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Adult literacy achievement: Its correlates and consequences

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Introduction

The literacy levels of countries' populations are related strongly to individuals' incomes and to the national productivity of those countries (Hanushek and Wossman, 2007). In the past, limited data on adult skills achievement have been available and educational attainment has been used as a proxy indicator of human capital formation. However, considerable variation exists between and within countries in the skills developed by young people for a given level of educational attainment. In short, direct measures of human capital achievement are superior to educational attainment as a proxy indicator in predicting individual returns and national productivity growth.

In 2006, Australia took part in the OECD-sponsored Adult Literacy and Life Skills (ALLS) survey. A nationally representative sample of 8,988 individuals provided information on the literacy skills of the population as a whole and of sub-groups of that population, based on age, gender, language background and many other characteristics. In addition to literacy achievement, respondents provided extensive demographic information. The survey includes information on educational attainment, labour market status, occupation and income. These data enable factors that are thought to be causally related to literacy achievement to be investigated and outcomes attributable to skills development to be evaluated.

The survey assessed four components of literacy, namely prose literacy, document literacy, numeracy and problem solving (ABS, 2008a, p. 4).

Performance scales are established for each of the four dimensions of literacy, each scale ranging from 0 to 500 units. On the basis of their responses to test items, individuals are located along this scale, with individuals having poor literacy being at the lower end of the scale and those with well developed literacy skills towards to upper end of the scale.

For prose and document literacy and numeracy, five performance levels are recognised, from Level 1 (the lowest level) to Level 5. Four levels of problem solving performance were recognised. Level 3 literacy is regarded as the minimum needed for success in a modern knowledge-based economy. Of concern, almost half of those surveyed in Australia had literacy scores that placed them below level 3 (46% for prose literacy, 47% for document literacy, and 53% for numeracy), while 70% scored below Level 3 on problem solving.

Data

Data from ABS ALLS basic and expanded Confidentialised Unit Record Files (CURFs) are used in the analyses presented in this paper (ABS, 2008b,c). In the analyses presented below, males and females are treated separately, although the same models are evaluated for both. The analyses are restricted to individual aged between 20 and 59 years, as this age range represents most of the working age population. Full-time students and permanent retirees are excluded from the analyses.

Analyses on all four skill domains have been undertaken. Scores in these domains are very highly correlated and regression parameters are very similar, so only the results for prose literacy are presented here.

Correlates of literacy achievement

In this paper, we focus on labour market returns to literacy achievement. A more extensive report (Curtis, in preparation) deals with relationships between demographic characteristics, educational attainment and literacy achievement.

In brief, we find that certain groups of individuals receive less education than others. Low parental educational attainment is associated with low attainment by individuals. People living in regional and rural locations have lower attainment than those in major cities. Individuals whose home language is other than English have lower educational attainment than those who speak English at home. This effect is more pronounced for females than males.

We find that literacy achievement is influenced by demographic characteristics and educational attainment. In particular, low levels of parental education are associated with low literacy achievement. By far the largest influence on literacy achievement is home language background. Individuals who speak a language other than English at home have much lower literacy achievement than English speakers. There is an expected gain in literacy achievement per year of formal education.

Literacy achievement and labour market outcomes

We examine the influence of literacy achievement on labour market outcomes. We deal first with employment status and then with the wage return to literacy.

Literacy and employment status

In this section, the influences of literacy achievement, educational attainment and demographic characteristics on employment status are evaluated.

Employment status is coded as either full-time or part-time employment, unemployed (and seeking work) or being out of the labour force (NILF, not working and not seeking work). As the criterion variable is categorical, multinomial logistic regression is used to model employment status and full-time employment is the reference category. The proportions of males and females in each of the employment status categories are shown in Table 1. There are obvious differences between male and female patterns of labour market participation, with much higher proportions of women than men being out of the labour force or being in part-time employment.

