Skills, qualifications and wages

An analysis from the Adult Literacy and Life Skills Survey

Literacy, language and numeracy research

This report forms part of a series called literacy, language and numeracy research.
This series covers research on teaching and learning in literacy, language and numeracy and analyses of
international surveys on adult literacy and numeracy.

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Key findings

— Higher English-based literacy and numeracy and higher qualifications are both related to higher hourly wages

— The effects of literacy and qualifications differs across industries, with

  o agriculture, forestry and fisheries only rewarding higher literacy and not higher qualifications, and

  o construction, finance and real estate, and education and training only rewarding higher qualifications and not higher literacy.

— All industries reward higher numeracy. This is in addition to premiums for qualifications, with the exception of agriculture, forestry and fisheries.

— There is no premium for either skills or qualification in agricultural worker and labourer occupations.

— In most other occupations, qualification level determines entry and premiums are paid for higher levels of literacy or numeracy skills within the occupation.

— Administrator and manager occupations are notable for paying substantial premiums for both literacy and numeracy in addition to premiums for qualification level.

— Overall, females earn less than males even after controlling for qualifications, skills levels, first language, age and hours of work.

— Higher levels of numeracy have a greater positive effect on wages for women than for men.

— The increase in median wages from 25 to 35, having controlled for other factors, is similar in size to the increase attributable to holding a tertiary non-degree qualification.

— Overall, people with English as an additional language earn less than those with English as a first language – however, in most occupations this effect disappears once their English-based literacy or numeracy is taken into account.

— Managers and administrators with English as an additional language are likely to earn less, even after their English-based literacy or numeracy and their educational qualifications are taken into account.

Executive summary

Recent studies have shown a positive relationship between the proportion of the workforce with higher-level tertiary qualifications and labour productivity. The Adult Literacy and Life Skills (ALL) Survey provides an opportunity to look at skill levels in literacy and numeracy, along with educational qualifications, and relate these to hourly wages within industries and occupations. Hourly wages can be viewed as a measure of employee productivity.

This study uses the ALL data to look at the extent to which hourly wages can be explained by skills and qualifications across industries and occupations. It addresses the following questions:

- Do employers value educational qualifications or skills or both?

- For employees with the same level of educational qualification, how much additional value is put on higher levels of literacy and numeracy?

- For employees with the same level of literacy or numeracy, how much additional value is put on having a higher level of education?

- Do some industries or occupations put greater value on literacy and numeracy than others?

The findings of this study are presented in three sections. The first looks at the distribution of literacy and numeracy skills for people in employment. The second looks at the distribution of hourly wages. The third presents results of regression models looking at the relationships of skills, qualifications, occupation and industry to hourly wages.

Skills of people in employment

The ALL survey measured English-language based skills across four domains: prose literacy, document literacy, numeracy and problem solving. For people in employment, these domains are highly correlated with each other. The largest differences in the scores of individuals were between numeracy and prose literacy and between numeracy and problem solving.

There is a moderate but definite relationship between skill levels in each of these domains and qualification level. The difference in score between those with no qualification and those with a bachelors degree represents just over one standard deviation of the score distribution for each domain.

The ALL tests were conducted in English, resulting in a noticeable difference in test scores for people with English as an additional language. These differences persist across educational levels and are larger for people who have a non-European language as their first language and/or immigrated to New Zealand as an adult.

Literacy and numeracy scores vary by age, with people aged 30 to 49 having the highest median scores.

People with the highest levels of skills are most likely to work in finance and real estate, professional and administrative services or education and training. People with the lowest levels of skills are most likely to work in primary industries, manufacturing, construction, retail and wholesale trade and health and social services.

In terms of occupation, people with the highest skill levels are most likely to work as administrators and managers, professionals or technicians and associate professionals. People with the lowest levels of skill are most likely to work as agricultural workers, plant and machinery operators and assemblers or labourers.

Hourly wages

Hourly wages are related to both qualification levels and skills. The effect of having a tertiary qualification is to not only to increase median incomes but also to extend the relative range of income that it is possible to earn. Similarly, with skill levels, people with low skills have a relatively restricted range of hourly wages, compared to people with higher skills. A 50 point difference in skills (around one standard deviation) is associated with 20 percent difference in hourly wages. This is just slightly less than the differences in average wages between a person with no qualification and a person with a non-degree tertiary qualification.

People with English as an additional language are likely to earn less. This effect is evident across all qualification levels, but is greater for those with tertiary qualifications. This difference remains even once English-based literacy skills are accounted for. Immigrants with a non-European language as their first language earned less than immigrants with a European language as their first language, even once qualifications and English-based literacy skills were accounted for.

Overall, women have lower hourly wages than men. These differences also persist across qualification levels, with the smallest difference being at degree level. Average hourly wages increase with age up until the age of 45 and then decrease after that.

The distribution of hourly wages varies by industry. The highest median wages are in professional and administrative services and education and training. The lowest are in retail and wholesale trade. Wages also vary by occupation, with managers, professionals and technicians earning the highest wages, while agricultural workers earn the lowest. There is a small but distinct relationship between hours worked and hourly wages, with people working longer hours being more likely to be paid more per hour.

Relationship of skills and qualifications to wages

Wages can be explained by a number of factors. These include the characteristics of the individual, such as age and gender, as well as the combination of literacy and numeracy skills and educational qualification.

Characteristics such as age, gender, language and hours worked explain around 20 percent of the variation in hourly wages. Adding in literacy or numeracy skill explains 30 percent of the variation. If educational qualifications are considered instead of skills, then 34 percent of the variance can be explained. Considering both qualifications and skill level (in addition to the other characteristics) explains almost 40 percent of the variance in hourly wages.

When age, gender, first language, hours worked are controlled for:

— A one standard deviation increase in either prose literacy or numeracy results in just over a 10 percent increase in hourly wages (when holding qualifications constant)

— Given the same level of skills and compared with no qualification, a school-level qualification results in a 9 percent increase in hourly wages, a tertiary non-degree

qualification in an 18 percent increase, a bachelors degree in a 38 percent increase and a postgraduate qualification in a 64 percent increase.

Having controlled for English-language prose literacy or numeracy skill and qualification level:

— Females are still likely to earn about 13 percent less than males – the difference being smaller when numeracy is controlled for (when holding all other factors constant)

— The increase in median wages from 25 to 35 years of age is similar to the effect attributable to gaining a tertiary non-degree qualification. The age period can be interpreted as representing the development of on-the-job experience.

— Native English speakers are still likely to earn 13 percent more than those with English with an additional language (when holding all other factors constant)

Taking the industry of employment into consideration adds some further explanation to hourly wages, in addition to individual characteristics, skills and qualifications. There are also interesting differences in the effect of skills and qualifications within industries.

When age, gender, first language and hours worked were taken into account:

— In agriculture, forestry and fisheries there is no premium for qualifications once prose literacy or numeracy is taken into account – with the premium for numeracy being higher than that for prose literacy

— In construction and education and training there is no premium for prose literacy once qualifications are taken into account. However, this is not the case is numeracy is taken into account. That is, numeracy is rewarded over and above educational qualifications in these industries

— In industries that have premiums for both skills and qualifications, prose literacy is most highly rewarded in professional and administrative services and numeracy is most highly rewarded in health and social services.

When skills and qualifications were taken into account:

— Females are likely to earn less than males in half of the industries – with the effect reduced when numeracy is taken into account

— Hourly wages increased from age 25 to 35 across all industries

— Native English speakers are likely to earn more than people with English as an additional language in four out of the ten industries.

Occupation provides a very strong predictor of wages. Adding skills and qualifications in addition to occupation doesn't add much further explanation, suggesting that occupation acts as a strong proxy for skill and qualification level. Again, the more interesting differences are in the effect of skills and qualifications within occupations.

When age, gender, first language, hours worked are taken into account:

— There is no additional premium for either skills or qualifications for agricultural workers and labourers

- There is no premium for prose literacy or numeracy for clerks once qualifications are controlled for

- In other occupations, there were greater rewards for higher numeracy skills than for higher literacy skills

- There are only additional premiums for qualifications over skills for administrators and managers, technicians and associate professionals. This reflects qualifications acting as an entry requirement to many occupations.

- Prose literacy is most highly rewarded in sales and service worker and professional occupations. Numeracy is most highly rewarded in professional, technical and associate professional and trade worker occupations.

When skills and qualifications are taken into account:

- Females are likely to earn less than males in most occupations, even after other factors are controlled for

- Hourly wages increased with age across all occupations

- In nearly all occupations, hourly wages are the same for people with and without English as a first language, once English-based literacy or numeracy is controlled for

- Administrative and management occupations is the only occupational group where native English speakers continued to earn more than people with English as an additional language after controlling for English-based literacy or numeracy skill.

1 Introduction

1.1 Purpose and key questions

Recent studies of productivity in New Zealand (Razzak and Timmins, 2008a and Szeto and McLoughlin, 2008) have shown that there is a positive relationship between the proportion of the workforce with higher-level tertiary qualifications and labour productivity. However, these studies relied on using educational qualifications as a proxy for skills and knowledge. People who undertake more education are likely to have higher levels of literacy, numeracy and other cognitive skills. It is not clear whether the relationship to productivity is a result of educational achievement or the innate ability of those who hold higher level qualifications (Leigh, 2008).

The Adult Literacy and Life Skills (ALL) Survey provides an opportunity to look at skill levels in numeracy and literacy separately from educational qualifications and relate these to hourly wages.

Hourly wages can be viewed as a measure of employee productivity 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 a situation for employees where there were 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 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 a close approximation of the productive value of an employee.

This study uses the ALL data to look at the extent to which hourly wages can be explained by skills and qualifications across industries and occupations. It addresses the following questions:

- Do employers value educational qualifications or skills or both?

- For employees with the same level of educational qualification, how much additional value is put on higher levels of literacy and numeracy?

- For employees with the same level of literacy or numeracy, how much additional value is put on having a higher level of education?

- To what extent to do other factors, such as age, gender and first language still affect wages once literacy, numeracy and/or qualifications are accounted for?

- Do some industries put greater value on literacy and numeracy than others?

- Do some occupations reward literacy and numeracy more than others?

The answers to these questions illuminate important policy questions about whether the greater economic value lies in raising literacy and numeracy or raising qualification levels or in raising both.

Further analysis is required to look at the relationship of education and skills to labour market participation. Hourly wages captures the 'productivity effect' of education and skills. However, people with higher levels of education are likely to also have greater labour market participation. That is, they are more likely to have full-time employment in permanent positions. This has an additional effect on annual income (Leigh, 2008). The 'participation effect' may vary across industries and occupations.

1.2   The Adult Literacy and Life-skills (ALL) Survey

The Adult Literacy and Life Skills (ALL) Survey directly measured the literacy, numeracy and problem solving skills of an achieved sample of 7,131 New Zealanders aged 15 to 65 in 2006. The survey also collected extensive background information on education, employment, income and other areas.

The ALL survey tested skills across four domains:

— **Prose literacy** – the ability to read continuous texts, such as news stories and instruction manuals

— **Document literacy** – the ability to read discontinuous texts, such as maps and timetables

— **Numeracy** – the ability to read and work with numeric information

— **Problem solving** – the ability to reason in situations where no routine procedure exists.

The tests were designed to assess skills across the full range of competency, from limited to highly-developed skills. However, the tests were designed to cover general, cognitive skill levels and did not attempt to assess specialist knowledge and skills (see Satherley and Lawes, 2007).

For this report a sub-sample of 4,137 respondents to the survey has been used. This sample was defined on the basis of being in paid employment within the last 12 months. Self-employed people were excluded on the basis that they have a different income distribution and also that their income reflects a return on capital as well as labour.

