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Skills, qualifications, experience and the distribution of wages

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SKILLS, QUALIFICATIONS, EXPERIENCE AND THE DISTRIBUTION OF WAGES

KEY FINDINGS

An important benefit of tertiary education is the ability of graduates to contribute to the economy, and receive higher wages in return. The Adult Literacy and Life Skills (ALL) survey provides a unique opportunity to look at the relationship of literacy skills and qualifications to hourly wages. This paper extends previous work in the area to look at the relationship of literacy skills and qualifications to the distribution of hourly wages.

The results of this analysis show that:

- People with higher levels of literacy have significantly greater opportunities to earn higher incomes, where they are earning above the median wage
- School qualifications and level 1-3 tertiary certificates provide limited opportunities for higher earnings compared with having no qualification
- Qualifications at level 4 and above provide greater opportunities for higher incomes for people who earn over the median wage
- Experience, as measured by age, has the strongest effect on increasing wages for people in higher wage jobs and has little effect on increasing wages for people in low wage jobs.

Introduction

An important benefit of tertiary education is the ability of graduates to contribute to the economy, and receive higher wages in return. There is an ongoing interest in how skills, knowledge and experience are rewarded in the workplace. This is often looked at in terms of the average earnings premiums associated with various levels and types of educational qualifications by age. In most data sets, qualifications are the only available measure of skills and knowledge. Age is often used as a proxy for experience.

Over the last 10 years there has been a greater focus on developing the literacy and numeracy skills of the adult population. Literacy is a general skill that enables people to understand information in various forms and apply it to work and life situations. In today's society, higher levels of literacy are required in a larger proportion of jobs. There is recognition that many adults do not have sufficient literacy and numeracy to function fully in a knowledge society and that lack of these skills may be holding back productivity in the workplace. Recent policy focus has been on developing these skills through work-place programmes and within lower-level tertiary qualifications.

The Adult Literacy and Life-Skills (ALL) survey provides an opportunity to look more directly at the combined effects of literacy skills and educational qualifications, along with experience. Most previous analyses have looked the effect of qualifications on total income, which includes the effect of labour market participation as well as wages. The ALL survey also provides an opportunity to look at the direct relationship to hourly wages. Hourly wages provide the most direct measure of the value a person receives from their labour.

Earle (2009a) used the data from the ALL survey to look at the overall relationship between skills, qualifications and wages and also looked at differences between industries and occupations. The analysis showed that a one standard deviation difference in literacy or

numeracy skills accounted for, on average, a 20 percent difference in hourly wages. This is similar to the average increase in earnings associated with holding a tertiary non-degree qualification, compared with having a school-level qualification, or the average increase in earnings associated with having a degree compared with a tertiary non-degree qualification. When literacy or numeracy skills and qualifications were considered together, the increase in wages attributable just to literacy or numeracy differences was reduced to around 10 percent for each standard deviation difference in literacy or numeracy skills. A change of one standard deviation is equivalent to a change of one level on the literacy and numeracy scales derived from the ALL survey, as presented in Satherley, Lawes and Sok (2008) and other reports.

This paper goes a step further to look at the ***distribution*** of wages for a given level of skill, qualification and experience. That is, do people with higher skills have a wider or narrower distribution of wages, given their qualifications, experience and other background characteristics?

Wages, skills and productive value

Hourly wages can be viewed as a measure of the productive value of an employee on the assumption that differences in wages reflect differences in the marginal value of production. That is, that a more productive worker will receive a higher reward for his or her labour, and that reward will reflect the skills, knowledge and ability applied to the job. In this manner, average hourly wages are used to develop measures of labour productivity which account for changes in labour quality (Schwerdt and Turunen, 2007 and Statistics New Zealand, 2008).

In practice, various other aspects of labour markets also influence wages, such as discrimination, collective bargaining, signalling and mismatch of supply and demand (Schwerdt and Turunen, 2007 and Ho and Jorgenson, 1999). During the period in which the ALL data was collected, employment rates were high and there was high demand for skilled employees. This gave rise to good opportunities for employees to attain jobs that matched their skills and qualifications. From the employer side, there were incentives to consider all applicants on merit and less incentive to filter on the basis of gender or nationality, or respond to signals such as level and type of qualification. Therefore, during this period, hourly wages can be regarded as an especially close approximation of the productive value of an employee.