Table 1 Employment status, males and females aged 20 to 59 years (%)

Employment status	Males	Females
Employed, full-time	84.1	41.7
Employed, part-time	7.6	33.6
Unemployed	2.6	3.3
Not in the labour force	5.8	21.4
Total (%)	100.0	100.0
Total (N)	3002	3012

Note: Excludes full-time students and retirees

In multinomial logistic regression, the log of the odds of being in any of the alternative states (part-time employment, unemployed or NILF) relative to being in full-time employment is

modelled. The logarithm of odds (B in the tables below) can be converted to an odds ratio by taking the exponent of the parameter (exp(B)) and this is shown in the tables. When an outcome is equally likely for members of a group compared with the reference group, the odds ratio is unity (or not significantly different from it). When an outcome is more likely, the odds ratio is greater than unity, and when it is less likely the odds ratio is less than unity.

The pattern of influences of variables included in the model differs between males (see Table 2) and females (see Table 3), and they are discussed separately.

Males

The regression parameter for prose literacy is negative for each of part-time employment, unemployment and NILF relative to full-time employment, although the parameter for unemployment is non-significant. There is a reduced likelihood of high literacy achievers being in other than full-time employment, or it could be said, there is an employment penalty to low levels of literacy. The regression parameters are small (e.g. -0.004 for part-time compared with full-time employment). However, this is the penalty per unit change in the literacy score which is measured on a 0 to 500 point scale. The gap between literacy performance levels is 50 points on that scale, so the effect of an individual being one performance level above another is -0.2 units (50*-0.004), and this corresponds to a reduced likelihood ($e^{-0.2}$=0.82) of being in part-time rather than full-time employment. That is, a person whose literacy level is one performance band higher than another is 18% less likely to be in part-time rather than full-time employment, net of other explanatory factors.

Table 2 The likelihood (odds ratio) of being in part-time employment, unemployed or not in the labour force, relative to being in full-time employment (males)

	Employment status (relative to full-time employment)								
	Part-time employment			Unemployed			NILF		
	B	Sig.	Odds ratio	B	Sig.	Odds ratio	B	Sig.	Odds ratio
Intercept	4.728	<0.001		2.739	0.154		9.221	<0.001	
Prose literacy	-0.004	0.021	0.996	-0.002	0.389	0.998	-0.006	0.001	0.994
Years of formal education	0.005	0.825	1.005	-0.100	0.032	0.904	-0.152	<0.001	0.859
Part-time study (ref None)									
Undertaking part-time study	0.163	0.408	1.177	-0.176	0.630	0.838	-1.494	0.003	0.225
Age (years)	-0.219	<0.001	0.804	-0.120	0.138	0.887	-0.069	0.294	0.933
Age squared	0.003	<0.001	1.003	0.001	0.209	1.001	0.001	0.370	1.001
Location (ref Capital city)									
Balance of state	0.191	0.207	1.211	0.046	0.859	1.048	0.152	0.422	1.165
First language (ref English)									
Other than English	0.372	0.102	1.450	0.319	0.428	1.376	-0.235	0.494	0.790
Home language (ref English)									
Other than English	0.051	0.865	1.052	0.980	0.032	2.663	0.729	0.086	2.073
Dependent children (ref None)									
At least one dependent child	-0.247	0.105	0.781	-0.357	0.154	0.699	-0.427	0.032	0.653
Physical health (SF12)	-0.026	0.003	0.974	-0.027	0.054	0.973	-0.094	<0.001	0.910
Mental health (SF12)	-0.031	<0.001	0.969	-0.035	0.003	0.965	-0.058	<0.001	0.944

Each additional year of formal education is associated with a reduced likelihood of being either unemployed or out of the labour market, although its influence on part-time rather than full-time employment is non-significant. Each additional year of education reduces the likelihood of being unemployed or out of the labour market by 10% and 14% respectively. (The corresponding odds ratios are 0.904 and 0.859, see Table 2).

Attention is drawn to the non-significant parameters for location (capital city against other locations) and language background. That is, there is no significant influence of location or language background, net of the influences of measured literacy skill level and educational attainment, on employment status. However, it may be noted that individuals who are non-English speakers at home tend to have substantially lower literacy skills than English speakers, so the influence on employment of being a non-English speaker is captured by literacy skill level.

Females

Females have a different pattern of workforce participation than males (see Table 1). Fewer females compared to males are in full-time employment, many more are in part-time employment, and many more are out of the labour force. Results of modelling employment status on literacy achievement, educational attainment and demographic characteristics are shown in Table 3.