The ALL survey asked respondents to identify their main job in the last 12 months and collected information about the occupation and industry of employment, as well as their income from it. There were a series of questions about hours worked and pay that can be used to calculate the hourly wage for their main job.[1] The sub-sample was restricted to people whose calculated hourly wage was between $4.50 and $130. This removed a small number of extreme observations, many of which appeared to be the result of data entry or response errors. In calculating the hourly wage, the maximum hours worked per week was set at 60 hours. That is, 60 hours was used in the calculation for anyone with 60 hours or more per week. This reduced the effect of extreme values and response errors.

1.3   Report structure

The findings of this study are presented in three sections.

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[1] These questions are separate from those asked about total annual income, which have been used in other reports, such as Satherley et al (2008) and Schagen and Lawes (2009).

The first section looks at the distribution of literacy and numeracy skills for people in employment. The purpose of this section is to understand how differences in skills relate individually to factors such as educational qualifications, age, gender, first language, industry and occupation.

The second section looks at the distribution of hourly wages. The purpose of this section is to understand how wages relate individually to literacy and numeracy and qualifications, as well as other factors.

The third section looks at how literacy and numeracy interact with other factors to influence wages. It presents four regression models looking at prose literacy and numeracy by occupation and by industry. These models examine the effects of skill level, qualification and other factors on wages.

2 Skills of people in employment

This first section looks at the distribution of literacy and numeracy skills of people in employment by factors such as educational qualifications, age, gender, first language, industry and occupation. The purpose of this section is to understand how differences in skills relate to each of these other factors individually.

2.1 Relationships between skill domains

As noted in the introduction, the ALL survey measured literacy and numeracy skills across four domains. These domains are closely related and interdependent, with the result that the measures for each were highly correlated with each other.

Table 2.1 shows the correlations between scores for people in employment. It shows that strongest correlation was between document literacy and prose literacy. The weakest correlations were between prose literacy and numeracy and numeracy and problem solving.

Table 2.1: **Correlations between ALL skill domains for people in employment**

	Document literacy	Numeracy	Problem Solving
Prose literacy	0.92	0.82	0.88
Document literacy		0.87	0.87
Numeracy			0.82

Figure 2.1 shows distribution of score differences between the domains, after applying a standard distribution to scores within each domain. It provides a different visualisation of the information in Table 2.1, with the range of differences following the pattern of the correlation values. Comparing prose and document literacy, half of those in employment had scores within one quarter of a standard deviation each other and 90 percent had scores within two-thirds of a standard deviation. Comparing prose literacy and numeracy, half of those in employment had scores 0.4 of a standard deviation, and 90 percent had scores within one standard deviation.

Figure 2.1: **Distribution of differences in standardised scores between ALL skill domains for people in employment**
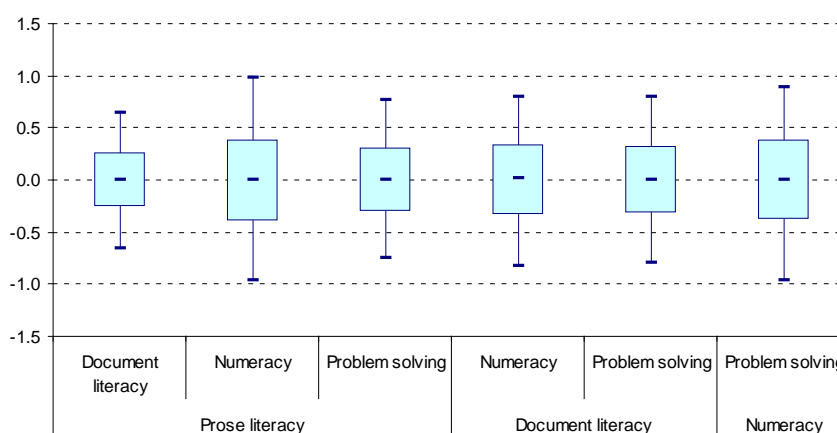
Note: The graph shows the distribution of the difference between standardised scores in the top category line and the score in the bottom category line. Where the standardised scores are the same the value is shown as zero. Each score was standardised to a distribution of mean 0 and standard deviation 1. Boxes indicate range from 25th to 75th percentiles. Line indicates median. Bars indicate range from 5th to 95th percentile.

These two measures show that prose and document literacy were most closely related for people in employment. Numeracy and prose literacy, and numeracy and problem solving, were the least closely related skills.

2.2   Skills and qualifications

For people in employment, there was a moderate but definite relationship between skill levels and qualifications. The differences are more noticeable for people with lower levels of educational qualifications. The difference in literacy and numeracy skill between those with degrees and those with postgraduate qualifications was minimal.

The relationship between qualification level and skills was similar across all four domains, with a slightly stronger relationship in the case of numeracy. The difference in median scores between no qualifications and a bachelors degree was 57 points for all domains, with the exception of numeracy where it was 67 points. The differences represent just over 1.1 to 1.2 standard deviations for each domain.

Figure 2.2:   Skill levels by highest qualification for people in employment
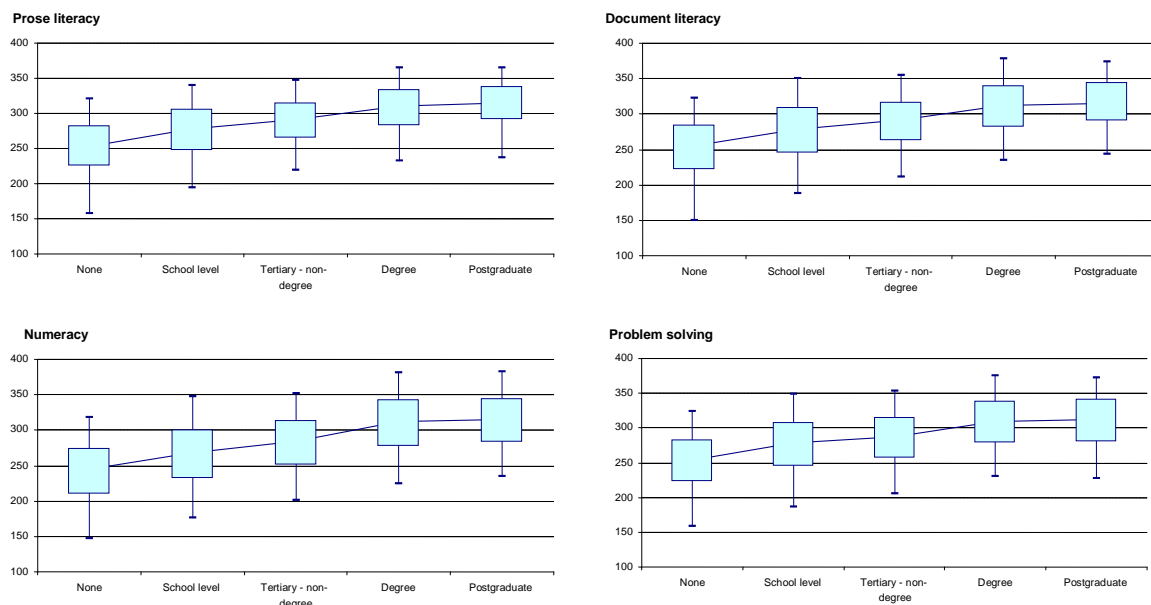
Note: Boxes indicate range from 25th to 75th percentiles. Line indicates median. Bars indicate range from 5th to 95th percentile.

2.3   Skills and first language

The ALL tests were conducted in English, resulting in a noticeable impact on test scores according to whether the person had English as a first language or not. These differences persisted across educational levels. While the distributions are wider for people with lower levels of education, the differences in the median scores between those with and without English as a first language were similar across all levels of education. After taking educational level into account, having English as a first language adds on average from 42 points for prose literacy and

to 53 points for problem solving[2]. These differences represent 0.89 and 0.97 standard deviations in each case.

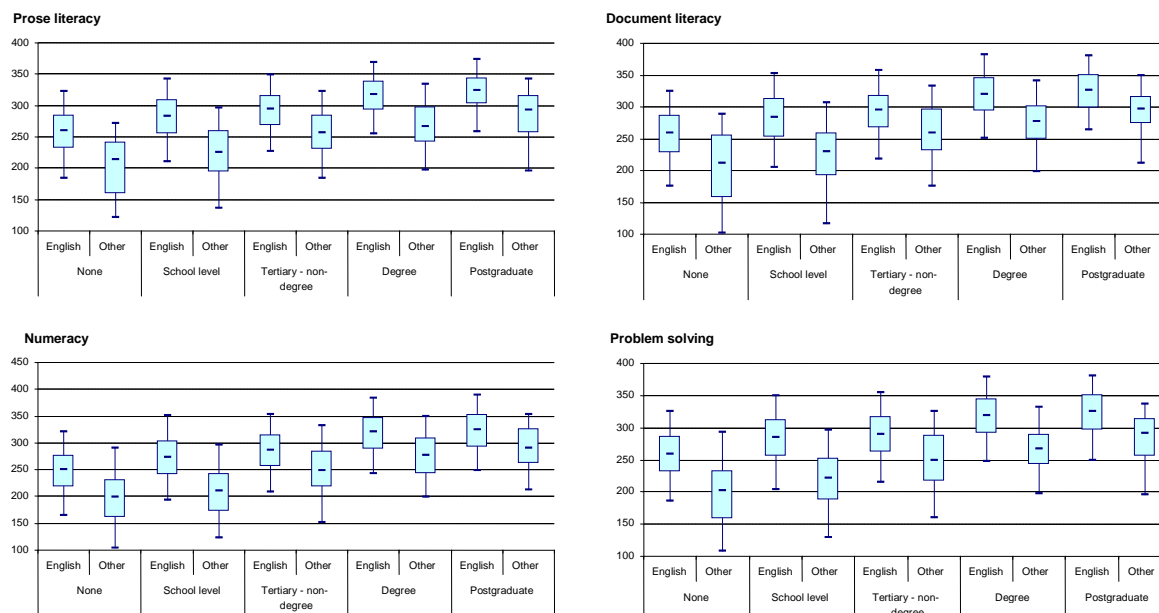**Figure 2.3:   Skill levels by first language and highest qualification for people in employment**

Note: Boxes indicate range from 25th to 75th percentiles. Line indicates median. Bars indicate range from 5th to 95th percentile.

For immigrants with English as an additional language, their age at immigration had a major impact on their literacy and numeracy scores. Those who arrived in New Zealand before they turned 16 had literacy and numeracy scores that were around 30 to 40 points higher than those who arrived in New Zealand at age 16 or older[3].

There were also differences in literacy and numeracy scores across first languages spoken by adult immigrants. Adult immigrants with a European language as their first language had slightly lower scores than immigrants with English as a first language, with no statistically significant difference in numeracy scores. Immigrants with a non-European language as their first language had significantly lower literacy and numeracy scores than immigrants with a Western European language as their first language[4].

2.4   Skills and age

The ALL survey is a snapshot of skills in the adult population as at 2006. In looking at skills and age of people in employment it is important to understand that differences reflect differences in opportunities to participate in education as well as differences that occur as people grow older and gain experience.

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2   Estimates are linear regression coefficients, where the ALL score is the dependent variable and language and qualifications are classification variables.

3   Estimates are linear regression coefficients, where the ALL score is the dependent variable and arrival before or after age 16 and qualifications are the classification variable. Models were run for those in employment for people whose first language was not English.

4   Based on linear regression using ALL scores as the dependent variable and first language and qualifications as classification variables. Models were run for those in employment who immigrated to New Zealand at age 16 or older.

Across all four skill domains, there was a similar pattern whereby the median skills of those in employment increased with age for people aged under 30. This was less pronounced in document literacy than in the other three domains. People aged 30 to 49 had similar levels of skills. Skill levels were lower for people aged 50 and over. The differences by age were most apparent at the median and 75th percentile. For those at the bottom of the skills distribution, there appears to be less variation by age.