Estimating effects across the wage distribution

Earle (2009a) made use of ordinary least squares regression (OLS) to estimate the effect of literacy or numeracy, qualifications and experience on wages. This approach estimates average wages as a function of skills, qualifications, experience and other factors. It assumes that the average is a good representation of the overall distribution of wages. However, just as the average value can provide an incomplete picture of the wage distribution, so too can the regression results provide an incomplete picture of the relationships between the predictive variables and the outcome. One strategy for completing the picture is to use quantile regression (Koenker and Hallock, 2001).

Quantile regression provides estimates for the relationships between variables and an outcome at different parts of the outcome distribution. It is useful for exploring changes in the shape of the distribution of wages, controlling for various factors. It is useful where there are complex interactions, of which not all can be measured, and where limiting factors may apply as constraints (Cade and Noon, 2003).

In the following analysis, quantile regression has been used to establish the relationship of the explanatory variables to the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} percentiles of the wage distribution.

These results are presented in two ways. The first is to show the difference in the wage premium across the wage distribution. In each of these graphs the quantile regression results are shown in the darker lines, with the dotted lines indicating the 90 percent confidence intervals.[1] The lighter, straight lines show the result of the OLS regression, that is the effect at the mean. The second is to show the predicted wage distributions, indicating the change in the wage distribution for one variable, having controlled for all of the other variables in the model. The results of the quanitle regression is shown as boxes and whiskers, with the mean values from the OLS regression overlaid as a continuous line. The wage values in the graphs apply to the specified reference group. If a different reference group was used, the values would be different but the relative position would be broadly the same.

Following Earle 2009a, the quantile regressions related the natural log of hourly wages to literacy, highest qualification, gender, first language and age. The models were run for people in employment, aged 26 to 65. This removes the distorting effects of students in part-time employment (as discussed in Earle 2009b).

Document literacy has been used in this paper because it provides an intermediate measure between prose literacy and numeracy. The assessment tasks involved understanding short texts, charts and tables. In this way, it most closely fits common workplace literacy and numeracy tasks.[2] The scale used in this report for document literacy is a standardised measure, where 0 represents the New Zealand population mean and 1 represents one standard deviation.

Further technical notes can be found at the end of this paper. The output from the models is available on http://www.educationcounts.govt.nz, along with the electronic version of this paper.

Effect of document literacy skills

The results of the quantile regression demonstrate that the wage premium for document literacy varies across the wage distribution.

Figure 1 below shows the increase in wages that can be attributed to a one standard deviation increase in document literacy across the wage distribution. The straight light lines show the average premium (as calculated by the OLS regression). On average, a one standard deviation increase in document literacy is associated with a 12 percent increase in wages, after controlling for qualifications, age and other factors. The heavy lines show the change in the premium across the wage distribution (as calculated by the quantile regression). This shows that a one standard deviation increase in document literacy is associated with a 10 percent increase in wages at the lower end of the wage distribution and about a 15 percent increase at the top end. This suggests that the wage rewards for higher document literacy are proportionately higher for people in higher wage jobs.

[1] At the 90 percent confidence interval, if the confidence intervals for two values are not overlapping, it can be safely assumed that the values are statistically significantly different. This is not the case at the 95 percent confidence interval.

[2] In addition, each respondent in the ALL survey was only required to attempt assessment tasks in some of the domains. Their scores for the other domains were then imputed based on their results in the completed task and their background characteristics. Prose and document literacy had the highest proportion of attempted tasks in the New Zealand sample (77 percent). In numeracy and problem solving, only 33 percent of respondents attempted assessment tasks. The large proportion of imputed values for numeracy results in a high correlation with prose and document literacy. Applying quantile analysis to the numeracy scores revealed very little difference in results from prose and document literacy.