Table 3 The likelihood (odds ratio) of being in part-time employment, unemployed or not in the labour force relative to being in full-time employment (females)

	Employment status (relative to full-time employment)								
	Part-time employment			Unemployed			NILF		
	B	Sig.	Odds ratio	B	Sig.	Odds ratio	B	Sig.	Odds ratio
Intercept	-0.567	0.512		3.068	0.083		6.932	<0.001	
Prose literacy	-0.002	0.188	0.998	-0.004	0.147	0.996	-0.005	<0.001	0.995
Years of formal education	-0.072	<0.001	0.931	-0.191	<0.001	0.826	-0.228	<0.001	0.796
Part-time study (ref None)									
Undertaking part-time study	-0.066	0.594	0.936	0.798	0.002	2.221	-0.663	<0.001	0.515
Age (years)	0.058	0.104	1.060	-0.097	0.209	0.907	-0.067	0.104	0.935
Age squared	0.000	0.477	1.000	0.001	0.259	1.001	0.001	0.096	1.001
Location (ref Capital city)									
Balance of state	0.073	0.442	1.076	0.580	0.014	1.786	0.031	0.793	1.031
First language (ref English)									
Other than English	-0.043	0.774	0.958	0.502	0.150	1.651	0.118	0.515	1.125
Home language (ref English)									
Other than English	-0.319	0.150	0.727	0.878	0.032	2.407	0.526	0.026	1.692
Dependent children (ref None)									
At least one dependent child	1.321	<0.001	3.745	0.949	<0.001	2.582	1.616	<0.001	5.032
Physical health (SF12)	-0.010	0.059	0.990	-0.028	0.015	0.973	-0.046	<0.001	0.955
Mental health (SF12)	0.003	0.522	1.003	-0.037	<0.001	0.964	-0.029	<0.001	0.972

Prose literacy achievement is not significantly related to part-time employment or to unemployment relative to full-time employment, but is related to being out of the labour force. A female whose literacy achievement is one performance band (50 scale points) higher than another's is 22% less likely to be out of the labour force.

Each additional year of formal education is associated with a reduced likelihood of being in any state other than full-time employment. Each additional year of education reduces the likelihood of part-time employment by seven per cent, of unemployment by 17% and of being out of the labour force by 20%.

Women residing outside capital cities experience greater unemployment, compared with those in capital cities net of literacy skill and educational attainment. Similarly, there is a net negative influence of being a non-English speaker at home on employment status. Non-English-speaking women are more likely than English-speakers to be unemployed or out of the labour force. This

effect is in addition to the influence of language background on literacy skill achievement and of literacy skill on employment status.

Wages returns to literacy achievement

The question that is addressed in this section is 'Is there a wages return to literacy achievement net of other factors?' This question is investigated by modelling earnings on selected explanatory variables.

Hourly wage rates are used as the criterion measure. The number of hours worked, even among full-time employees, is highly variable so rather than using weekly earnings, the hourly wage rate is calculated. The distribution of the hourly wage rate is highly skewed and platykurtic, making the variable unsuitable for modelling. However, its natural log transformation is much less skewed and approximates normality adequately. Therefore, the natural log of hourly wages is regressed on selected predictors to evaluate the return to literacy skill, net of other factors. Literacy achievement is correlated with educational attainment and with the possession of post-school qualifications. It is useful to examine the influence of literacy alone, and then to examine its influence in the presence of other predictors. The model is developed in four stages. Initially only literacy is modelled, then educational attainment (years of formal education), highest educational qualification (a university degree or a VET qualification), and finally a selection of demographic variables are added.

As with previous analyses, variables have been retained if they are significant for either males or females for any of the four literacy domains.

Individuals who are not working do not have a wage so their cases are not used when earnings are regressed on literacy achievement. But individuals who are not working tend to have lower literacy achievement than those who are working (see the negative parameters for literacy achievement and other variables for NILF in Table 2 for males and Table 3 for females). Thus there is evidence of some selection bias in attempts to model the influence of literacy achievement on earnings. This selection bias may lead to misestimates of the influences of the variables included in the model and it is overcome by using the Heckman correction (Briggs, 2004). This uses a two-stage procedure. First, the likelihood of being a wage earner is modelled on the set of predictors used in the preceding multinomial regressions. This procedure generates a selection term (Lambda) that is included in the second substantive stage in which explanatory variables are used for earnings and in which the selection term corrects for selection bias. The results of this analysis are shown in Table 4 for males and Table 5 for females. In those tables, regression parameters are shown to three significant figures. In the discussion below, more precise estimates are presented. The results of this model are discussed separately for males and females.