The increase in median skills for people aged 15 to 30 most likely reflects the further development of skills as younger people gain experience in the workforce. It will also be an effect of higher skilled people staying longer in education before entering employment. These people will not be counted in employment until their mid-twenties. The decrease in skills for people aged 50 and over is likely to reflect generational differences. Those aged 50 and over in 2006 had fewer opportunities to undertake further education than those aged under 50.

Figure 2.4:   Skill levels by age for people in employment
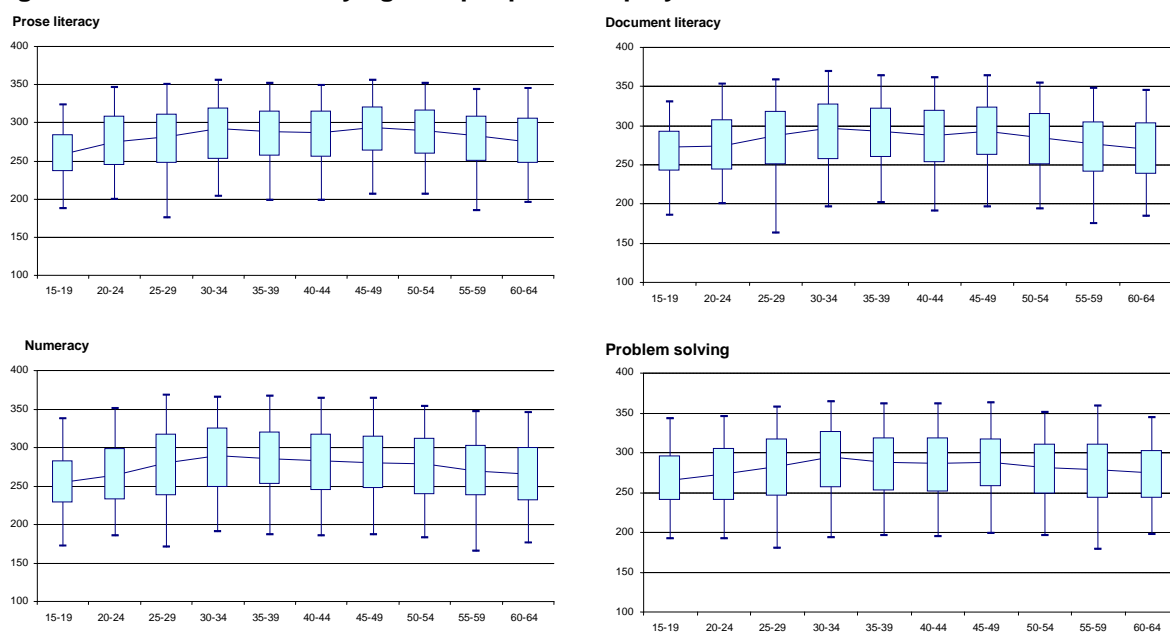
Note: Boxes indicate range from 25th to 75th percentiles. Line indicates median. Bars indicate range from 5th to 95th percentile.

2.5   Skills and industry

The distribution of skill levels varied across industries. Primary, manufacturing, construction, trade and transport industries, on average, had employees with lower skill levels. The distribution of skills across these industries was very similar in all four domains.

The finance, professional, education, health and other service industries, on average, had employees with higher skills. In prose literacy, education had the highest skill profile. In document literacy, finance and real estate and professional and administrative services had the highest skill profile. In numeracy, professional and administrative services had the highest skill profile. In problem solving, professional and administrative services and education had the highest skill profile.

Looking at the overall distribution, people with the highest skill levels were most likely to be found in finance and real estate, professional and administrative services and education. People with

the lowest skills were most likely to be found in primary industries, manufacturing, construction, retail and wholesale trade and health and social services.

Figure 2.5:   Skill levels by industry

Note: Boxes indicate range from 25th to 75th percentiles. Line indicates median. Bars indicate range from 5th to 95th percentile.
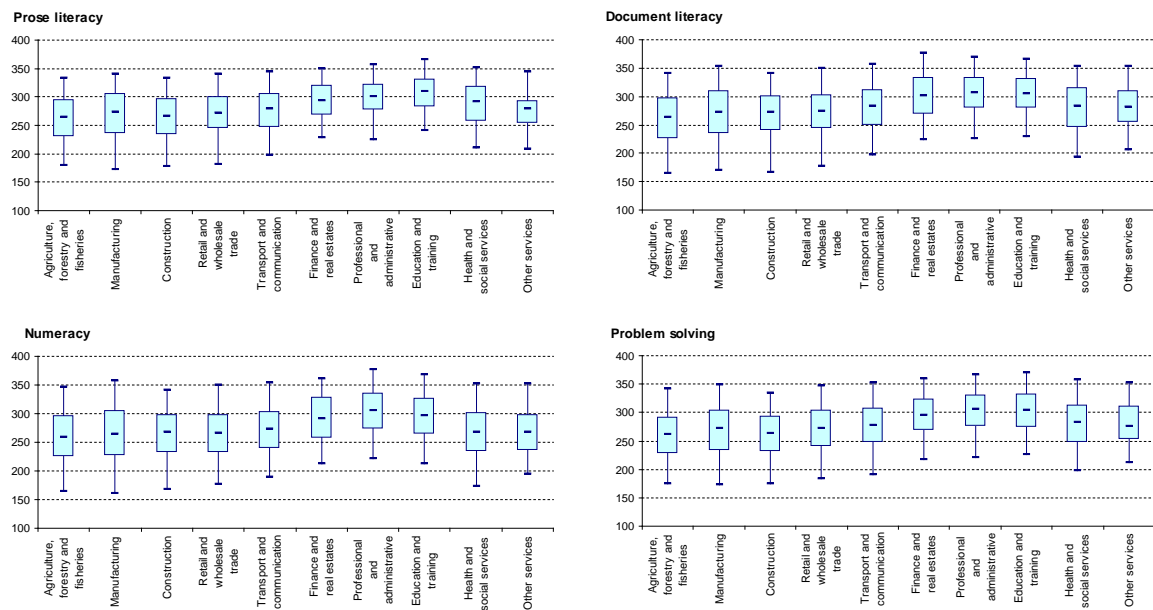
2.6   Skills and occupation

The distribution of skill levels also varied across occupations. Managers and professionals had the highest median skill levels across all four domains. The next most skilled groups were technicians and clerks. Amongst the other occupations, trades workers had higher skills in the case of numeracy.

Looking at the overall distribution, people with the highest skill levels were most likely to work as administrators and managers, professionals or technicians and associate professionals. People with the lowest levels of skill were most likely to work as agricultural workers, plant and machinery operators and assemblers or labourers.

Figure 2.6:   Skill levels by occupation

Numeracy

Problem solving

(Horizontal axis categories for both charts: Administrators and managers; Professionals; Technicians and associate professionals; Clerks; Service and sales workers; Agricultural workers; Trades workers; Plant and machinery operators and assemblers; Labourers)
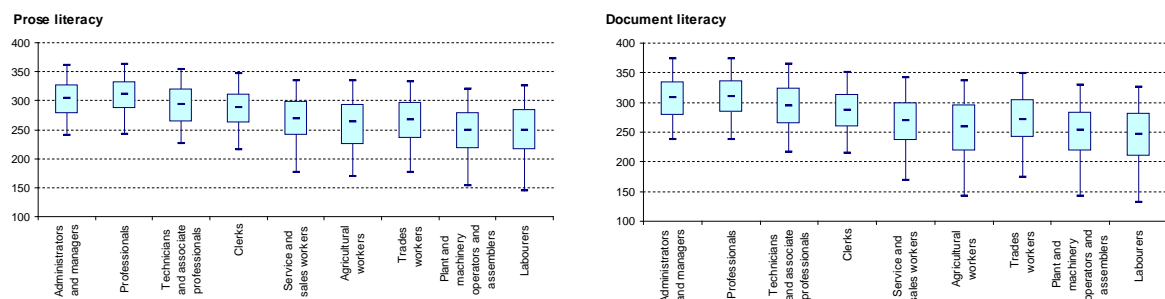
Note: Boxes indicate range from 25th to 75th percentiles. Line indicates median. Bars indicate range from 5th to 95th percentile.
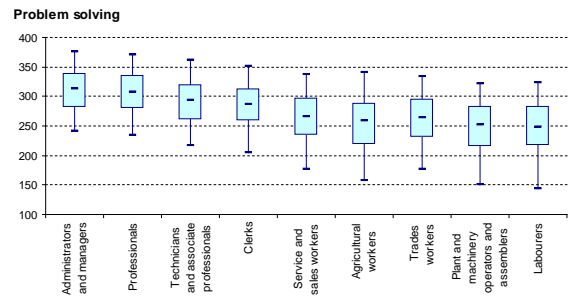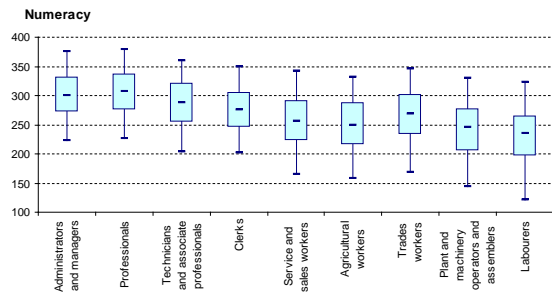
3 Hourly wages

This section looks at the factors that influence hourly wages, starting with skills and qualifications. The purpose of this section is to understand how differences in wages relate to each of these other factors individually.

Wages are presented here on a logarithmic scale, where each horizontal line on the graphs represents a percentage increase in wages. This reflects that wages generally increase proportionally. That is, employees are more likely to receive percentage increases in their wages than fixed dollar increases.

3.1 Wages and qualifications

The ALL data shows that people with higher-level qualifications tend to have earned higher hourly wages. The difference was greater at the top end of the wage distribution and less at the bottom end. At the median, having a non-degree tertiary qualification raised hourly wages by 25 percent (compared with a school level qualification), having a degree raised wages by a further 14 percent and having a postgraduate qualification by a further 29 percent. At the 95th percentile, the increase for a non-degree tertiary qualification over a school level qualification was 23 percent, for a degree it was a further 21 percent and for a postgraduate qualification a further 34 percent.

The effect of having a tertiary qualification is not only to increase the median income, but to extend the range of income that is possible to earn. This is particularly noticeable at degree level and above.

Figure 3.1: Hourly wages by highest qualification
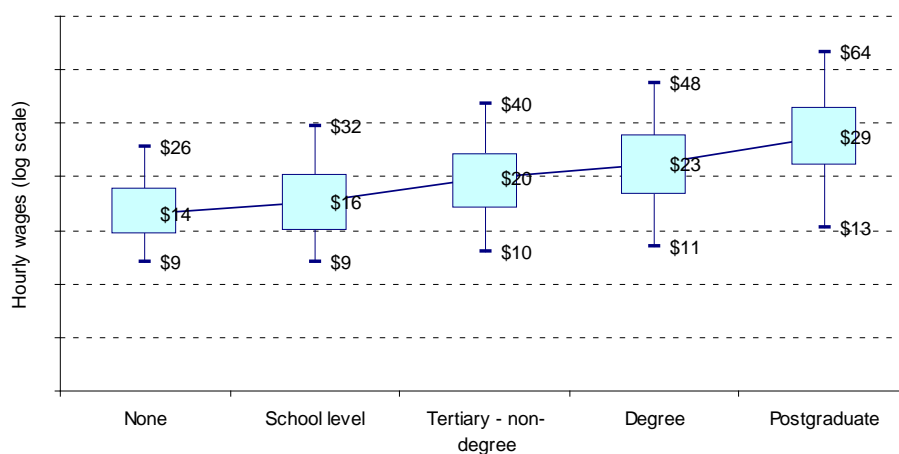
Note: Boxes indicate range from 25th to 75th percentiles. Line indicates median. Bars indicate range from 5th to 95th percentile.