Figure 1
Wage premium for a one standard deviation increase in document literacy

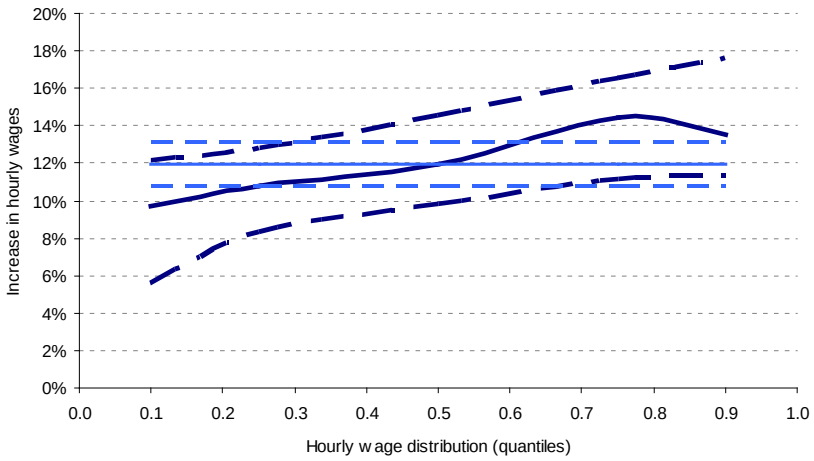
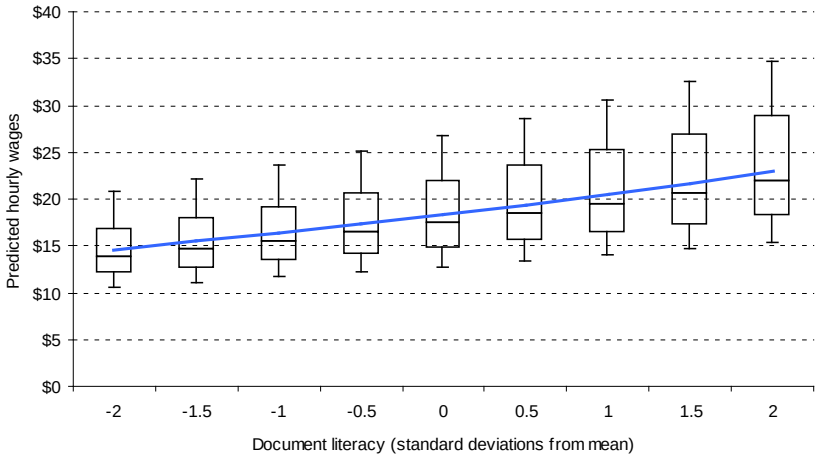


Figure 2 shows the predicted distribution of wages at various levels of document literacy, having controlled for qualifications, age and other factors. This chart shows that the effect of increased document literacy is to widen the distribution of earnings for people with incomes above the median. From this analysis it can be concluded that people with higher levels of document literacy have significantly greater opportunities to earn higher incomes, where they are earning above the median wage.

Figure 2
Predicted distribution of hourly wages by document literacy



Note: Boxes indicate the range from 25th to 75th percentile, the line dividing the boxes indicates the median and the bars indicate the 10th and 90th percentile. The predicted average wage, from the OLS regression, is shown as the continuous line. The reference group is males, aged 40, with no qualifications, who speak English as a first language.