Returns to literacy: males

It is useful to examine the influence of literacy alone and then in the presence of correlated predictors, particularly educational attainment. This is the main purpose of models 1, 2 and 3 shown in Table 4.

The influence of literacy (a) alone, then (b) in the presence of educational attainment, (c) with post-school qualification and (d) with demographic variables is 2.78×10^{-3}, 2.18×10^{-3}, 2.12×10^{-3}, 1.98×10^{-3}. The change in this parameter (22%) is especially notable in the presence of educational attainment. Individuals with high literacy skills are likely to seek additional years of education and additional education is likely to lead to higher levels of literacy.

We now examine the influence of literacy net of other predictors(see model 4 in Table 4). The regression parameter for prose literacy is 0.002 ($1.98x10^{-3}$). This is the change in the natural log of the hourly wage rate that attends a one unit change in prose literacy. A change of one performance level (50 units on the literacy scale) therefore would lead to a change in the log of hourly wage of 0.099. This may be compared with the influence of each additional year of education for which the parameter is 0.023. In many studies of returns to skill, educational attainment is used as a proxy for skill level as direct measures are rarely available. The current analysis indicates that direct measures of literacy skills explain a proportion of earnings comparable with that explained by educational attainment. It is worth noting that having a university degree is advantageous in addition to literacy skill achievement and the number of years invested in education for males and females. Having a VET qualification yields a return for males (but not for females), net of years of educational attainment.

Table 4 Influences of selected characteristics on log of hourly wage rate (males)

	Parameter estimates				
	B	Std error	Beta	t	Sig.
Model 1					
Constant	2.469	0.071		34.593	<0.001
Prose literacy	0.003	0.000	0.256	12.086	<0.001
Model 2					
Constant	2.190	0.078		28.045	<0.001
Prose literacy	0.002	0.000	0.200	9.127	<0.001
Years of education	0.032	0.004	0.182	8.256	<0.001
Model 3					
Constant	2.331	0.086		27.049	<0.001
Prose literacy	0.002	0.000	0.195	8.878	<0.001
Years of education	0.018	0.005	0.104	3.717	<0.001
University degree (ref=no) Has university degree	0.166	0.038	0.126	4.353	<0.001
VET qualification (ref=no) Has VET qualification	0.034	0.027	0.028	1.249	0.212
Model 4					
Constant	1.141	0.315		3.617	<0.001
Prose literacy	0.002	0.000	0.182	7.611	<0.001
Years of education	0.023	0.005	0.133	4.729	<0.001
University degree (ref=no) Has university degree	0.191	0.038	0.144	4.985	<0.001
VET qualification (ref=no) Has VET qualification	0.060	0.030	0.050	2.006	0.045
Age (years)	0.040	0.007	0.758	5.384	<0.001
Age squared	-0.000	0.000	-0.593	-4.218	<0.001
Location (ref Capital city) Balance of state	-0.086	0.022	-0.073	-3.828	<0.001
First language (ref English) Other than English	-0.132	0.035	-0.089	-3.746	<0.001
Home language (ref English) Other than English	-0.080	0.051	-0.039	-1.580	0.114
Physical health (SF12)	0.006	0.002	0.075	2.487	0.013
Mental health (SF12)	0.004	0.002	0.056	2.361	0.018
Lambda	0.145	0.175	0.035	0.824	0.410

Note $R^2 = 0.183$; $F_{12,2487} = 47.389$, $p<0.001$ for Model 4

Hourly rates are modelled against age and its square, as it is expected that the relationship is non-linear. For males, hourly wage rates increase to about age 50 and then plateau and decline slightly, while for females there is very little variation with age. For males, there is a significant difference

in hourly wage rates by location, with those residing in capital cities receiving higher rates. However, occupation is not included in the model, and occupations attracting higher earnings are less common outside of capital cities, with proportionately fewer professionals and more labourers.