3.2 Wages and skills

As with qualifications, wages also increased with skills. People with low skills had a restricted and low range of hourly wages. People with higher skills had a much broader range of hourly wages.

Figure 3.2:   Distribution of hourly wages by skill level
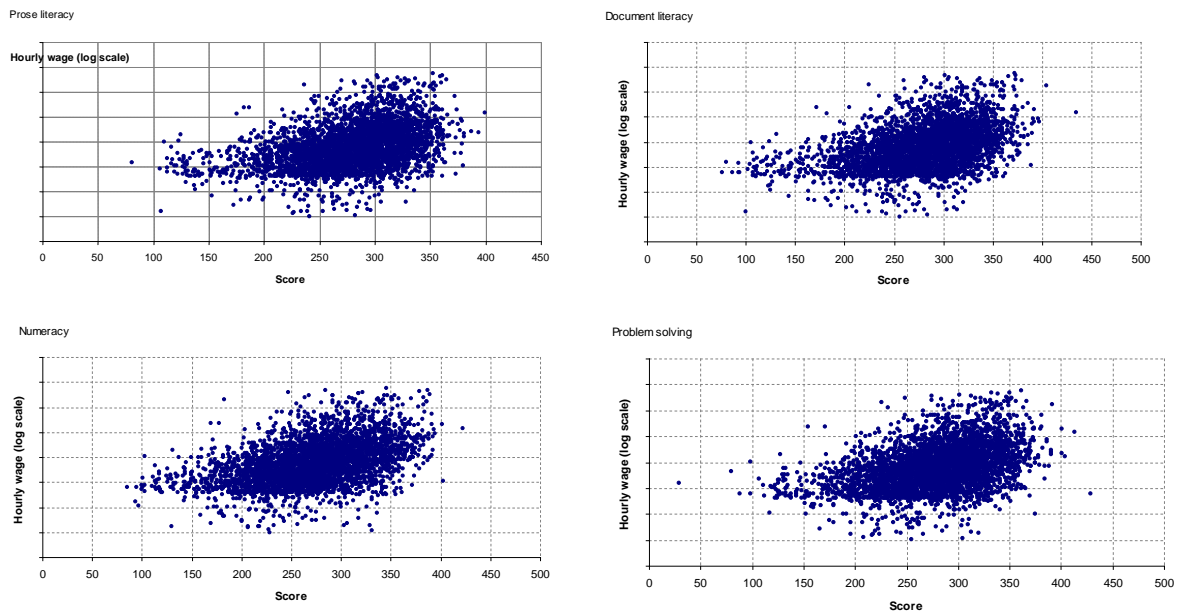
These plots show unweighted observations.

The relationship between skills and wages is clearer when looking at the average hourly wage paid at each skill level (in groups of 10 points). This shows that there was a consistent relationship between higher skills and higher earnings. The relationships were very similar across domains. Regression estimates show that a 50 point increase[5] in prose literacy raised hourly wages by 19.6 percent; the same increase in document literacy raises wages by 18.1 percent; for numeracy by 18.6 percent; and for problem solving by 17.5 percent.[6]

Figure 3.3:   Average hourly wages by skill level

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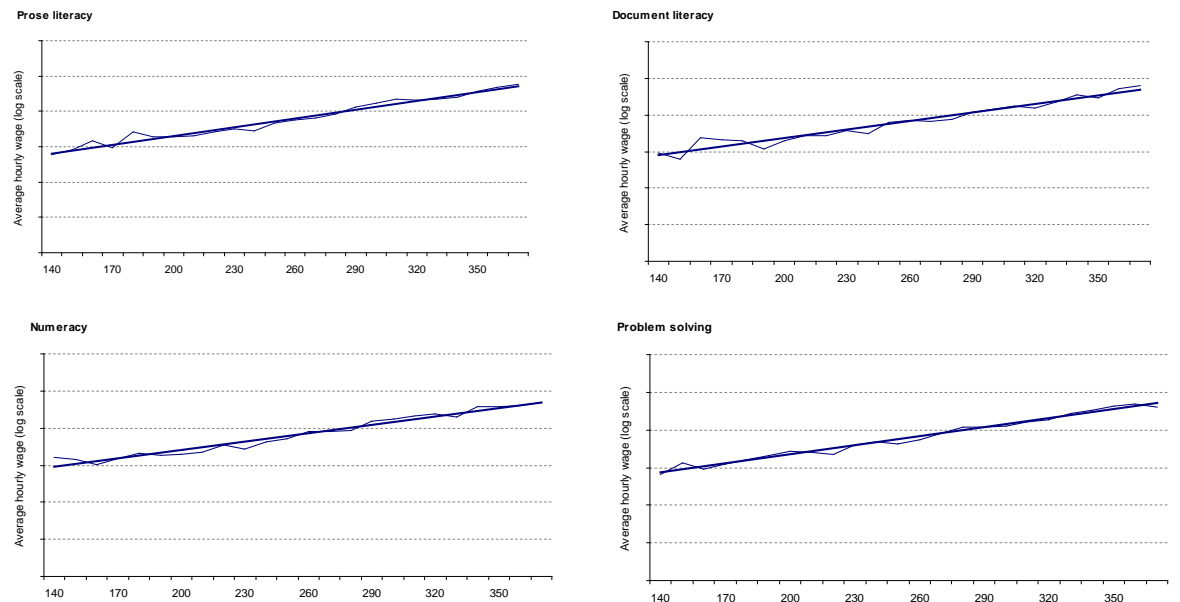
[5] 50 points represents a shift in skills of around one standard deviation in each domain.

[6] Using a log linear OLS regression with hourly wages as the dependent variable and ALL score as the independent variable.

3.3   Wages and first language

Having English as an additional language had a noticeable association with lower hourly wages. This association was evident across all qualification levels. Those with English as an additional language had lower median wages and they were less likely to be earning top end salaries. The difference in the median hourly for native and non-native English speakers was greater for those with tertiary education, where having English as a first language added around 30 percent, compared with 16 percent for those without tertiary qualifications.

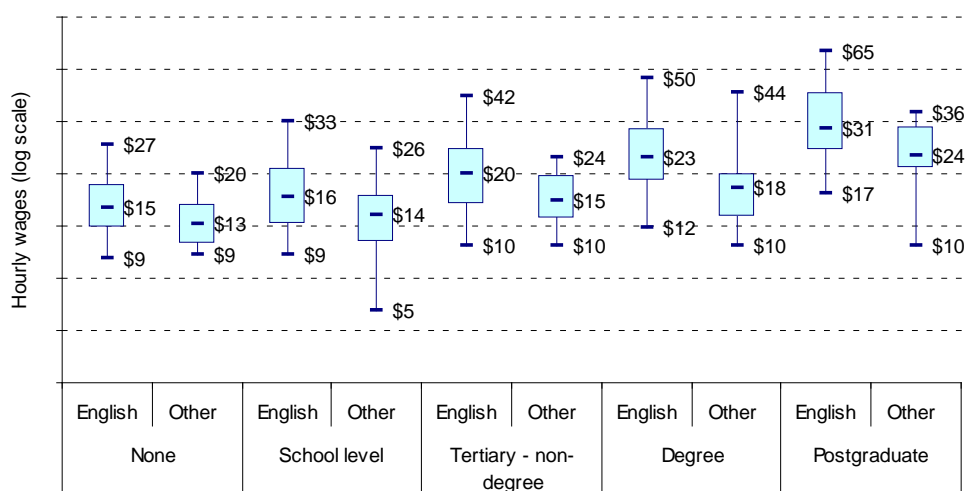**Figure 3.4:   Hourly wages by first language and highest qualification**

Note: Boxes indicate range from 25th to 75th percentiles. Line indicates median. Bars indicate range from 5th to 95th percentile.

On average, people with English as a first language earned about 26 percent more than those with English with an additional language, once qualifications are controlled for[7]. If prose literacy scores are also controlled for (that is, adjusting for English-based literacy), a difference of 15 percent in wages still remains.[8]

For people with English as an additional language, the age at which they arrived in New Zealand did not have any effect on their wages, once prose literacy, education and age at the time of the survey were taken into account.[9]

Even once qualifications, age, gender and prose literacy are controlled for, the first language spoken by immigrants had a notable effect on wages. Immigrants with a Western European language as their first language had the same wages as immigrants with English as their first language. Immigrants with an Asian language as their first language earned around 20 percent less on average than immigrants with English as a first language.[10] This finding is consistent with Zodgekar (1998), Winklemann and Winklemann (1998) and Boyd (2003).

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[7] Using a log-linear OLS regression with hourly wages as the dependent variable and first language and qualifications as the dependent variables. Model was run for all people in employment.

[8] Adding prose literacy as a dependent variable to the above model.

[9] Using a log-linear OLS regression with hourly wages as the dependent variable and arrival in New Zealand before or after age 16, qualifications, prose literacy and age as dependent variables.

[10] Using a log-liner OLS regression with hourly wages as the dependent variable and first language spoken, prose literacy, qualifications, age and gender as dependent variables. The model was run for people in employment who were not born in New Zealand.

3.4   Wages and gender

Overall, women had lower hourly wages than men. The differences by gender existed across all qualification levels, with the greatest proportional difference in median wages being for those with school level qualifications (83 percent of male wages) and the smallest being for those with degrees (90 percent of male wages).

A number of factors influence the gap in wages between men and women. Differences in education level and time in employment explain part of the difference. Also, differences in industry and occupational distribution have an impact on the overall gap, with wages for female dominated occupations and industries continuing to be lower than those in more male dominated areas. Also, time taken out of the workforce for parenting and family responsibilities reduces the opportunities for women to build experience and gain promotion (Dixon, 2000).

Figure 3.5:   Hourly wages by gender and highest qualification
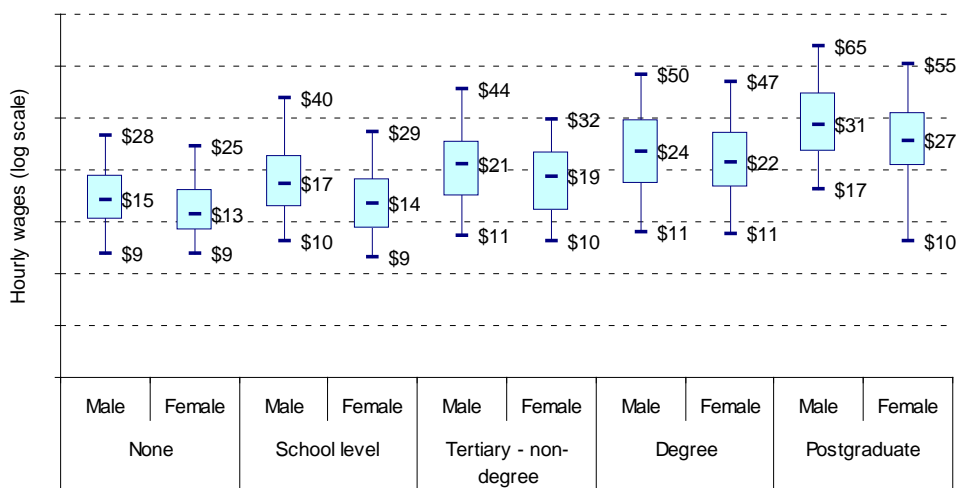
3.5   Wages and age

The data shows a curvilinear relationship between hourly wages and age. Average wages increased with age from ages 15 to 40. The income distribution was similar from 40 to 55, and then decreased slightly for people age 55 and over. This pattern shows up more clearly when looking at the median hourly wage by single years of age.