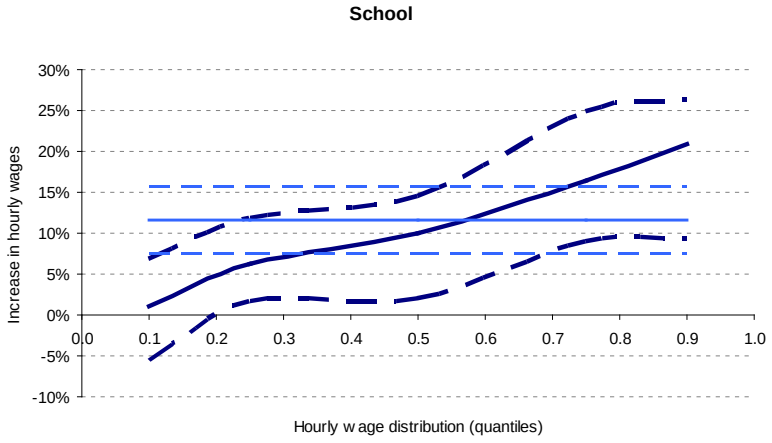
Effect of qualifications

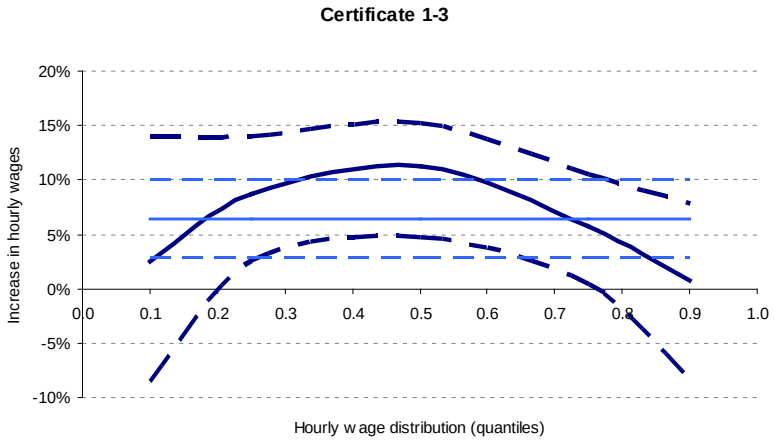
The OLS regression results show consistently increasing average wage premiums for higher levels of tertiary qualifications. Compared to no qualification, and controlling for literacy, age and other factors, a school qualification is associated with a 12 percent increase in wages on average. A tertiary level 1 to 3 certificate is associated with only a 6 percent increase compared with no qualification, a tertiary non-degree qualification is associated with a 21 percent

increase, a degree with a 43 percent increase and a postgraduate qualification with a 67 percent increase.

Figure 3 compares the results of the quantile regression with the averages from the OLS regression. These results show different patterns of premium for each level of qualification across the wage distribution compared with no qualification. There is little to no premium for school qualifications in the low income jobs, while the premium increases significantly with wage levels. For people with level 1 to 3 certificates, the income advantage compared to no qualification is mostly in the middle of the wage distribution. People at both the bottom and top of the distribution have little advantage compared with no qualifications. For people with level 4 to 7 certificates and diplomas, the premium rises steadily from low to middle income jobs and again picks up in high income jobs. For people with degrees, the premium is lower in low income jobs and higher in the highest income jobs. However, for postgraduate qualifications the premium is fairly steady across the wage distribution, although it does increase at the upper level.