Among males, having a first or home language other than English is associated with lower hourly earnings, although these relationships are non-significant among females. Higher levels of both physical and mental health are associated with higher earnings for both males and females.

The criterion variable in these regression models is the natural log of the hourly wage rate. It is useful to convert the regression parameters to the hourly rate in dollars. This is done in Figure 1 where the returns to literacy ($ per hour) are shown relative to a person whose literacy achievement score is 275; that is, at the threshold of performance level 3 – the level regarded as the minimum acceptable level in an advanced economy.

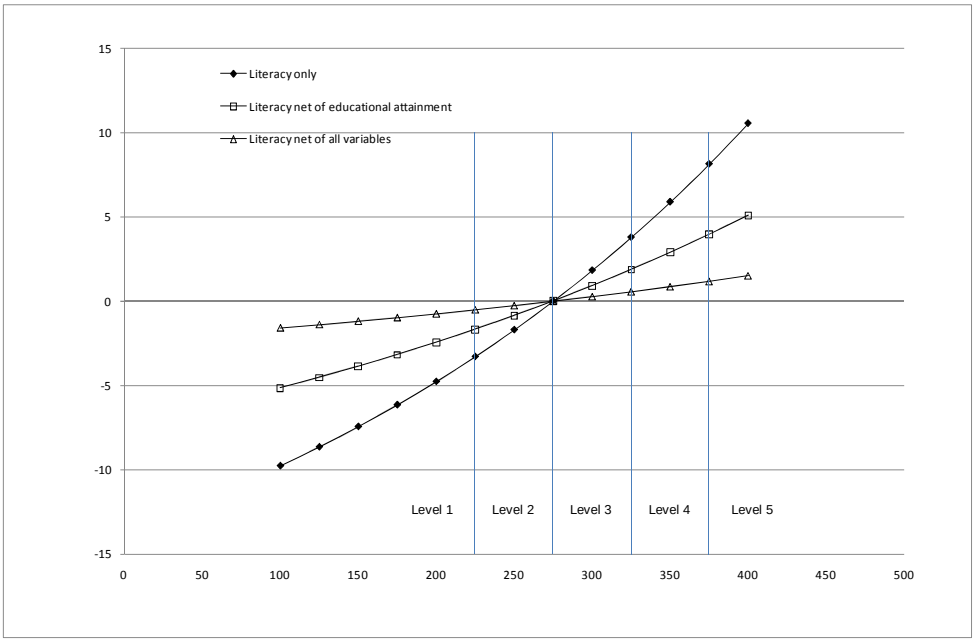

Figure 1 Returns to literacy achievement ($ per hour) relative to a person at the threshold of performance level 3 (males)

When only literacy achievement is considered, the returns to high achievement, or conversely the penalty of poor achievement, are vey high. Relative to a person at the level 3 threshold, a person at the level 5 threshold (a score of 375 on the prose literacy scale) is expected to gain $8.13 per hour. A person at the level 2 threshold (a score of 225) has a penalty of $3.29. When educational attainment is taken into account, the return to literacy is approximately half of that observed for literacy alone. When all modelled factors are considered, including age, location and language background, the return is much more modest, being a gain $1.18 per hour at a score of 375 and a deficit of $0.51 per hour at a score of 225.

Returns to literacy: females

Again, the influence of literacy achievement on hourly wags is modelled (a) alone, (b) in the presence of educational attainment, (c) with educational attainment and post-school qualifications, and (d) net of all modelled variables. The regression parameters for literacy achievement in these models are 1.913×10^{-3}, 1.565×10^{-3}, 1.464×10^{-3}, and 1.631×10^{-3} respectively.

Net of other factors modelled, the change in the natural log of the hourly wage rate that attends a one unit change in prose literacy is 0.002. A change of one performance level (50 units on the literacy scale) therefore would lead to a change in the log of hourly wage of 0.082. This may be compared with the influence of each additional year of education for which the parameters are 0.029 (Model 4).