The increase in wages up to age 40 is likely to reflect both increased experience and higher qualifications attained. As with skills, the decrease in wages for older workers is likely to be related to generational differences in education and work experience.

Figure 3.6:   Distribution of hourly wages by age
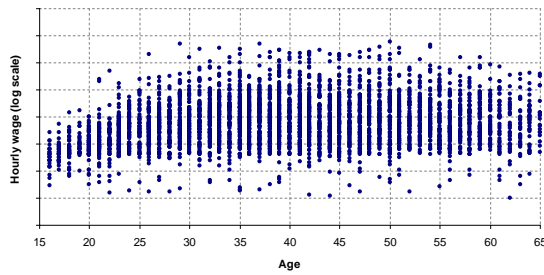
Figure 3.7:   Average hourly wages by age
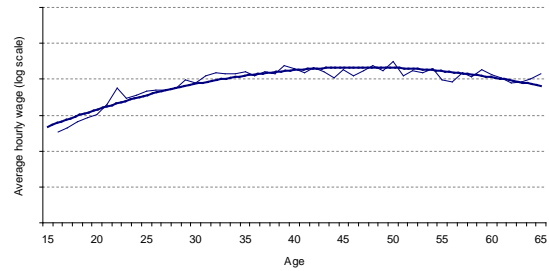
3.6   Wages and industry

There were differences in overall hourly wages between industries. The highest median wages were in professional and administrative services, and education and training. The lowest median wages were in retail and wholesale trade, followed by primary industries and other services.

Figure 3.8:   Hourly wages by industry
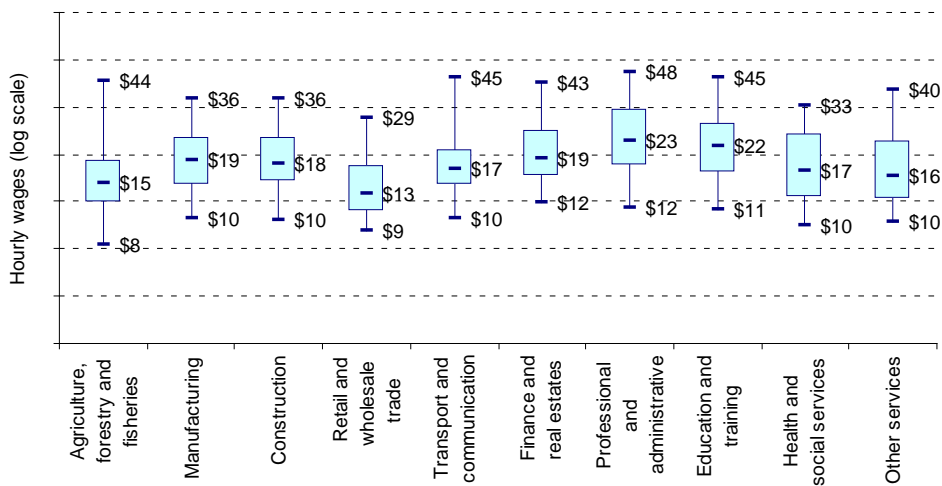
Note: Boxes indicate range from 25th to 75th percentiles. Line indicates median. Bars indicate range from 5th to 95th percentile.

3.7   Wages and occupation

Wages also varied by occupational group, both in terms of median and range. Managers, professionals and technicians had the highest hourly wages. The lowest hourly wages overall were for agricultural workers, followed by service and sales workers and labourers.

Figure 3.9: Hourly wages by occupation
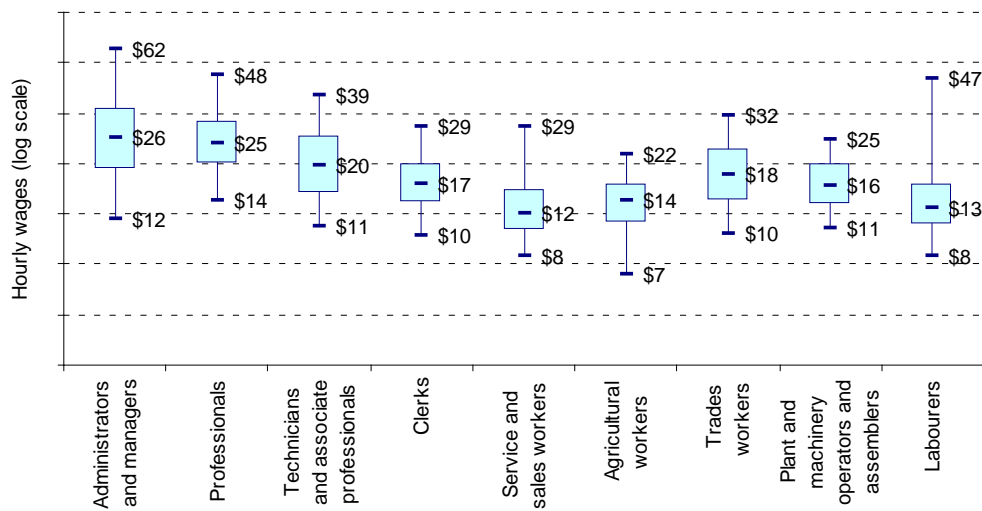
Note: Boxes indicate range from 25th to 75th percentiles. Line indicates median. Bars indicate range from 5th to 95th percentile.

3.8 Wages and hours worked

There was a small but distinct relationship between hourly wages and hours worked. The more hours worked during the week, the higher the hourly wage was likely to be. However, this effect was fairly limited. On average, one additional hour of work related to a 0.6 percent increase in hourly wages.[11] Nevertheless, it is sufficient to consider hours worked as a control variable in modelling.

Figure 3.10: Distribution of hourly wages by hours worked per week
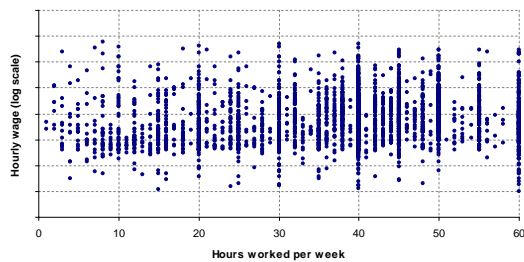
Figure 3.11: Average hourly wage by hours worked per week

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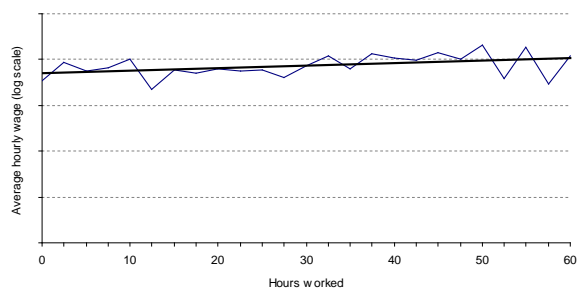
[11] Using a log-linear OLS regression with hourly wages as the dependent variable and hours worked per week as the independent variable.

4   Relationship of skills and qualifications to wages

This section presents the results of a number of regression models that look at the relationship of qualifications, skills and other factors to hourly wages. These models use ordinary least squares regression, with wages modelled on a logarithmic scale to allow for the proportion growth in wages as the predictive factors change.

4.1   To what extent do qualifications and skills, as measured in ALL, predict average hourly wages?

This first set of models explores the overall explanatory power of different sets of variables with regard to hourly wages. The basic model allowed for age, gender, first language and hours worked. Variables were then added to the model to see how much more explanatory power they added to predicting hourly wages. The explanatory power of the models is set out in Table 4.1. The statistic shows the proportion of variation in the observed outcome that is explained by the variables included in each model.

Table 4.1:   Explanatory power of variables with regard to hourly wages (log scale)

					Percent of variation explained		
						plus industry	plus occupation
Age, gender, language and hours worked					19%	28%	40%
	+ prose literacy				30%	36%	43%
	+ document literacy				30%	36%	43%
	+ numeracy				31%	37%	43%
	+ problem solving				30%	35%	42%
	+ qualifications				34%	38%	43%
		+ prose literacy			37%	41%	45%
		+ document literacy			38%	41%	45%
		+ numeracy			38%	41%	45%
		+ problem solving			37%	41%	44%

Using only age, gender, first language (English or other) and hours worked in the model explained 19 percent of the variance in hourly wages. Adding any one of the ALL skill domains increased the explanatory power to 30 percent. Adding just qualifications, without skill levels, added greater explanatory power, bringing it up to 34 percent. When skill levels were added in addition to qualification, a further 3 to 4 percent of the variance was explained.

This confirms that pay is related to both skills and qualifications. Qualifications alone are slightly better predictors of pay than literacy and numeracy skills alone. As qualifications capture some information about skills, the effect on overall explanatory power of skill levels in addition to qualification levels is small.

The same process was repeated with industry of employment added in at the start. Adding industry to the basic model increased the explanatory power of the model from 19 to 28 percent. Adding any one of the skill domains increased the explanatory power to 35 to 37 percent. Adding just qualifications to industry increased the explanatory power to 38 percent. Adding skills as well as qualifications increased the explanatory power by to 41 percent.

The process was repeated again with occupation added in instead of industry. Adding occupation to the basic model increased the explanatory power from 19 percent to 40 percent. Adding either skill levels or qualifications in addition to occupation only added a further 2 to 3 percentage points

of explanatory power. Adding skill levels and qualifications in combination added a 1 to 2 percent over qualifications alone, raising the explanatory power to 44 to 45 percent.

This analysis suggests that industry of employment provides some additional explanatory information about wages, particularly when the skills and qualifications of employees are unknown. However, occupation is a much strong predictor of hourly wages than industry. Entry to occupational groups is dependent on both skills and qualifications. Therefore, occupation contains implicit information about skills and qualifications. Explicitly adding skills and qualifications doesn't add much additional explanation overall.

4.2   Overall relationship of skills and qualifications to wages

Three models were run to explore in more detail the relationship of skills and qualifications to hourly wages. The first model excluded any skill measurements, the second included numeracy and the third included prose literacy. Numeracy and prose literacy were chosen out of the four skills domains as being the least related to each other and therefore likely to provide contrasting results.

Table 4.2 shows the observed values for each variable. This is the impact of each variable when it is considered on its own and the impacts of other variables are not taken into account. These observed values are compared with the predicted values from the models. These predicted values take account of differences in the other variables. For example, it can be observed that having a tertiary qualification increases wages, as does having a higher literacy or numeracy score. However, people with degrees also have higher literacy and numeracy. The model provides a way of separating the effect of qualifications from the effect of skills.

The relationship between numeracy, qualifications and wages, using the predicted values, is shown graphically in Figure 4.1.

