently studying. Sample in Panel A is respondents with 9-12 years of schooling and no post-school qualifications. Sample in Panel B is respondents with 11 or fewer years of schooling. Sample in Panel C is respondents with 12 years of schooling. Specifications in column 1 are restricted to those with positive hourly wages, and specifications in column 2 are restricted to those with positive annual earnings. All regressions include indicator variables for each single year of experience, interacted with the respondent's sex, plus year fixed effects. Regressions in Panel B also control for years of high schooling.

TABLE 6

PER-YEAR RETURNS TO EDUCATION

All results are percentage effects, assuming 10% upwards ability bias			
	(1)	(2)	(3)
Dependent variable:	**Log hourly wage**	**Log annual earnings**	**Indicator for positive earnings**
Panel A: High school and earnings			
Sample is respondents with no post-school qualifications			
Grade 10	9%	20%	5%
Grade 11	0% (ns)	7% (ns)	8%
Grade 12	11%	30%	6%
Panel B: Vocational training and earnings			
Sample is respondents with 11 or fewer years of high school			
Certificate Level I or II	1% (ns)	-12% (ns)	31%
Certificate Level III or IV	7%	19%	5%
Diploma or Advanced Diploma	6%	10%	4%
Panel C: Post-school qualifications and earnings			
Sample is respondents with 12 years of high school			
Certificate Level III or IV	-3% (ns)	-3% (ns)	0% (ns)
Diploma or Advanced Diploma	6%	8%	2%
Bachelor degree	11%	15%	3%
Graduate Diploma or Graduate Certificate	9%	10%	3%
Masters or Doctorate	8%	13%	2%

Note: Results are based on percentage effects in Panel C of Tables 2, 3, and 4, divided by the number of years of full-time study assumed for each the qualification (0.5 years for Certificate I/II, 1 year for Certificate III/IV, 2 years for a Diploma or Advanced Diploma, 3 years for a Bachelor degree, Bachelor degree, 4 years for a Graduate Diploma or Graduate Certificate, and 5 years for a Masters or Doctorate). ns=not statistically significant.