Table 5 Influences of selected characteristics on log of hourly wage rate (females)

	Parameter estimates				
	B	Std error	Beta	t	Sig.
Model 1					
Constant	2.680	0.098		27.211	<0.001
Prose literacy	0.002	0.000	0.162	6.569	<0.001
Model 2					
Constant	2.187	0.116		18.862	<0.001
Prose literacy	0.002	0.000	0.132	5.388	<0.001
Years of education					
Model 3					
Constant	2.400	0.121		19.848	<0.001
Prose literacy	0.001	0.000	0.124	5.069	<0.001
Years of education	0.020	0.006	0.109	3.357	0.001
University degree (ref=no) Has university degree	0.181	0.041	0.147	4.429	<0.001
VET qualification (ref=no) Has VET qualification	-0.025	0.031	-0.020	-0.805	0.421
Model 4					
Constant	1.252	0.270		4.642	<0.001
Prose literacy	0.002	0.000	0.138	5.460	<0.001
Years of education	0.029	0.007	0.159	4.472	<0.001
University degree (ref=no) Has university degree	0.189	0.042	0.153	4.540	<0.001
VET qualification (ref=no) Has VET qualification	-0.007	0.032	-0.005	-0.210	0.833
Age (years)	0.036	0.008	0.702	4.303	<0.001
Age squared	-0.000	0.000	-0.576	-3.505	<0.001
Location (ref Capital city) Balance of state	-0.071	0.025	-0.061	-2.873	0.004
First language (ref English) Other than English	-0.043	0.040	-0.029	-1.082	0.279
Home language (ref English) Other than English	-0.064	0.061	-0.030	-1.061	0.289
Physical health (SF12)	0.002	0.002	0.022	0.884	0.377
Mental health (SF12)	0.004	0.002	0.062	2.559	0.011
Lambda	0.029	0.007	0.159	4.472	<0.001

Note $R^2 = 0.163$; $F_{12,1995} = 33.460$, $p<0.001$ for Model 4

For females, the returns to literacy (measured in $ per hour) are rather less than those observed for males. The situation for females, relative to a person with a score of 275, is shown in Figure 2. Relative to a woman scoring at the level 3 threshold, a person at the level 5 threshold (a score of 375 on the prose literacy scale) is expected to gain $5.20 per hour when literacy achievement is considered in isolation from other factors. A woman at the level 2 threshold (a score of 225) has a penalty of $2.25. Compared to males, the benefits or penalties to literacy achievement are approximately two-thirds as great. When educational attainment is taken into account, the return to literacy is approximately half of that observed for literacy alone, the benefit of a high score (a score of 375) is $2.32 and the penalty of a low score is $1.03. Taking into account all modelled

factors, the return is much more modest, being a gain $0.97 per hour at a score of 375 and a deficit of $0.43 per hour at a score of 225.

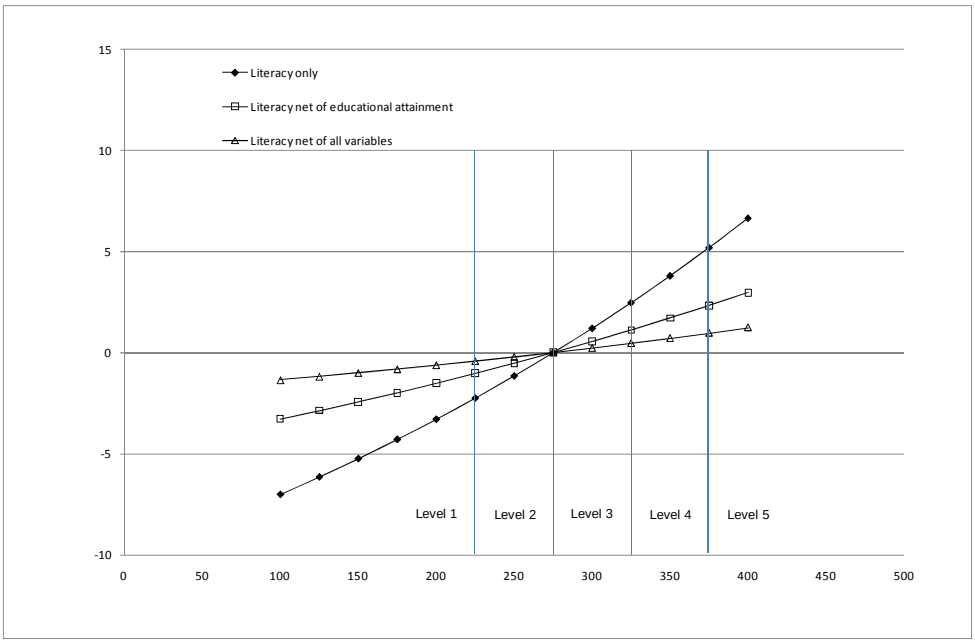

Figure 2 Returns to literacy achievement ($ per hour) relative to a person at the threshold of performance level 3 (females)

Summary and implications

The main interest in this paper is the influence of literacy skill on labour market outcomes, but a sequence of factors influence literacy achievement and therefore, directly or indirectly, affect labour market outcomes.