Table 4.2:   Percent increase in average hourly wage for each factor

	Observed values	Predicted values		
			Prose literacy	Numeracy
1 standard deviation increase in skill	(prose) 21% (numeracy 19%	-	10.4%	11.3%
Compared with no qualification:				
School	11%	13%	8.5%	8.9%
Tertiary non-degree	33%	27%	18%	18%
Degree	55%	56%	39%	37%
Postgraduate	99%	89%	65%	64%
Female (compared with male)	-13%	-13%	-15%	-12%
Age (35 compared with 25)	26%	21%	20%	20%
English as a first language	18%	24%	13%	14%
Working 5 hours more per week	3.2%	0.7%	0.8%	0.7%

Figure 4.1:   Relationship of numeracy and qualification level to average hourly wages
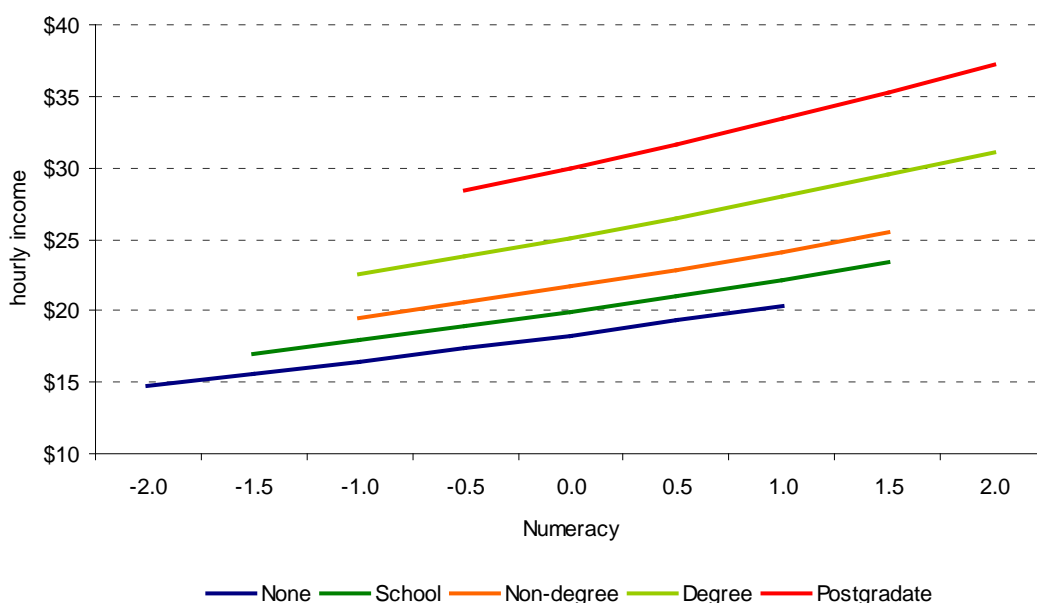
Reference group: age 40, male, English as a first language, working 38 hours

In the first predictive model in Table 4.2, controlling for other variables changed the effect of qualifications on hourly wages. The value of a school level qualification was found to be higher than observed when other factors were accounted for. The values of a non-degree and a postgraduate qualification were found to be lower, when other factors were accounted for. The difference in wages by gender remained the same when other factors were accounted for, but the value of having English as a first language increased and the value of additional hours worked decreased.

Age has been included in this, and subsequent models, as age and age squared. This allows for diminishing percentage increases in hourly wages with increased age. As discussed in section 3.5, average hourly wages peaked around 45 years of age. To illustrate the effect of age, the percent increase in wages from age 25 to 35 is included in the table. This represents an age period when many employees have completed their initial education and are developing their on-the-job skills. This cohort also had similar experiences of education, in comparison with older generations. In the first model, the increase in wages due to age is lower than the observed value, reflecting that the observed value captures some information about higher qualifications. Even so, the effect on wages of being 35 compared to 25 is similar to that of having a tertiary non-degree qualification.

Adding numeracy or prose literacy to the model reduces the premiums for higher levels of qualifications, as well as the premium for having English as a first language. That is, people with higher levels of English-based literacy or numeracy skills can attain higher wages, even if they have lower levels of qualification and/or English as a second language. The value of additional prose literacy or numeracy is less than the observed, when other factors are considered. This is a result of distinguishing the effect of additional qualifications from additional skills.

However, in the models that include literacy and numeracy skills there is still an overall wage 'penalty' for having English as an additional language. That is, a person with English as a second language is likely to earn less than a person with English as a first language, even when they have the same level of qualification and the same level of English-based proficiency in numeracy or literacy. This issue is explored further in the analysis by occupation and industry.

The results for the numeracy and prose literacy models are very similar for most factors. The major difference is that the gap between male and female wages decreases when numeracy is controlled compared with controlling for prose literacy. This suggests that there is an added advantage for women having higher levels of numeracy, compared with having higher levels of prose literacy. This finding is consistent with a United Kingdom numeracy study, which found that the effects of low numeracy compared with low literacy were more significant for women (Parsons and Bynner, 2006)

4.3 Relationship of prose literacy and qualifications to wages within industries

The next stage of analysis was to look at the effect of industry of employment on the relationship between prose literacy, qualifications and hourly wages. A set of models was run to look at the relationship of qualifications and prose literacy to hourly wages within industries. The models included age, gender, hours worked and first language. The same model was run initially for each industry and statistically non-significant factors were eliminated from each model.

The percent increase in hourly wages attributable each factor, holding all other factors constant, is shown in Table 4.3. Prose literacy had the largest impact on wages in professional and administrative services, followed by manufacturing, and health and social services.

Most industries paid premiums for both skill level and qualification level. That is for two people with the same qualification level, the person with the higher skill level was likely to be paid more. Similarly for two people with the same skill level, the person with the higher qualification was likely to be paid more.

Table 4.3: **Percent increase in average hourly wage for each factor by industry, controlling for prose literacy**

| Occupation	R^2	Prose literacy (1 std dev)	Female	Age (35 comp. with 25)	Hours worked (5 hours extra)	English as first language	School	Non-degree	Degree	Postgraduate
							Compared with no qualification			
Agriculture, forestry and fisheries	.22	9.5	-17.5	28.4						
Manufacturing	.31	12.6	-16.8	8.9			18.9	ns	32.2	45.1
Construction	.37			23.3		47.0	ns	16.7	40.7	Ns
Retail and wholesale trade	.42	10.9	-14.7	15.1	2.9		ns	9.6	13.0	Ns
Transport and communication	.23	9.3		19.5			ns	21.7	ns	ns
Finance and real estate	.42			31.4	6.9	27.3	ns	31.7	ns	ns
Professional and admin services	.39	13.9	-12.6	22.7		19.0	ns	24.6	41.7	67.3
Education and training	.35		-18.0	19.1	-3.2	18.8	ns	46.8	76.2	95.4
Health and social services	.46	12.6	-13.3	12.1			ns	30.3	63.1	80.6
Other services	.33	11.8		8.1	3.5		ns	27.7	ns	ns

Notes: Grey boxes indicate terms eliminated from the models as not statistically significant. 'ns' indicates categories within terms that were not statistically significant.

In agriculture, forestry and fisheries, qualifications did not have an effect on pay once prose literacy is taken into account. This may reflect a low reliance on qualifications as a signal for skills and wage levels in those industries. By contrast, in education and training, prose literacy had no effect on pay once qualifications are taken into account. This may reflect a high reliance on qualifications for pay setting. The same result is evident in the construction and finance and real estate industries.

In six out of the ten industries, females were likely to earn less than males, even once all other factors were controlled for. In all industries, hourly wages increased with age from 25 to 35, which can be read as a proxy for experience and seniority. Age counted most towards wages in finance and real estate and agriculture, forestry and fisheries. In a number of industries, the increase in wages from 25 to 35 was at least equivalent to the increased wages from having a tertiary non-degree qualification. The exceptions were manufacturing, education and training, health and social services and other services, where tertiary qualifications counted more than age.

In four of the industries, a premium for having English as a first language was evident, even after controlling for the level of English-based prose literacy. In three industries, people who worked longer hours had higher hourly wages. In education and training, the opposite was true, reflecting the extent to which employees were on fixed salary and not rewarded for working additional hours.

Figure 4.2:   Hourly wages by prose literacy and highest qualification for industries
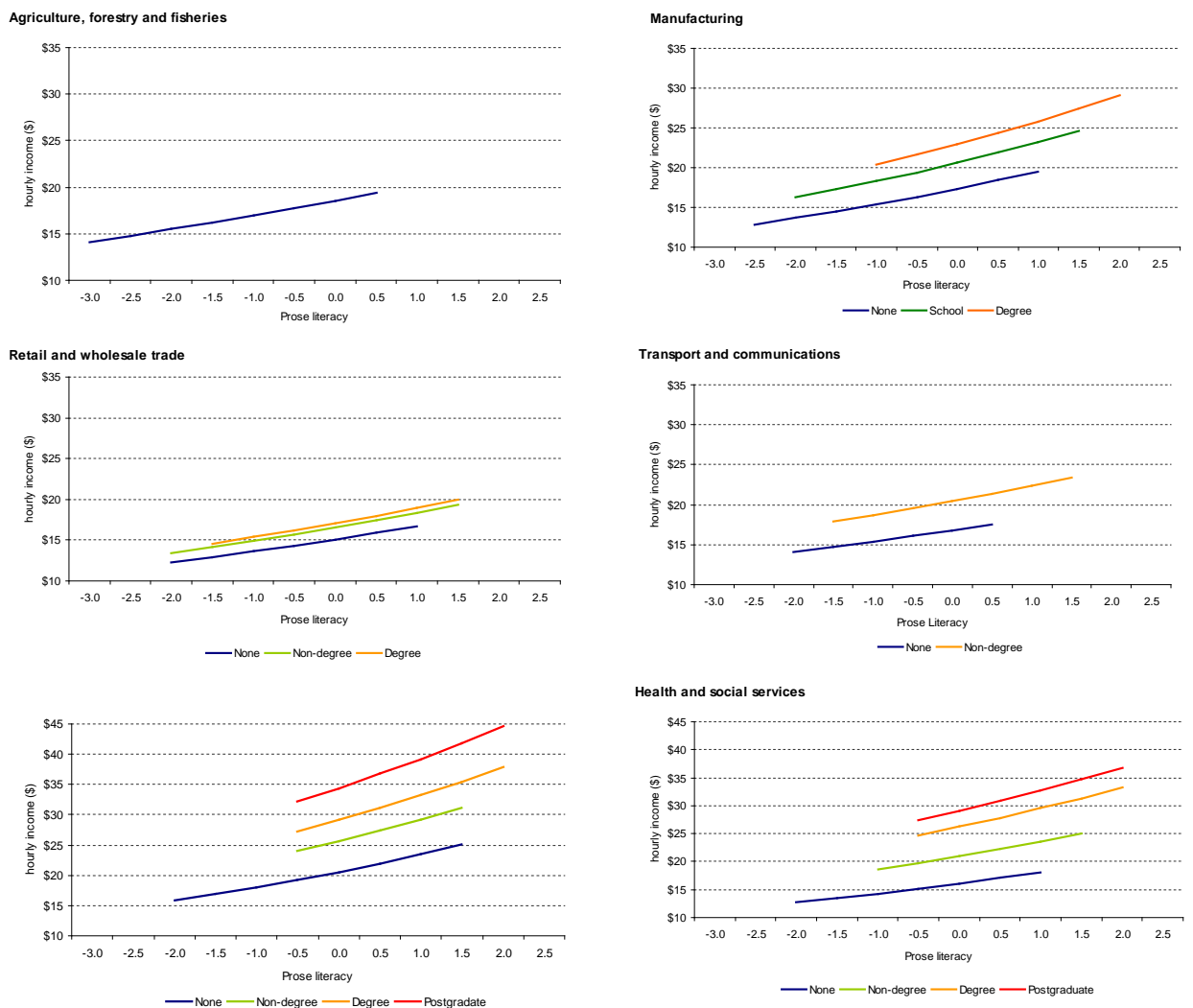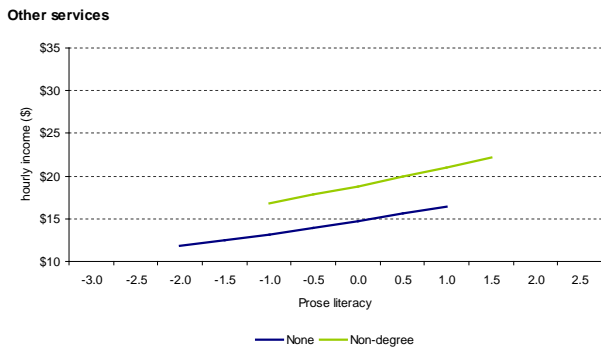
Other services

Notes: Reference groups are English as a first language, male and mean of age and hours worked for each industry. Scores have been standardised to a mean of 0 and standard deviation of 1 for the New Zealand population.