Figure 3
Wage premiums for qualification levels compared with no qualification





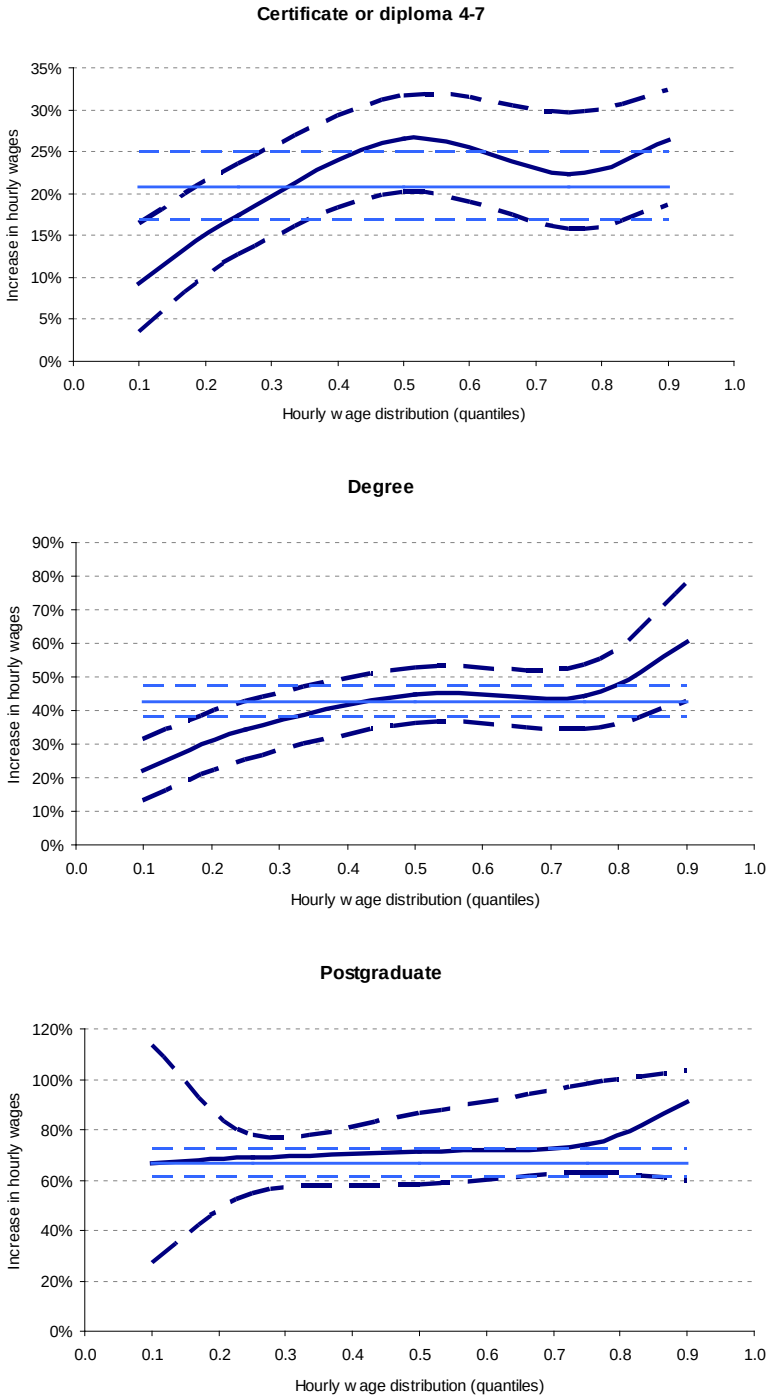
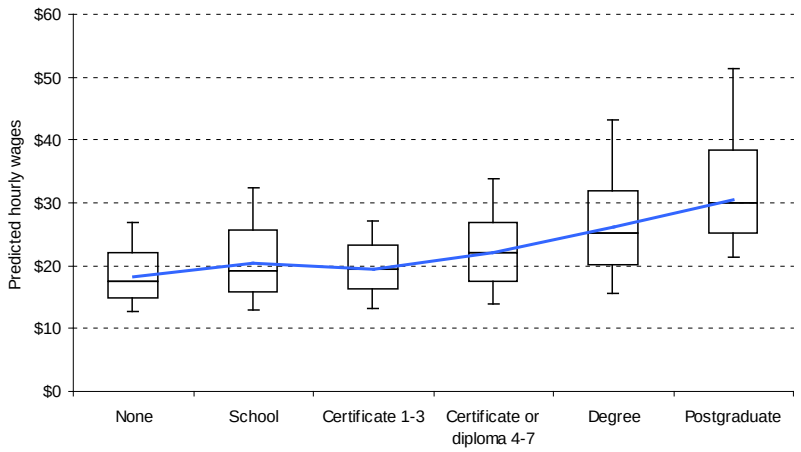


Figure 4 shows the predicted distribution in wages for each qualification level, having controlled for document literacy, age and other factors.

The results show a small gain in median wages for people with school qualifications or level 1 to 3 tertiary certificates, compared with people with no qualifications. People with school qualifications have a higher range of wages at the top end, while people with level 1-3 tertiary certificates have a more restricted range of earnings. From level 4 certificates to postgraduate qualifications there is a steady increase in the median wage for each qualification level. There is also a broader distribution of wages above the median at each level. Another way of looking at this result is to conclude that attaining a degree or above is essential to entry to higher paid jobs.