Two labour market outcomes are evaluated in this study, employment status (employed on a full- or part-time basis, unemployed, or not in the labour force) and wage returns to literacy. Hourly wage rates are used to assess the wages return.

Employment status

Having literacy achievement one performance level below another is associated with an increased likelihood of being out of the labour force, relative to full-time employment (26% for males and 22% for females). For males, there is also an increased likelihood of part-time rather than full-time work (by 18%). This effect is in addition to the influences of other factors such as educational attainment, age, language background and health.

Hourly wage rates

Hourly wage rates are used as an indicator of the productivity return to literacy skill achievement and to other factors.

When literacy skill is considered in isolation from other factors, it has a very strong influence on hourly wage rates. Males who score at the threshold of prose literacy performance level 4 (325 on the scale) earn on average $3.78 per hour more than those at the level 3 threshold (275 on the prose literacy scale). For females, the hourly gain is $2.48. When educational attainment is taken into account, the net hourly returns to an increase of one performance level in literacy are $1.87

and $1.12 for males and females respectively. While the gains, net of educational attainment ,are approximately half that of literacy considered alone, they remain considerable. Further, and while the modelling takes into account the likelihood of participating in the labour force, individuals with lower literacy levels tend to work fewer hours. When hours worked and hourly rates are considered, the returns to literacy are substantial.

Several other factors affect hourly wage rates. Holders of a post-school qualifications have a wages benefit, net of literacy and educational attainment. The return to university degrees may reflect the value placed on specific occupational skills, but it may also indicate a signalling function of the qualification. Males who hold a VET certificate or diploma also gain a net benefit from that qualification, although it is smaller that the return to a degree. Females enjoy the same return to a degree as males, but get no net return to a VET qualification.

There are wages penalties to living outside a capital city and to impaired physical health for males and females. In addition, there are penalties to males for having a first language other than English and to poor mental health. The lower wages observed for residents outside capital cities appears to reflect the occupations available in regional and rural locations.

Implications

It is apparent that increasing literacy achievement is likely to increase employment opportunities for males and females and that increases can be expected in wages returns to individuals. This is expected to lead to increases in productivity at a macro level, although this needs to be demonstrated for Australia. (It has been shown in a cross-national study, see Coulombe, Tremblay & Marchand, 2004).

In examining hourly wage returns, we did not take into account the number of hours worked. Analyses of employment status reveal that low literacy achievement is related to part-time rather than full-time employment for males. Therefore low literacy achievement is associated with working fewer hours and with a lower hourly return leading to a substantially lower annual return.

The improved employment outcomes for males and females suggest that some effort should continue to be expended on enhancing the literacy skills of Australian adults.

Further analyses are required to identify where effort should be invested. It seems obvious that those with the lowest literacy levels should be the main targets of interventions. From analyses of the influences of demographic characteristics on educational attainment and of education attainment on literacy achievement, we note that individuals from low SES backgrounds or whose parents had low educational attainment have low attainment themselves. This translates into lower literacy achievement. Further, we note that individuals from non-English-speaking backgrounds, and especially those whose main home language is other than English, have low literacy achievement.

Thus individuals, who are out of the labour force or who are unemployed, and individuals for whom English is a second or other language, and who have low literacy levels are obvious targets for literacy improvement programs. Programs exist for these groups, namely the Workplace English Language and Literacy (WELL) program, the Language Literacy and Numeracy Program (LLNP) and the Australian Migrant English Program (AMEP). The extent of investment in these programs could be established through an examination of the expected labour market returns to them and through an analysis of expected improvements to national productivity attributable to enhanced literacy skill for these groups.

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