4.4   Relationship of numeracy and qualifications to wages within industries

The same models were run again to look at the effect of industry on the relationship between numeracy, qualifications and hourly wages. As with prose literacy, the same model was run initially for each industry and statistically non-significant factors eliminated from each model.

The percent increase in hourly wages attributable each factor, holding all other factors constant, is shown in Table 4.4. Numeracy had the largest impact on wages in agriculture, forestry and fisheries, and health and social services.

Table 4.4:   Percent increase in average hourly wage for each factor by industry, controlling for numeracy

Occupation	R^2	Numeracy (1 std dev)	Females	Age (35 comp with 25	Hours worked (5 hours extra)	English as first language	School	Non-degree	Degree	Postgraduate
							Compared with no qualification			
Agriculture, forestry and fisheries	.24	16.1		26.0						
Manufacturing	.30	12.1	-14.8	8.4			19.4	ns	31.9	ns
Construction	.38	11.5		24.0		32.2				
Retail and wholesale trade	.42	9.4	-12.7	15.4	3.0	12.3	ns	10.2	ns	ns
Transport and communication	.23	9.4		19.7			ns	22.8	ns	ns
Finance and real estate	.46	9.7		28.3	6.3	23.2	ns	31.0	ns	ns
Professional and admin services	.37	11.3	-10.5	24.0		21.6	ns	25.3	40.8	68.4
Education and training	.35	7.5	-15.6	18.7	-3.1		ns	40.5	60.3	75.4
Health and social services	.48	15.2	-11.1	12.3			ns	29.8	56.9	75.0
Other services	.32	9.9		9.2	3.2		ns	30.6	ns	105.6

Notes: Grey boxes indicate terms eliminated from the models as not statistically significant. 'ns' indicates categories within terms that were not statistically significant.

Comparing the premiums for prose literacy and numeracy within occupations there is no consistent favouring of one over the other. Agriculture, forestry and fisheries and health and social services paid more for additional numeracy than for prose literacy, while retail and wholesale trade and professional and administrative services paid more for additional prose literacy than for numeracy. In other industries the premiums were either similar or there was a different set of effects of skills and qualifications, as discussed below.

Unlike prose literacy, there is evidence of premiums being paid for numeracy in all industries. In eight out of ten industries premiums were paid for both numeracy and qualification level. The exceptions were agriculture, forestry and fisheries and construction.
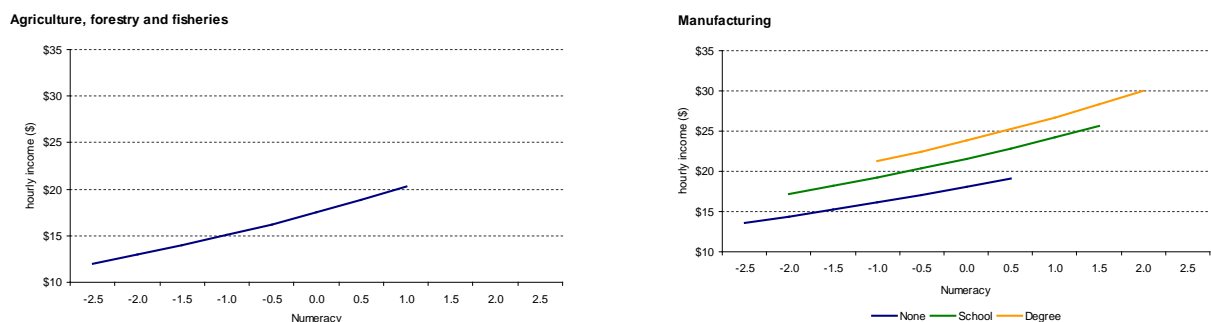
There were three industries where the balance of qualifications and skill changes when numeracy was taken into account rather than prose literacy. In construction, taking numeracy into account wiped out any effect on wages from qualifications. That is, the industry pays for better numeracy skills irrespective of qualification level. However, when prose literacy was taken into account, only qualification levels were important to predicting hourly wages. In finance and real estate and in education and training, no additional premium was found for higher prose literacy over qualification level. However, a premium was paid in both industries for higher numeracy over and above qualification level.
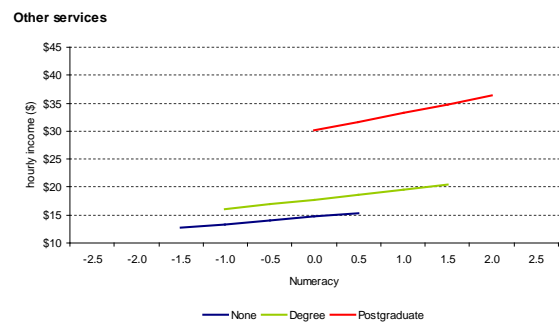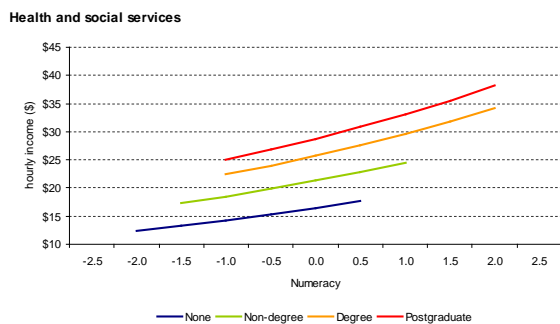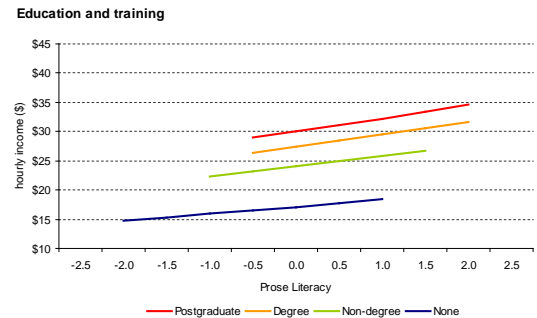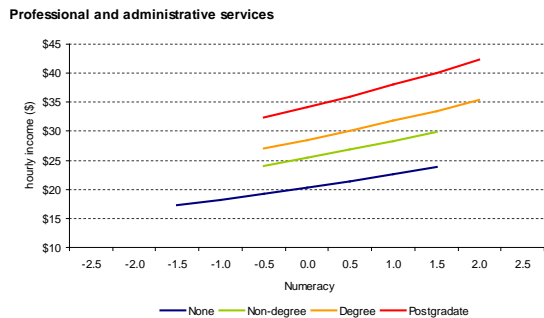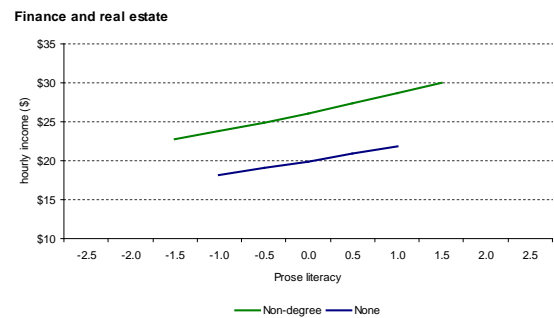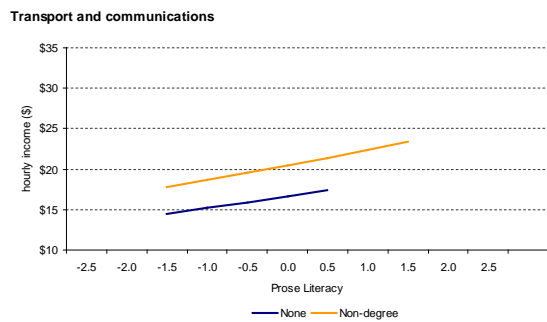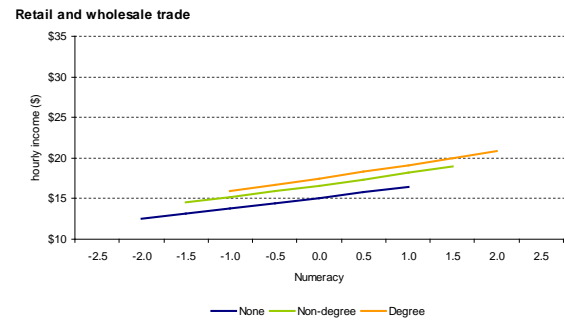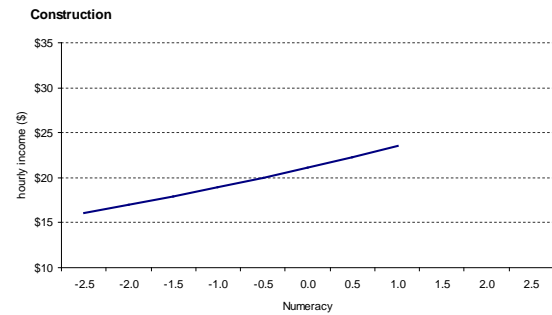
As with prose literacy, in five of the industries females were likely to earn less than males, even once all other factors were controlled for. However, in the case of numeracy, this effect was not significant for agriculture, forestry and fisheries and was significant for retail and wholesale trade.

Also as with prose literacy, hourly wages increased with age from 25 to 35 in all industries. The effects of age on wages were similar when controlling for numeracy as when controlling for prose literacy. The effects of working longer hours on hourly wages were also similar when numeracy was taken into account as when prose literacy was accounted for.

The effect of having English as a first language was similar in finance and real estate and professional and administrative services for both the numeracy and prose literacy models. In construction, when numeracy was taken into account, the effect of having English as a first language decreased. In education, the effect of English as a first language disappeared when numeracy was controlled for. In retail and wholesale trade, a premium was evident for English as a first language when numeracy was controlled for, which was not evident when prose literacy was controlled for.

Figure 4.3:   Hourly wages by numeracy and highest qualification for industries

Construction

hourly income ($) — Numeracy

Retail and wholesale trade

hourly income ($) — Numeracy

None — Non-degree — Degree

Transport and communications

hourly income ($) — Prose Literacy

None — Non-degree

Finance and real estate

hourly income ($) — Prose literacy

Non-degree — None

Professional and administrative services

hourly income ($) — Numeracy

None — Non-degree — Degree — Postgradate

Education and training

hourly income ($) — Prose Literacy

Postgraduate — Degree — Non-degree — None

Health and social services

hourly income ($) — Numeracy

None — Non-degree — Degree — Postgraduate

Other services

hourly income ($) — Numeracy

None — Degree — Postgraduate

Notes: Reference groups are English as a first language, male and mean of age and hours worked for each industry. Scores have been standardised to a mean of 0 and standard deviation of 1 for the New Zealand population.

4.5 Relationship of prose literacy and qualifications to wages within occupations

Another way of looking at the relationship of qualifications and skill level to hourly wages is to examine this relationship within occupational groups. Entry into occupations is more directly related to qualifications and skills than employment within an industry. To examine these relationships, a further set of models was run to look at the relationship of prose literacy and qualifications to hourly wages within each occupational group.

The percent increase in hourly wages attributable to each factor, holding all other factors constant, is shown in Table 4.5. For agricultural workers and labourers, no significant factors were

found other than age or gender. Prose literacy had the largest effect for sales and service workers and professionals. It had no significant effect for clerks. However, qualifications were significant for this occupation.

Only three occupations showed significant effects on hourly wages from the level of qualification, once prose literacy was accounted for. The most pronounced effect was for managers, followed by technicians and associate professionals with a postgraduate qualification. In the case of professional occupations, a certain type and level of qualification is required to enter an occupation. Therefore, the model suggests that having attained the entry requirement, no premium is paid for higher levels of qualification. The same may also be true for trades workers.