Figure 4
Predicted distribution of hourly wages by highest qualification



Note: Boxes indicate the range from the 25th to 75th percentiles, the crosses indicate the median and the bars indicate the 10th and 90th percentiles. The predicted average wage, from the OLS regression, is shown as the continuous line. The reference group is males aged 40, with mean document literacy, who speaks English as a first language.

Effect of experience

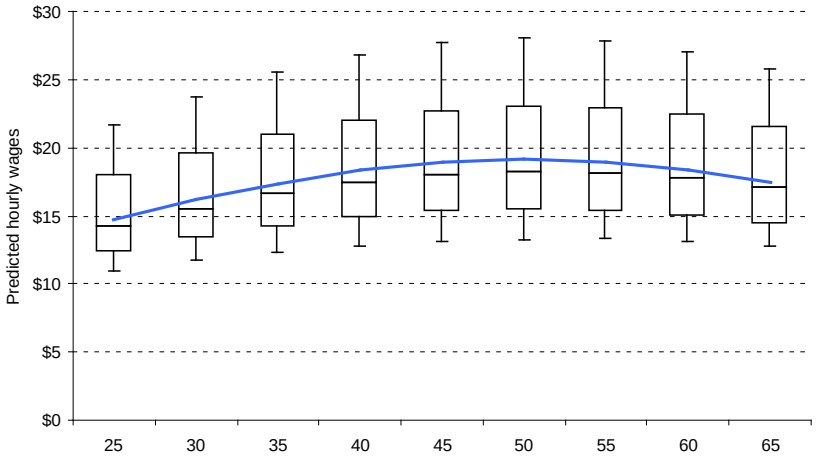
In the models, age can be interpreted as a proxy for experience. Both age and age-squared are included to capture the changing returns to experience. The greatest returns to experience are in the earlier years of working life. After this wages tend to flatten out and then diminish somewhat on average.

The inclusion of age and age-squared in the models means that it is not particularly informative to look at the premiums across the wage distribution. It is more informative to look at the predicted distribution of wages, having controlled for document literacy, qualifications and other factors, as shown in Figure 5.

The results from the OLS regression show the average wage increasing to age 50 and then decreasing. The results from the quantile regression show that the median wage increases steadily from age 25 to age 45, flattens out and then declines somewhat for people aged over 55. In the younger age groups, the distribution of wages below the median is quite narrow. However, with increased age, it is the upper distribution that broadens out more than the lower distribution, with the estimated wage at the 90th percentile peaking at age 50. Similarly for those aged over fifty, the upper distribution of wages begins to narrow again.

The other way of reading this graph is to say that in low income jobs, experience (as measured by age) has little impact on wages, after controlling for qualifications and literacy skills. In middle income jobs, experience continues to have a positive effect on wages to around age 45. In high income jobs, experience continues to have an effect on wages to age 50.

Figure 5
Predicted distribution of hourly wages by age



Note: Boxes indicate the range from the 25th to 75th percentiles, the crosses indicate the median and the bars indicate the 10th and 90th percentiles. The predicted average wage, from the OLS regression, is shown as the continuous line. The reference group is males, with no qualifications and mean prose literacy, who speaks English as a first language.

Effect of gender and first language

Gender and first language were included in the model to control for the two largest demographic impacts on the relationship between qualifications, literacy skills and experience and wages.

Figure 6 shows that on average, men earn 18 percent more than women having controlled for document literacy, qualifications and age (according to the OLS result). The quantile regression results suggest that this wage difference is constant across most of the wage distribution. The gender gap is slightly lower in the lowest paid jobs and slightly higher in the highest paid jobs.