Table 4.5: **Percent increase in average hourly wage for each factor by occupation, controlling for prose literacy**

Occupation	R^2	Prose literacy (1 std dev)	Females	Age (35 comp. with 25)	Hours worked (5 hours extra)	English as first language	School	Non-degree	Degree	Postgraduate
							Compared with no qualification			
Administrators and managers	.40	8.7	-16.2	24.7		35.5	19.6	25.0	58.7	97.8
Professionals	.21	11.0	-19.5	21.1	-2.8					
Technicians and associate professionals	.17	7.8	-14.3	7.3			ns	ns	20.6	52.2
Clerks	.15		-10.7	16.7			11.6	14.3	14.2	ns
Sales and service workers	.38	11.9	-17.0	14.2	3.0					
Agricultural workers	.06			8.2						
Trades workers	.33	8.3		25.0						
Plant and machine operators and assemblers	.20	6.6	-21.2	11.2						
Labourers	.06		-18.5							

Notes: Grey boxes indicate terms eliminated from the models as not statistically significant. 'ns' indicates categories within terms that were not statistically significant.

Six out of the nine occupational groups showed significant differences in pay by gender, even once qualifications, skills levels and hours worked were controlled for. Age had a definite effect in all occupations, except for labourers. The strongest effect was for trade workers and managers and administrators. As was the case when looking at industry, the age effect from 25 to 35 is of similar scale to attaining a non-degree tertiary qualification.

English as a first language was only statistically significant for managers, where it had quite a sizeable effect. Hours worked had small effects on hourly wages for professionals, sales and services workers and labourers.

Figure 4.4: **Hourly wages by prose literacy level and highest qualification for occupational groups**
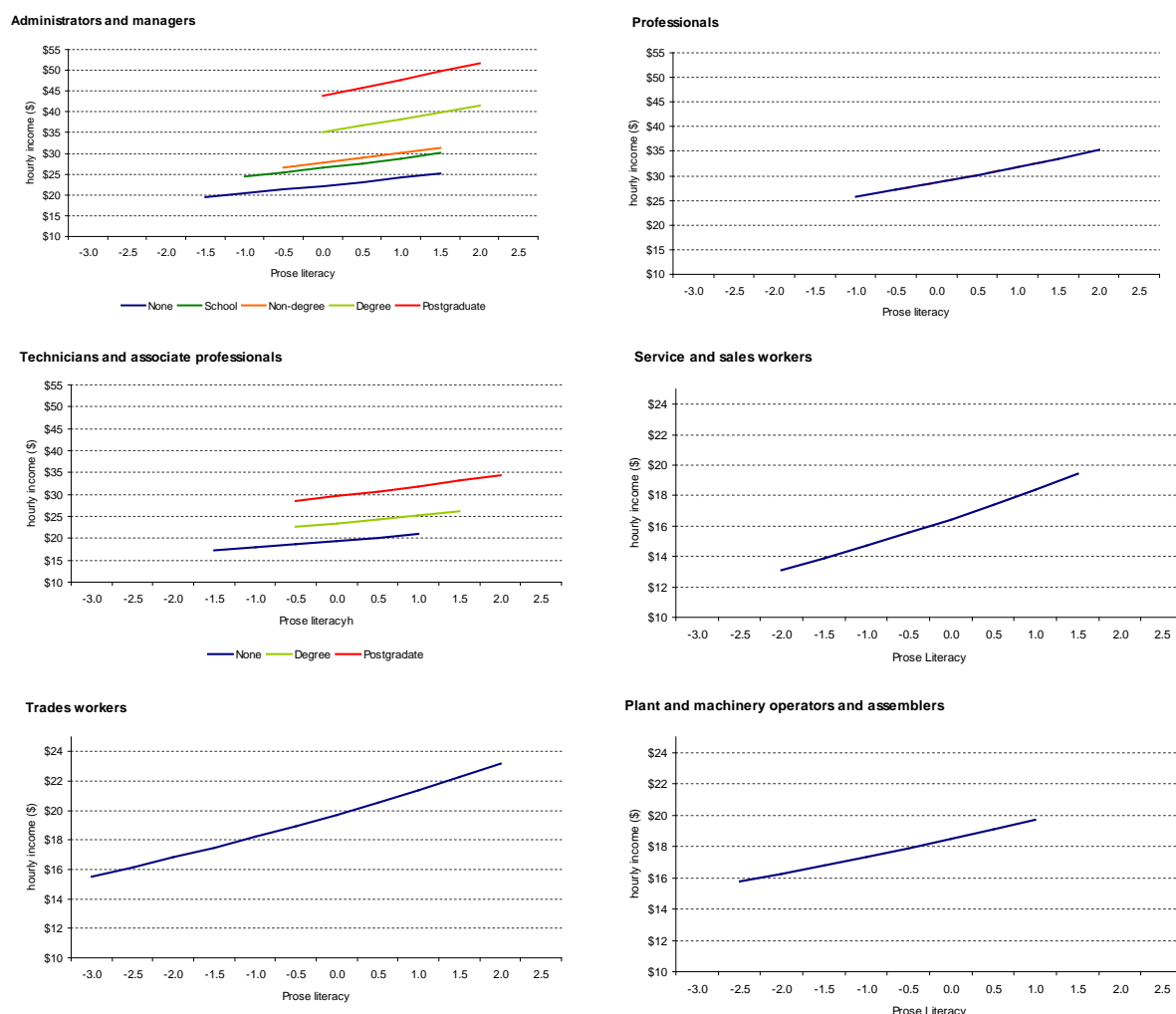
Notes: Reference groups are English as a first language, male and mean of age and hours worked for each occupation. Scores have been standardised to a mean of 0 and standard deviation of 1 for the New Zealand population.

4.6   Relationship of numeracy and qualifications to wages within occupations

A further set of models was run to look at the relationship of numeracy and qualifications to hourly wages within each occupational group. The percent increase in hourly wages attributable each factor, holding all other factors constant, is shown in Table 4.6.

Table 4.6: **Percent increase in average hourly wage for each factor by occupation, controlling for numeracy**

Occupation	R^2	Numeracy (1 std dev)	Females	Age (35 comp with 25)	Hours worked (5 hours extra)	English as first language	School	Non-degree	Degree	Postgraduate
								Compared with no qualification		
Administrators and managers	.41	11.1	-14.2	24.7		33.7	18.2	22.6	54.6	90.7
Professionals	.24	13.9	-15.5	21.9	-3.2					
Technicians and associate professionals	.20	12.8	-11.6	7.3			ns	ns	15.0	43.8

Occupation									
Clerks	*.15*		-10.7	16.7		11.6	14.3	14.2	ns
Sales and service workers	*.37*	11.4	-15.1	14.9	3.0				
Agricultural workers	*.06*			8.2					
Trades workers	*.39*	12.6		25.1	3.1				
Plant and machine operators and assemblers	*.22*	7.7	-19.7	10.6					
Labourers	*.06*		-18.5						

Notes: Grey boxes indicate terms eliminated from the models as not statistically significant. 'ns' indicates categories within terms that were not statistically significant.

As with prose literacy, no significant factors were found to affect wages for agricultural workers and labourers other than age or gender. In the remaining occupation, numeracy had a larger impact on wages than prose literacy, except for sales and service workers, where the impacts were similar. Numeracy had the largest impact for professionals and sales and service workers. It had no significant impact for clerks. However, qualifications were significant for this occupation.

As with prose literacy, only three occupations showed significant effects on hourly wages from level of qualification. Again, the largest impact was for managers.

Most occupations showed significant differences in pay by gender, even once qualifications, skills levels and hours worked were controlled for. These differences were lower when numeracy is controlled for than when prose literacy is controlled for. This reinforces the idea that numeracy skills serve to reduce the gap in wages between men and women.

The effect of age from 25 to 35 was similar for each occupation when controlling for numeracy as it was when controlling for prose literacy.

As with prose literacy, English as a first language was only statistically significant for managers, where it had quite a sizeable effect. Hours worked had small effects on hourly wages for professionals, sales and service workers and trades workers.
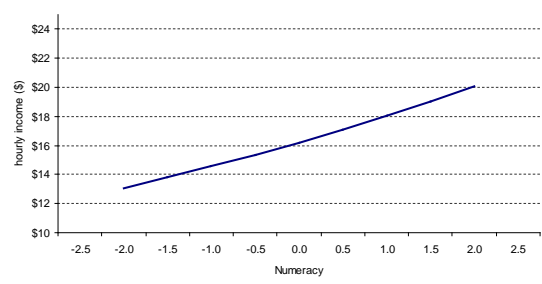
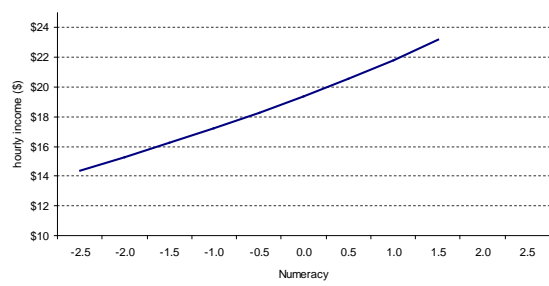**Figure 4.5:** **Hourly wages by numeracy level and highest qualification for occupational groups**
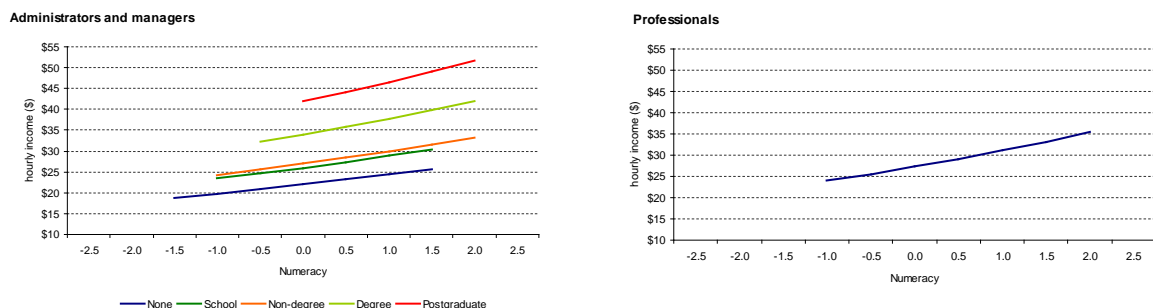
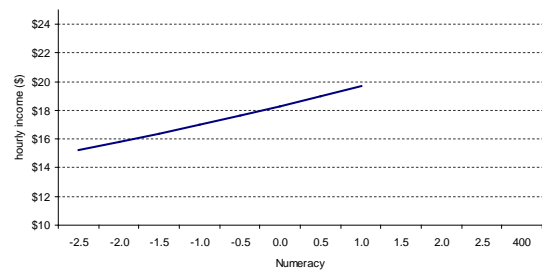**Technicians and associate professionals**
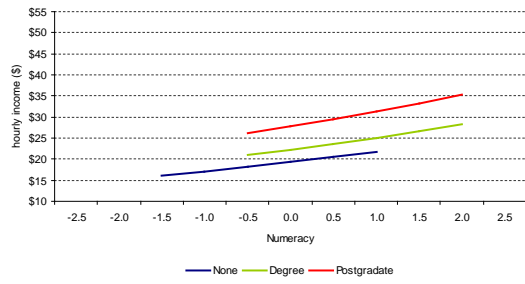
Service and sales workers

Trades workers

Plant and machinery operators and assemblers

Notes: Reference groups are English as a first language, male and mean of age and hours worked for each occupation. Scores have been standardised to a mean of 0 and standard deviation of 1 for the New Zealand population.

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