Figure 6
Wage premium for males compared with females

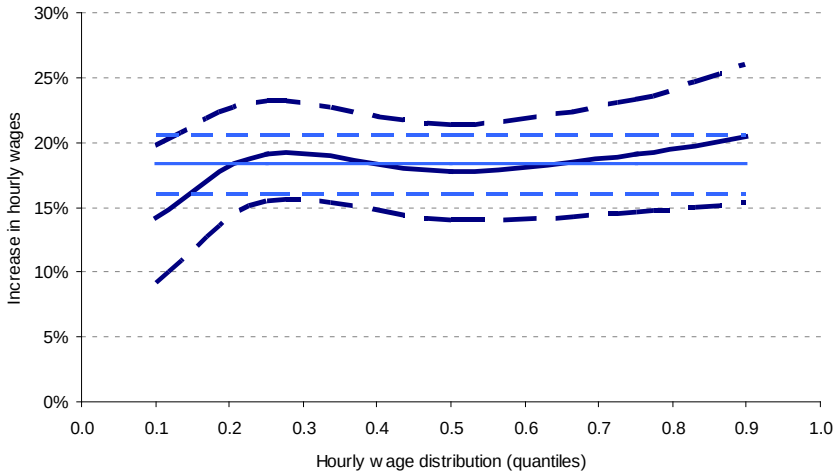
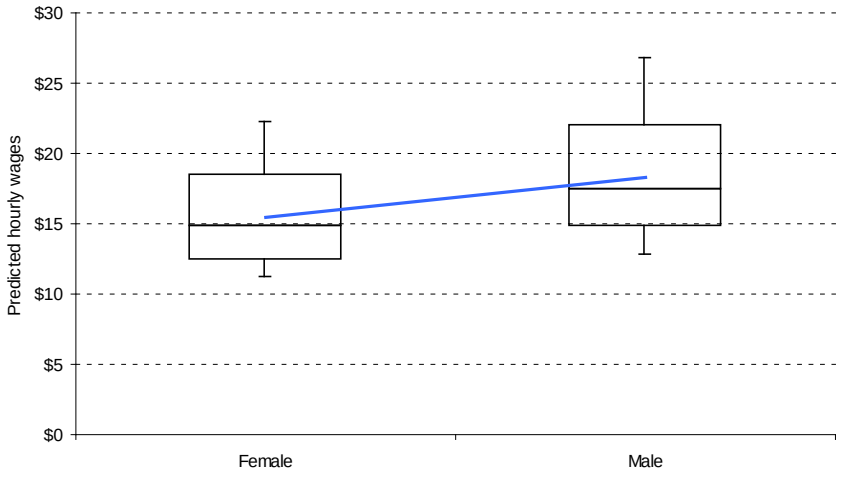


Figure 7 shows the predicted values for the wage distribution, with a wider spread of wages for men earning above the median wage.

Figure 7
Predicted distribution of hourly wages by gender



Note: Boxes indicate the range from 25th to 75th percentile, the line dividing the boxes indicates the median and the bars indicate the 10th and 90th percentile. The predicted average wage, from the OLS regression, is shown as the continuous line. The reference group is people aged 40, with no qualifications and mean document literacy who speak English as a first language.

Figure 8 shows that on average people with English as first language earn 14 percent more than people with English as an additional language, having controlled for English-based document literacy, qualifications and age (according to the OLS results). The quantile regression results suggest that the advantage of having English as a first language is greater in low paid jobs than in higher paid jobs. This may be an effect of people with English as an additional language working in lower paid jobs than would be expected given their English-based literacy, qualifications and experience.

Figure 8
Wage premium for having English as a first language

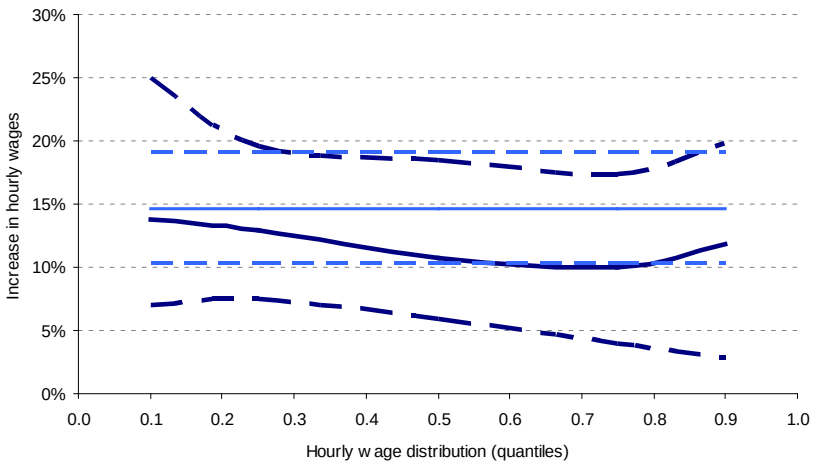
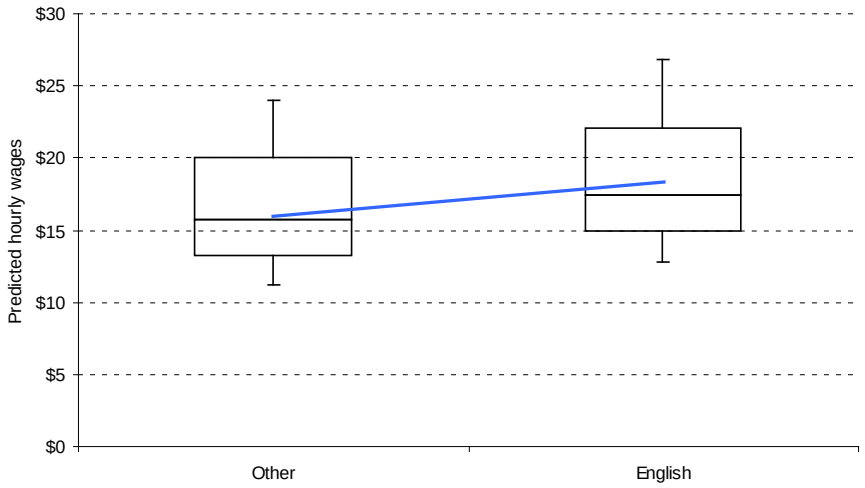


Figure 9 shows that this effect has a small difference on the distribution of wages. People with English as a first language have a slightly wider distribution of wages above the median and people with English as an additional language have a slightly wider distribution of wages below the median.

Figure 9
Predicted distribution of hourly wages by first language



Note: Boxes indicate the range from 25th to 75th percentile, the line dividing the boxes indicates the median and the bars indicate the 10th and 90th percentile. The predicted average wage, from the OLS regression, is shown as the continuous line. The reference group is males aged 40, with no qualifications and mean document literacy.

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Technical notes

The ALL survey was conducted in 2006 and had an achieved sample of 7,131 New Zealanders aged 16 to 65. The survey had a response rate of 64 percent. The survey was validated against official statistics to ensure it was representative of the New Zealand population. The technical notes in Earle (2009a) provide further details about the extent to which results from the ALL survey match other official data sources.

This analysis uses a sub-sample of 3,277 people, who were aged 26 to 65, were in employment at the time of the survey and had valid data from which to derive an hourly wage.

The regression models were all run using SAS. The OLS regressions were run using PROC SURVEYREG (using the population weight and the 30 replicate weights) and the quantile regressions were run using PROC QUANTREG (using the population weight only). The procedures were run using each of the five plausible values of document literacy. The estimates are the average of the estimates across the results from the five runs. The standard error is the square root of the sample variation and the imputation variance. The sample variance is the mean of the variances across the five plausible values. The imputation variance is the variance of the estimates. The outputs of the models are available on http://www.educationcounts.govt.nz along with the electronic version of this paper.

The same definitions of variables were used as listed Appendix A of Earle (2009b). Of particular note are that:

- Document literacy has been standardised for the entire population aged 16 to 65 to a mean of 0 and a standard deviation of 1.
- In this report, school-level qualifications have been split out into qualifications attained at school and level 1 to 3 certificates attained through tertiary education.
- First language refers to the language the respondent first learned at home and still understands.